

CCGL9042 THE EVOLUTION OF CIVILISATION

Question Bank

I. Questions from Quiz 1

- (1) Bo makes 3 axes or 2 cups daily. What is her opportunity cost for a cup?

A. 1.5 B. 1.5 axes C. $\frac{2}{3}$ D. $\frac{2}{3}$ axes E. $\frac{2}{3}$ cups

Solution: The answer is 1.5 axes. She could either spend a day making 3 axes or 2 cups. In one-half of a day, she could either make $\frac{3}{2}$ axes or 1 cup.

- (2) How was the invention of fire and cooking most advantageous to the evolution of hunter-gatherer societies?

A. Made self-sufficiency possible for hunter-gatherer societies.
B. Encouraged both men and women to participate in hunting equally.
C. Allowed hunter-gatherer societies to hunt and gather at night.
D. Encouraged specialisation by gender and allowed the sharing of food.
E. Allowed hunter-gatherer societies to migrate north to colder regions.

Solution: Cooking predisposed humans to the exchange of different kinds of foods. As economist Haim Ofek stated, “fire itself is hard to start but easy to share; likewise, cooked food is hard to make but easy to share.” Within hunter-gatherer societies, fire and cooking gave rise to the first division of labour and specialisation, where women gathered and cooked, and men hunted.

- (3) Small, isolated populations tend to

A. concentrate on mining.
B. suffer fewer wars, allowing more resources to be spent on technological development.
C. lose abilities.
D. diversify their abilities.
E. focus on a few skills or products, thus becoming expert beyond larger populations.

Solution: In Chapter 2, Ridley claimed about the Tasmanians, “Isolation - self-sufficiency - caused the shrivelling of their technology.”

- (4) In recent decades, economic equality has

A. decreased globally and increased within the most populous countries.
B. not changed in a consistent direction over time.
C. decreased globally and decreased within the most populous countries.
D. increased globally and decreased within the most populous countries.
E. increased globally and increased within the most populous countries.

Solution: Ridley said that “while inequality has increased within some countries, globally it has been falling. The recent enrichment of China and India has increased inequality within those countries by making the income of the rich grow faster than that of the poor - an income gap is an inevitable consequence of an expanding economy. Yet the global effect of the growth of China and India has been to reduce the difference between rich and poor worldwide.”

- (5) What was likely the first specialization of labor?

A. Children sewed clothes with needle and thread, and adults grew fibers for thread.
B. Particular adults cut stones to construct buildings.
C. Children made clay objects, and adults laid bricks.
D. Children and women gathered, and men hunted.
E. Individuals became copper smelters.

Solution: Matt Ridley said in Chapter 2, “The first and deepest division of labour is the sexual one. It is an iron rule documented in virtually all foraging people that ‘men hunt, women and children gather’.”

- (6) What is the collective brain?

A. The human mind’s toolkit of abilities allowing an individual to perform a wide array of tasks
B. A Marxist concept of communal intellectual work to perform a specific commercial or industrial job, analogous to collective farms

- C. The human mind's tendency to acquire knowledge, allowing the development of civilization
- D. The combination of multiple computers to allow applications such as cloud computing or artificial intelligence
- E. The set of many people who contribute bits of knowledge that can make goods and services

Solution: In Chapter 1 of *The Rational Optimist*, Ridley said, "This is what I mean by the collective brain. As Friedrich Hayek first clearly saw, knowledge 'never exists in concentrated or integrated form but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess'."

- (7) Matt Ridley argues that gains in prosperity might best be seen by
- A. gains in self-sufficiency of the average person,
 - B. increases in pollution.
 - C. a reduction in the amount of work it takes to acquire a given item.
 - D. a reduction in the difference between what the richest people have as compared to the poorest.
 - E. increases in the cost of housing.

Solution: Matt Ridley said, "This is what prosperity is: the increase in the amount of goods or services you can earn with the same amount of work."

- (8) Once hominids learned how to make Acheulean hand axes,
- A. other stone tools appeared in rapid succession.
 - B. the bronze age quickly followed.
 - C. stone tools disappeared from the archeological record.
 - D. tool development stagnated for a long time.
 - E. Tyrannian foot spears were soon invented.

Solution: Ridley says at the start of Chapter 2 that hominids made the Acheulean biface almost unchanged for about a million years, and then, after a slight change, another 600,000 years with almost no change. Thus, the answer is that tool development stagnated for a long time.

- (9) Which does Matt Ridley claim is unique to humans?
- A. Using tools
 - B. Barter
 - C. Reciprocity
 - D. Cannibalism
 - E. Violence by groups

Solution: Ridley said that "There is strikingly little use of barter in any other animal species." Later he said that "this appetite for barter, had somehow appeared in our African ancestors some time before 100,000 years ago."

- (10) To explain the theme of "The Rational Optimist", Matt Ridley makes the analogy that sex is to biological evolution as
- A. a hand axe is to a computer mouse.
 - B. optimism is to pessimism.
 - C. language is to big brains.
 - D. exchange is to cultural development.
 - E. Neanderthals are to modern humans. Feedback

Solution: In the Prologue to "The Rational Optimist", Matt Ridley says, "Exchange is to cultural evolution as sex is to biological evolution."

- (11) Compared to the distant past, each person is, on average worldwide,
- A. less often a victim of violence.
 - B. less prosperous.
 - C. less happy.
 - D. about as prosperous.
 - E. more self-sufficient.

Solution: "Less often a victim of violence.;; Ridley states that "violence was a chronic and ever-present threat...The warfare death rate of 0.5 per cent of the population per year that was typical of many hunter-gatherer societies would equate to two billion people dying during the twentieth century (instead of 100 million)."

- (12) Compared to now, Matt Ridley thinks the environment in a century, like the condition of humanity itself, will be
- A. a hellish nightmare that will make Venus look like paradise
 - B. the same

- C. rather worse
- D. non-existent because we will destroy Earth
- E. far better

Solution: The Prologue of The Rational Optimist says, “It will not be easy, but it is perfectly possible, indeed probable, that in the year 2110, a century after this book is published, humanity will be much, much better off than it is today, and so will the ecology of the planet it inhabits.”

- (13) According to Richard Dawkins, what is the main role of a living individual?
- A. To act as a disposable survival machine for carrying genes
 - B. To be an essentially immortal messenger of coded information
 - C. To contribute to the stability of the environment of other individuals and species
 - D. To cooperate with other individuals
 - E. To compete with other individuals

Solution: In the video of Dawkins in Lecture 1, he said, “An individual organism is a throwaway survival machine for the self-replicating, coded information which it contains.”

- (14) According to Sapiens, the Cognitive Revolution was characterized by emergence of all of the following abilities, EXCEPT
- A. Being readily able to gossip
 - B. Innovative collaboration among a small group of individuals
 - C. Being able to warn other individuals about imminent dangers
 - D. Telling of myths, legends, and religions
 - E. Sharing of information about one’s social relationships

Solution: The Cognitive Revolution, which happened between 70,000-30,000 years ago, enabled new ways of thinking and communication among Homo sapiens, distinguishing the human language and those of other hominids. The sharing of information about one’s current physical surroundings, such as warning one another in the presence of a predator, was key for survival and social cooperation, but this was a shared trait among other animals and archaic humans.

- (15) Matt Ridley thinks that the best way to get happier is:
- A. Political and social liberty
 - B. Social Security
 - C. Wealth
 - D. Scientific Innovations
 - E. Longevity

Solution: Ridley argues that wealth is not the best route to happiness. “Social and political liberation is far more effective.”

- (16) Which one of the following is not an example of an imagined reality?
- A. The Japanese Yen
 - B. Human rights
 - C. The United States
 - D. Google
 - E. Climate change

Solution: Yuval N. Harari states that the entities that bring us together, such as the notion of gods, money, nations, corporations, and laws of justice, are all a product of our common imagination.

- (17) Which individual can make a computer mouse?
- A. An assembly line worker
 - B. A designer
 - C. Nobody
 - D. Any of these: engineer, designer, or assembly line worker
 - E. An engineer

Solution: The answer is nobody. In the TED Talk where he introduced the ideas in the book, Ridley said that nobody knows how to make a mouse. A CEO knows how to run a company and an engineer can design a mouse, but no one person can do it alone. It requires many people, maybe millions, to contribute to making a mouse.

- (18) According to Ridley, which of the following has been the most effective factor causing people to become happier over time?
- A. We are getting more interdependent.
 - B. Poverty has reduced drastically in the past few decades.
 - C. Our average life expectancy increased over time.
 - D. Combined efforts by the government keep housing prices high.
 - E. We have more free choices in life.

Solution: Ridley stated, “It is the increase in free choice since 1981 that has been responsible for the increase in happiness... (Ridley, 2011, under sub-theme Happiness of Chapter 1)”

- (19) According to the Flynn effect, which of the following generations would have had the highest average score in an IQ test if all of them took it when they were 20?
- A. Generation Z (those born from 1997 onwards)
 - B. Generation X (those born from 1965 to 1980)
 - C. Boomer (those born from 1946 to 1964)
 - D. Generation Y (those born from 1981 to 1996)
 - E. We can't determine from this information, as an individual's IQ varies based on multiple biological and environmental factors.

Solution: The Flynn effect, as explained in *The Rational Optimist*, describes the general increase of IQ among populations throughout the 20th century (i.e., “... steady, progressive and ubiquitous improvement in the average IQ scores...” (Ridley, 2011, p. 19))

- (20) Which of the following does Matt Ridley think contributed most to the development of human civilization?
- A. Imitation
 - B. Language
 - C. Standing upright
 - D. Evolution of a large brain
 - E. Specialization

Solution: Matt Ridley said, “The cumulative accretion of knowledge by specialists that allows us each to consume more and more different things by each producing fewer and fewer is, I submit, the central story of humanity... This is history's greatest theme: the metastasis of exchange, specialisation and the invention it has called forth, the ‘creation’ of time.” Large brains or language were likely not the key because Neanderthals may have talked and had brains at least as large as homo sapiens, yet Neanderthal civilization didn't advance because they didn't specialise.

- (21) According to Richard Dawkins, what is the main role of a living individual?
- A. To cooperate with other individuals
 - B. To be an essentially immortal messenger of coded information
 - C. To contribute to the stability of the environment of other individuals and species
 - D. To act as a disposable survival machine for carrying genes
 - E. To compete with other individuals

Solution: In the video of Dawkins in Lecture 1, he said, “An individual organism is a throwaway survival machine for the self-replicating, coded information which it contains.”

- (22) Matt Ridley argues that Homo sapiens (which Ridley calls *Homo dynamicus*) advanced technologically
- A. when they lived in relative isolation, not threatened by people they did not know.
 - B. when they had more opportunities to interact with other people outside their living groups.
 - C. as a result of a specific mutation in the FOXP2 gene.
 - D. due to changing climate, putting a premium on adaptability.
 - E. when they started eating a diet rich in both fruit and vegetables, developing larger brains as a result.

Solution: Ridley refuted theories that a change in climate or in a gene caused technological advancement. Instead he claimed that the cause was that homo sapiens “started, for the very first time, to exchange things between unrelated, unmarried individuals; to share, swap, barter and trade.”

- (23) What is true of comparative advantage?
- A. If I take longer than you to make an object, I might still benefit by producing and trading it with you.
 - B. If I don't want something, I have a comparative advantage in producing it.
 - C. Self-sufficiency shows some people have a comparative advantage in everything they do.
 - D. The great apes make use of comparative advantage when engaging in reciprocal grooming.
 - E. The excavations at Boxgrove Quarry illustrate that it is not always profitable to have a comparative advantage.

Solution: This may seem paradoxical, but as long as there is a difference in opportunity cost between two people, they may benefit by trading. In the fish-banana example in Lecture 2, Ann is more efficient at both farming and fishing than Bob, yet Bob still gains by trading. As I said in the lecture, “Even though Ann is better at both fishing and banana harvesting, she can gain by trading with Bob, and so could Bob.” He, in effect, gains from trade by sharing her efficiency.

The great apes answer is wrong because they do not necessarily have a comparative advantage; they may be equally good in grooming. Reciprocation (like for like) is not barter.

The Boxgrove Quarry answer is wrong. All I mentioned about Boxgrove Quarry was that hominids there used tools and buried their dead: nothing about comparative advantage or trade.

(24) How was the invention of fire and cooking most advantageous to the evolution of hunter-gatherer societies?

- A. Facilitated the development of culture and human civilization with new dishes and cuisines.
- B. Allowed hunter-gatherer societies to hunt more effectively.
- C. Encouraged specialisation by gender and allowed the sharing of food.
- D. Encouraged both men and women to participate in hunting equally.
- E. Allowed hunter-gatherer societies to migrate north to colder regions.

Solution: Cooking predisposed humans to the exchange of different kinds of foods. As economist Haim Ofek stated, “fire itself is hard to start but easy to share; likewise, cooked food is hard to make but easy to share.” Within hunter-gatherer societies, fire and cooking gave rise to the first division of labour and specialisation, where women gathered and cooked, and men hunted.

(25) Why did civilization regress in Tasmania after about 10,000 years ago?

- A. Hunting drove their main food source to extinction
- B. Genetic mutations that degraded health
- C. Repeated attacks from outsiders
- D. Self-sufficiency
- E. Depletion of resources

Solution: In Chapter 2 of *The Rational Optimist*, Ridley wrote, “Isolation - self-sufficiency - caused the shrivelling of their technology.” Rising sea levels caused by the end of the ice age cut-off Tasmania from the Australian mainland. This isolation led to self-sufficiency for the hunter-gatherer tribes, which experienced stagnation and technological regression because they lacked the numbers to sustain their existing technology.

(26) What was the most likely cause of human expansion and success in the last 200,000 years?

- A. The emergence of reciprocity, which only exists in modern humans
- B. Invention of the stone biface axe
- C. Exchange among unrelated, unmarried people, allowing specialisation
- D. A mutation or mutations allowing speech
- E. Climate change

Solution: Ridley asserted “that the answer lies not in climate, nor genetics, nor in archaeology, nor even entirely in ‘culture’, but in economics. Human beings had started to do something to and with each other that in effect began to build a collective intelligence. They had started, for the very first time, to exchange things between unrelated, unmarried individuals”

II. Questions from Quiz 2

- (1) What is a way to avoid some tragedies of the commons?
- A. Nepotism
 - B. Establishing a stronger welfare state
 - C. Privatization
 - D. Specialisation
 - E. An enforced agreement among all parties that the resource should remain freely accessible to all of them.

Solution: Privatization could avoid some tragedies of the commons by limiting usage of a resource to a sustainable level.

- (2) What did both Google and J.P. Morgan say was most important to them?
- A. Trust B. Freedom C. Innovation D. Intelligence E. A zero-sum game

Solution: In Chapter 3, Ridley says, “Google’s code of conduct echoes Morgan: ‘Trust is the foundation upon which our success and prosperity rest...’”.

- (3) Which of the following statements is most accurate?
- A. Comparative advantages result in unilaterally beneficial trade.
 - B. Self-interest can create public good through trade.
 - C. According to Michael Shermer, poverty is the barrier to charity.
 - D. Altruism is important for trade.
 - E. Conditions for TIT-FOR-TAT strategy success in the iterated prisoners’ dilemma are recognizing cooperation, remembering interaction, retaliating people, and rewarding cheating.

Solution: The correct answer is that self-interest creates public good through trade. If everyone is acting in his own interest, the collective result tends to be mutually beneficial. See lecture slide, “Doing good by being selfish?”

Comparative advantages do not generally result in unilaterally beneficial trade. They lead to mutually beneficial trade. See lecture slide, “The roots of prosperity.”

According to Michael Shermer, poverty is not the barrier to charity. The book says, “As Michael Shermer comments, ‘Poverty is not a barrier to charity, but welfare is.’”

The four Res are repeating interaction, remembering people, recognizing cheating and rewarding cooperation. See lecture slide, “Conditions for cooperation.”

Altruism is not important for trade. Altruism is good for people but not necessary for trade. See lecture slide, “Altruism.”

- (4) Which of the following best facilitate trade?
- A. Markets, a medium of exchange, tariffs, and trust
 - B. A medium of exchange, self-sufficiency, specialisation, and trust
 - C. A medium of exchange, justice, middlemen, and trust
 - D. Altruism, markets, specialisation, mobility, and trust
 - E. Altruism, a medium of exchange, self-sufficiency, and trust

Solution: A medium of exchange, justice, middlemen, and trust help trade take place. Altruism, self-sufficiency, or tariffs don’t facilitate trade.

- (5) Which one of the following statements is most accurate according to Hamilton’s rule?
- A. Hamilton’s rule says that I would let my grandfather die to save three of my aunts.
 - B. Hamilton’s rule explains the phenomenon of selflessly donating living organs for strangers.
 - C. Hamilton’s rule states that I should always challenge one who threatens my reputation, even if the challenge risks my life.
 - D. Hamilton’s rule explains why we should always think of our own individual interests and be selfish.
 - E. Under Hamilton’s rule, I should sacrifice my own life in exchange for anyone from my cousin’s family.

Solution: Hamilton’s rule states that an action benefits one’s gene if the cost of the action to one’s fitness is less than the benefit to other individuals, multiplied by their relatedness to the actor (“Hamilton’s rule” slide). Since my relatedness to my grandfather is $\frac{1}{4}$, which is less than my relatedness to three aunts ($3 \times \frac{1}{8}$), Hamilton’s rule says that I would save 3 aunts instead of my grandfather.

- (6) Which is a major implication one could infer from the Elephant Chart on global income inequality from 1988 to 2008?

- A. The poor have gotten poorer because the “trunk” of the Elephant Chart tilts upwards.
- B. Income inequality, from a global perspective, fell as incomes in the developing world rose, reducing the gap with incomes in developed countries.
- C. There has been major growth in real incomes in all countries around the world.
- D. Crises of income inequality have arisen in well-developed countries due to the stagnation of real wages and the hollowing-out of the richest 1% in these countries.
- E. All Asian countries, especially Japan, have had drastic income growth as a result of the phenomenon of “Resurgent Asia”, whilst European countries and the United States struggled to perform well economically.

Solution: Rising incomes among most of the poor people of the world have reduced the gap between rich and poor, thus income inequality, from a global perspective, fell as incomes in the developing world rose, reducing the gap with incomes in developed countries. The “Resurgent Asia” answer is wrong because it cannot be directly inferred from the graph, and because income did not grow in all Asian countries. Lower- and middle-class Japanese did not do well (at 1:26 of the Video).

(7) TIT-FOR-TAT success in society doesn’t need

- A. returning profits.
- B. rewarding cooperation.
- C. remembering people.
- D. repeating interaction.
- E. recognizing cheating.

Solution: TIT-FOR-TAT success in society needs 4 Re: repeating interaction, remembering people, recognizing cheating, and rewarding cooperation.

(8) Which of these will least likely raise oxytocin levels?

- A. Prayer
- B. Massage
- C. Anxiety
- D. Group dancing
- E. Chatting with friends

Solution: Oxytocin suppresses the activity of the amygdala, the organ that expresses fear. Thus anxiety is unlikely to raise oxytocin levels.

(9) What does Matt Ridley feel about markets?

- A. A system of individual self-interest that drives the creation of trust
- B. The tendency to become a top-down system monopolised by large corporations that deliver enormous cost savings to consumers
- C. The tendency for competition to promote altruistic behaviour
- D. The erosion of generosity because selfishness is the fundamental principle for the creation of markets
- E. A necessary evil that allows people to become wealthy despite many drawbacks such as loss of jobs

Solution: A system of individual self-interest that drives the creation of trust, as Ridley discussed in the section “If trust makes markets work, can markets generate trust?”.

(10) Which is correct about oxytocin?

- A. Oxytocin is a hormone that exists only in humans.
- B. Oxytocin is a hormone that raises trust or warm feelings.
- C. The trust game shows that oxytocin has an effect on reciprocity.
- D. Oxytocin does not affect fear.
- E. Oxytocin is a hormone that makes you feel angry.

Solution: According to Chapter 3 of “The Rational Optimist”, in the section entitled “The trust juice”, the trust game experiment proves that oxytocin improves trusting, even more than risk-taking. Oxytocin does not make you feel angry because the book explains that oxytocin is a “chemical that evolution uses to make mammals feel good about each other”. Oxytocin is common to all mammals, not only humans. The trust game experiment also shows that oxytocin doesn’t affect the trustee’s decision on back transfer, thus explaining why oxytocin does not have an effect on reciprocity. Oxytocin can suppress “the activity of the amygdala, the organ that expresses fear.”

(11) Which of these is LEAST likely to help facilitate trade?

- A. Both retaliation and forgiveness

- B. Reciprocal altruism
- C. Anonymous altruism
- D. Self-interest
- E. Ownership

Solution: A lecture slide entitled “Altruism” said that helping even without reciprocation is not important for trade.

- (12) Which is the most accurate statement regarding Harari’s arguments on the imagined order?
- A. Our interests and pleasures exist independently of the imagined order.
 - B. The imagined order is the prime command from a supreme being.
 - C. The natural order, unlike the imagined order, does not require believers.
 - D. Sapiens live in only one collective imagined order.
 - E. There is actually no order since entropy leads everything to chaos.

Solution: The natural order does not require believers since it does not cease to exist even if people stop believing in it. It is objective and is independent from human consciousness and beliefs.

The imagined order is inter-subjective, but cannot be altered by a single individual.

Sapiens live within layers of many imagined orders. Examples are the law, money, the notion of gods, and nations.

Our interests and pleasures are shaped and programmed by the imagined order. They are not independent desires.

Harari argues that “there is no way out of the imagined order”. Running awaytowards freedom only leads to a “bigger prison”, aka a larger imagined reality.

- (13) What is a conclusion from the ultimatum, dictator, and blinded dictator games?
- A. The data are strongly consistent with the theory of purely altruistic behaviour by natural selection.
 - B. All people are nice and trustworthy.
 - C. People are inherently mistrustful and will always treat each other unfairly unless they are closely related.
 - D. People’s decision-making seems to be driven by curiosity.
 - E. People in interconnected societies have a systemic bias toward cooperation and fairness.

Solution: People in interconnected societies have a systemic bias toward cooperation and fairness. Ridley commented “that the more people are immersed in the collective brain of the modern commercial world, the more generous they are.” The 3 games show that people may act nice. That behavior can be based on fear, which in turn can be driven by image-consciousness.

- (14) Which of these is the most successful strategy for the iterated prisoner’s dilemma?
- A. Cooperate after opponent defects, and defect after opponent cooperates
 - B. Defect at random times
 - C. Alternate between cooperating and defecting
 - D. Express altruism, be nice, and forgive
 - E. Be nice, retaliate, and forgive

Solution: The best strategy is generally tit-for-tat, which involves being nice, retaliating, and forgiving (“Evolutionary simulation” slide).

- (15) Which of the following best describes the broadest sense of what Harari means by ‘Building Pyramids’?
- A. The emergence of cultural systems during the Agricultural Revolution
 - B. The illustration of inequality among homo sapiens
 - C. The erection of huge stone monuments by Egyptian, Mayan, and other civilizations
 - D. The creation of structures, societal hierarchies, and orders
 - E. The hierarchy of human needs and desires

Solution: In Sapiens Chapter 6, Harari explores human progress during the Agricultural Revolution. He highlights the creation of imagined orders and social systems (ie. social pyramids) during this period, which also comes along with the building of physical structures, such as lawns and houses. The term ‘Building Pyramids’ illustrates this.

- (16) Which of the following factors would be most likely to deter long-term cooperation?
- A. Altruism

- B. Anonymity
- C. An ability to remember
- D. Positive experience of commerce and trade
- E. Release of more oxytocin

Solution: The correct answer is anonymity because it blocks the ability to remember trade partners for building long term cooperation and future reciprocation. Anonymity would eliminate the risk to one's reputation that would arise from betraying one's trading partner, and the blinded and unblinded dictator games demonstrate that reputation is an important factor in trade. The other options would not deter cooperation. An increase in blood oxytocin level promotes trust (Chapter 3). Commerce and trade are already a kind of cooperation. With repeating interaction, trust can be built and promote further cooperation (slide: "Conditions for cooperation"). An ability to remember encourages cooperation because it encourages trust after positive interactions. Altruism would increase cooperation.

- (17) Which is NOT an example of the tragedy of the commons?
- A. Logging of old-growth forests that leads to the loss of livelihood for indigenous populations depending on it for survival.
 - B. Collective ownership of grassland by a village where there is no incentive to stop overgrazing by livestock.
 - C. Littering in public spaces such as parks and recreation areas.
 - D. An agreement for reducing the burning of fossil fuels and carbon dioxide emissions.
 - E. Overcrowding in popular tourist locations like Venice or Machu Picchu.

Solution: An agreement for reducing the burning of fossil fuels and carbon dioxide emissions would avoid the tragedy of the commons.

- (18) According to Matt Ridley, the unexpected increase in productivity that the US saw in the 1990's was due particularly to
- A. improvements in efficiency first introduced by Walmart.
 - B. huge expansion in the use of steam engines to reduce the cost of transportation.
 - C. economic changes in Europe leading to the introduction of the Euro currency.
 - D. the mass adoption of smartphones.
 - E. reductions in tariffs, thus increasing imports of cheaper products from China.

Solution: Ridley states that, for productivity, "the 1990s surge in the United States was caused by (drum roll of excitement) logistical changes in business (groan of disappointment), especially in the retail business and especially in just one firm-Wal-Mart."

- (19) Which of the following is/are incorrect about oxytocin?
1. Oxytocin is a hormone that exists only in humans.
 2. Oxytocin is a hormone that raises trust or warm feelings.
 3. The trust game shows that oxytocin has an effect on reciprocity.
 4. Oxytocin does not affect fear.
- A. 2, 3, 4
 - B. 2
 - C. 1, 2
 - D. 1, 3, 4
 - E. 3

Solution: Oxytocin is a hormone that specifically increases trusting. According to Chapter 3 of "The Rational Optimist", in the section entitled "The trust juice", the trust game experiment proves that oxytocin improves trusting, even more than risk-taking. Oxytocin does not make you feel angry because the book explains that oxytocin is a "chemical that evolution uses to make mammals feel good about each other". Oxytocin is common to all mammals, not only humans. The trust game experiment also shows that oxytocin doesn't affect the trustee's decision on back transfer, thus explaining why oxytocin does not have an effect on reciprocity. Oxytocin can suppress "the activity of the amygdala, the organ that expresses fear."

- (20) What is the largest group of people whose incomes rose substantially in the 1990s and 2000s, according to analysis of the elephant graph?
- A. The middle class in Switzerland

- B. Africa
- C. The richest 1%
- D. The poorest 1% of people
- E. Resurgent Asia

Solution: In the video on the elephant graph, Branko Milanovic and Paul Solman discussed that the middle third or so of the global population had a big rise in income, and that this constituted Resurgent Asia, such as middle-class Indians, Chinese, and South Koreans. The middle class of developed nations is the wrong answer because these were the largest group whose income did NOT rise substantially. In the elephant graph, the big dip for the richest 30% of the world's income distribution (except the top 1%) represents the hollowing out of the middle class in developed countries, such as France, the UK, and the US. Income did not rise for the poorest 5% of people.

- (21) Natural resources, economic liberty, teaching program, strong government, and infrastructure might all predict prosperity of a country. Which would Matt Ridley likely consider most important?

A. Natural resources B. Infrastructure C. Economic liberty D. Teaching program E. Strong government

Solution: Ridley said, "a country's economic freedom predicts its prosperity better than its mineral wealth, education system or infrastructure do." He feels fragmented government could actually better support economic development than strong government.

- (22) For the tit-for-tat strategy to help people work together, all of these are needed, EXCEPT:

- A. People know when other people are being unfair.
- B. People can identify each other.
- C. People have different skills.
- D. People often deal with each other.
- E. People favor working together.

Solution: Tit-for-tat needs the 4 Re's: repeating interaction, remembering people, recognizing cheating, and rewarding cooperation. Thus tit-for-tat needs people to know when other people are being unfair, to often deal with each other, to favor working together, and to know each other. But it doesn't need people to have different skills.

- (23) TIT-FOR-TAT success in society does NOT need

- A. retaining kindness.
- B. remembering people.
- C. recurring contact.
- D. recognizing cheating.
- E. rewarding cooperation.

Solution: TIT-FOR-TAT success in society needs 4 Re: repeating interaction, remembering people, recognizing cheating, and rewarding cooperation. The first is equivalent to recurring contact. Therefore, the answer is retaining kindness.

- (24) Which of these will least likely raise oxytocin levels?

- A. Chatting with friends
- B. Public speaking
- C. Group dancing
- D. Massage
- E. Prayer

Solution: Oxytocin suppresses the activity of the amygdala, the organ that expresses fear. Thus public speaking is unlikely to raise oxytocin levels.

III. Questions from Quiz 3

- (1) Which of the following statements is most accurate?
- A. Norman Borlaug was a chemist who helped develop the Haber-Borlaug process to make synthetic fertilizer.
 - B. Farming started when humankind started to bake bread.
 - C. It requires millennia to selectively breed the largest and the smallest dogs.
 - D. Farming extends specialization to other species.
 - E. The first genetic modification of a food crop was performed several decades ago.

Solution: The correct answer is that farming extends specialization to other species (slide: “Farming begins: summary”). The first genetic modification of a food crop occurred with domestication thousands of years ago (slide: “History of genetically modified food”).

Humankind began to bake bread at least 23 ka ago, while farming became a common practice around 10 ka ago. The gap is due to the gathering of wild grains and wheat (slides: “(Not-so-fresh) Bread” and “Farming begins”).

The Haber-Bosch process turns nitrogen and methane (a natural gas) into ammonia to make fertilizer (slides: “Haber-Bosch process”).

It is a quick process to selectively breed the largest and the smallest dogs, within a century (slide: “Dogs”).

Farming extends specialization to other species, to provide foods and material for us (slide: “Farming begins: summary”).

- (2) According to Matt Ridley, what caused farming to start around 11500 years ago?
- A. People wanted to change their diet.
 - B. The invention of copper smelting
 - C. There were no longer any big animals to hunt.
 - D. The world became much warmer, wetter and more predictable.
 - E. People realized vegetables provide more nutrients to the human body.

Solution: Ridley, in “The Rational Optimist” stated that “around 11,500 years ago the temperature of the Greenland ice cap shot up by ten degrees (centigrade) in half a century; throughout the world conditions became dramatically warmer, wetter and more predictable. In the Levant intensification of cereal use could resume, the Natufians could return to settled homes and soon something prompted some body to start deliberately saving seed to plant.”

- (3) Which statement about GMOs is most accurate?
- A. Growing GMO crops lowers the production cost of farmers.
 - B. The DNA change in GMOs is injecting an unknown gene with unknown function into the genome of an organism.
 - C. Growing GMO crops will increase the use of herbicide and pesticide.
 - D. Since the introduction of GMO crops to India, the suicide rate of farmers has increased substantially.
 - E. Superweeds arise mainly due to GMO crops.

Solution: According to the lecture slide titled “Main benefits of GMO crops”, the main benefits of GMO crops include lower cost. The other choices are incorrect because the DNA change of GMOs is known. herbicides induce superweeds regardless of the use of GM crops, the suicide rate of Indian farmers did not change when GM crops began to be grown, and GM crops can actually reduce the use of herbicide and pesticide.

- (4) What were the causes of “The Wheat Problem”?
- A. The growing population and the lack of rainwater
 - B. The lack of sunlight and the lack of suitable acres to plough
 - C. The growing population and the lack of sunlight
 - D. The lack of sunlight and the lack of rainwater
 - E. The growing population and the lack of suitable acres to plough

Solution: The Rational Optimist quotes the British chemist Sir William Crookes as stating that “all civilisations stand in deadly peril of not having enough to eat” due to the growing population and the lack of acres to plough in the Americas. The Caucasian race “will be squeezed out of existence by races to whom wheaten bread is not the staff of life”. This problem could not be solved unless a scientific process can fix nitrogen from the air.

- (5) While shopping together, a family member asks you whether it’s better to buy organic fruit because it doesn’t have chemicals. Which of the following would be factual replies?

1. Though organic food doesn't have chemicals, it is not necessarily safer.
2. The levels of synthetic pesticides on fruit are generally much less than would be harmful.
3. Plants make chemicals that can be toxic.

A. None of the above **B. 2 and 3** C. 1 D. 2 E. 1 and 3

Solution: The lecture slide titled "Food is chemicals" says "Everything, including food, is chemicals." Therefore, organic food does have chemicals, and (1) is wrong. The slide titled "Are pesticides safe?" shows that even though apples commonly have pesticide residues, apples have much less than would be harmful (with mean exposure hundreds to thousands of times less than the reference dose), thus (2) is correct. The slide titled "Is food safe?" says that tobacco makes nicotine, a pesticide, and the "Food is chemicals" slide says that many food plants make cyanide, thus (3) is correct. Bruce Ames also supported this in his video.

- (6) What was a key factor which helped in proving Malthus's prediction wrong?

- A. The Haber-Bosch process for producing ammonia fertilizer**
- B. Adoption of organic farming around the world, leading to the availability of nutritious food
- C. Stabilization of the world population in the 20th century, allowing more people to eat
- D. The movement to grow food locally, raising efficiency
- E. India and Pakistan gaining independence, allowing them to produce more wheat

Solution: In the book, Ridley lists three factors as the chief reasons: "Borlaug's genes, sexually recombined with Haber's ammonium and Rudolf Diesel's internal combustion engine, have rearranged sufficient atoms ... to ensure that Malthus was wrong for at least another half-century". Organic Farming didn't contribute to higher yields, and in fact can even take up more land and do the opposite. It was not independence but rather Borlaug's intervention in India and Pakistan which increased their wheat yield. Growing food locally tends to decrease, not increase, yields, as Ridley explained: "Should the world decide...that countries should largely grow and eat their own food..., then of course a very much higher acreage will be needed". Ridley doesn't list the stabilizing of populations as one of the factors; in fact, population grew dramatically.

- (7) Which of the following statements is most correct about artificial selection in domestication?

- A. It requires genetic engineering.
- B. It needs millennia to significantly change traits.
- C. It attempts to enhance some favorable quality.**
- D. It selects traits that increase the likelihood of survival and hence reproduction.
- E. It is beneficial to humans, but not to the domesticated organism.

Solution: Its goal is to accentuate a desirable trait by selective breeding, according to a slide titled "Domestication".

- (8) Scientists bred new traits into crops as part of the Green Revolution. Which of the following traits were important in growing more food: resistance to plant diseases, taller plants to support more grain, or more protein for better nutrition?

- A. Disease resistance and taller plants
- B. Taller plants and more protein
- C. Taller plants, disease resistance, and more protein
- D. None of these
- E. More protein and disease resistance**

Solution: The new crop breeds were shorter, not taller. The slides said that Norman Borlaug bred high yield wheat strains that were short so they won't collapse, and that were multiply disease-resistant. In *The Rational Optimist*, Ridley said, "fertiliser caused the crop to grow tall and thick, whereupon it fell over, or 'lodged'. Vogel began crossing Norin 10 with other wheats to make new short-strawed varieties." Later, he said, "thanks to Borlaug's persistence, the dwarf wheats prevailed... Borlaug's wheat - and dwarf rice varieties that followed - ushered in the Green Revolution." The 10 minute video you previewed before the lecture also clearly explained the importance of shorter plants, that "some strains of wheat were modified to have a high protein level to compensate for a lack of protein" in the diet of many people, and that "agronomists were also able to create strains that were resistant to lethal plant diseases."

- (9) How may farming have created a positive feedback loop to encourage more farming?

- A. By supporting a larger population, which gathered more wild plants, decreasing their availability and forcing people to grow more plants to obtain enough food**
- B. By accumulating capital to fund copper smelting, supplying copper-based synthetic pesticides and herbicides
- C. By reducing hunting, leading to more manure from wild animals, supplying more fertiliser for farming

- D. By allowing the domestication of dogs, which supplied labor to grow plants on farms
- E. By domesticating plants, increasing the demand for fertiliser from fish and other animals obtained by hunting

Solution: The lectures stated the best answer: “By supporting a larger population, which gathered more wild plants, decreasing their availability and forcing people to grow more plants to obtain enough food”. Increasing the demand for animals from hunting doesn’t necessarily encourage farming. Farming may have increased rather than decreased hunting. Farming may have led to accumulation of capital to fund copper smelting, but the products were things like axes, not synthetic chemicals. Dogs were probably domesticated before widespread farming.

- (10) Why did Matt Ridley feel that “the invention of metal smelting was an almost inevitable consequence of the invention of agriculture”?
- A. Back in those days, people had to compete with farmers, so they invented metal smelting to earn money.
 - B. Farming created capital, a high density of people, and markets, thus making feasible the high investment required for smelting.
 - C. Slash and burn agriculture required the burning of forests, which occasionally melted surface-exposed copper deposits, triggering the idea of copper smelting.
 - D. People found that domesticating wheat was not enough for survival, so they invented metal smelting to produce more sharp, powerful weapons to hunt animals.
 - E. Copper tools were important for planting seeds and harvesting crops.

Solution: The correct answer is that farming created capital, a high density of people, and markets, thus making feasible the high investment required for smelting (see Chapter 4 and the slide titled “Capital”).

- (11) “The Rational Optimist” contains a quote by Professor Robert Paarlberg, who said, “Europeans are imposing the richest of tastes on the poorest of people.” What did he mean by this?
- A. The lucrative European market for luxury food induces farmers in low-income areas to grow these export crops instead of cheap local foods.
 - B. The invention by Haber and Bosch of an efficient way to make nitrogen fertilizer allowed the growth of an abundance of cheap food, contributing to the spread of overeating and thus medical problems such as diabetes and atherosclerosis.
 - C. By advertising fast food and junk food, companies are burdening the food budgets of poor people.
 - D. By promoting the purchase of GM seeds, which are expensive, European companies are impoverishing farmers in developing countries.
 - E. Opposition to the use of GM foods decreases agricultural efficiency and thus raises food prices, which many people in developed regions can easily afford but which many people in poor regions cannot.

Solution: The answer is that opposition to the use of GM foods decreases agricultural efficiency and thus raises food prices, which many people in developed regions can easily afford but which many people in poor regions cannot. “The Rational Optimist” quotes Kenyan scientist Florence Wambugu: “You people in the developed world are certainly free to debate the merits of genetically modified foods, but can we eat first?”

- (12) Which statement about chemicals and food safety is most accurate?
- A. Food containing synthetic chemicals over certain levels is unsafe to consume.
 - B. It is generally good to try to minimize the amount of chemicals in food.
 - C. Food is unsafe to consume if the total level of all chemicals is above a certain level.
 - D. Food containing natural chemicals over certain levels is unsafe to consume.
 - E. Food containing particular chemicals over certain levels is unsafe to consume.

Solution: Referring to the slide titled “Food is chemicals”, knowing which chemical was used and how much of it was used are the determinants of whether the food is safe to consume, not whether the chemicals are natural or synthetic. For example, to many people, cyanide might seem to be toxic, however, it is actually a natural chemical in some food (e.g., almond and potato). However, we would not die after eating those foods because the amount we normally consume gives us much less than a toxic amount of cyanide. The slide titled “Are pesticides safe?” shows that many apples have some synthetic chemicals (e.g., Carbaryl), but the amounts are far below dangerous levels.

- (13) Why did Matt Ridley feel that farming led to the use of copper?
- A. Back in those days, hunter-gatherers had to compete with farmers, so they invented metal smelting to earn money.
 - B. People found that domesticating wheat was not enough for survival, so they invented metal smelting to produce more sharp, powerful weapons to hunt animals.

- C. Copper tools were important for planting seeds and harvesting crops.
- D. Producing copper needed intensive investment, which farming enabled by accumulating wealth and people, and creating markets.
- E. Slash and burn agriculture required the burning of forests, which occasionally melted surface-exposed copper deposits, triggering the idea of copper smelting.

Solution: The correct answer is that farming created capital, a high density of people, and markets, thus making feasible the high investment required for smelting (see Chapter 4 and the slide titled “Capital”).

(14) Which one of the following statements is TRUE regarding lactose intolerance?

- A. All adults in East and South-East Asia possess functional lactase enzyme.
- B. Converting milk to cheese allowed lactose intolerant individuals to consume the product without diarrhea because the microbes in cheese produce chemicals that numb the nerves in the gut to prevent spasms. For this reason, cheese was an early anesthetic.
- C. Clay strainers were historically used to extract the liquids from the solids in milk, and the liquids were used to make the lactase enzyme.
- D. Mutations for adult production of lactase enzyme likely spread because they raised the chances of survival by providing nutrition in low-food and low-light environments.
- E. Drinking more milk allowed individuals to mutate themselves and produce the lactase enzyme to counteract the negative side-effects of milk.

Solution: It is true that the mutations for adult expression of lactase enzyme most likely spread in the population because they boosted an individual’s chances of survival in populations facing famine or in dark climates where Vitamin D could not be reliably and naturally synthesized through sunlight.

The other responses are incorrect because:

A low proportion of East and South-East Asian adult populations possess the lactase enzyme gene

Consumption of cheese without the negative side-effects of diarrhea is possible because cheese has little or no lactose

Individuals do not mutate themselves in response to the environment. Random mutations gave rise to versions of the lactase enzyme gene, and it evolved through the process of natural selection

Strainers separated solids from the liquids in the milk, and the solids were used to make cheese. The liquids were not used to make lactase enzymes

(15) Which is most likely TRUE about agriculture?

- A. Its introduction made people much more peaceful and self-sufficient.
- B. It started independently and became common on all inhabited continents within a relatively short period of a few thousand years. Australian farms stretched from coast to coast.
- C. It became feasible after the Ice Age ended and the climate stabilized to a temperature suitable for farming.
- D. It spread within a few thousand years once homo sapiens learned to control fire.
- E. It was invented in the Fertile Crescent (in the Middle East), and its knowledge was carried and implemented throughout the world within a few months.

Solution: In “The Rational Optimist,” Ridley says, “The Fertile Crescent was probably the place where agriculture first took hold, and from there the habit gradually spread south to Egypt, west into Asia Minor and east to India, but farming was quickly invented in at least six other places in a short time”. Therefore, knowledge of farming was not carried throughout the world; rather farming developed independently in multiple locations. Farming did become common within a period of several thousand years in the Americas, Africa, and Asia, but not in Australia because Australians “knew, or found out the hard way, that farming does not work in a highly volatile climate.” Farming did not make people peaceful. “Wherever archaeologists look, they find evidence that early farmers fought each other incessantly and with deadly effect.” Ridley says that “around 11,500 years ago the temperature of the Greenland ice cap shot up by ten degrees (centigrade) in half a century; throughout the world conditions became dramatically warmer, wetter and more predictable. In the Levant, intensification of cereal use could resume”. Thus, stabilization of the climate and a temperature suitable for farming made agriculture feasible.

(16) Which of the following statements about the development of agriculture is most correct?

- A. Agriculture moved people up the trophic pyramid.
- B. Agriculture was a slow, cumulative transition of human diet intensification.
- C. Early farmers were self-sufficient and did not rely on trade.

- D. Agriculture led to the invention of ovens for baking bread.
- E. Once people started farming, they did not go back to hunting and gathering.

Solution: Agriculture could not develop overnight. Early humans were hunter-gatherers, and their diet had been dependent on meat. Shifting a meaty diet towards a carbohydrate diet took time. Ridley said, “It was the culmination of a long, slow intensification of human diet that took tens of thousands of years.”

The other answers were wrong because early trading was frequent in places where farming existed, people regressed from farming to hunting and gathering during a cold snap, agriculture moved people down the trophic pyramid, and ovens were used to bake bread from wild grain long before farming.

(17) Which of the following statements about Ötzi is most accurate?

- A. He died approximately 2500 years ago.
- B. The weapons found with his body indicate that his main job was a weapons maker.
- C. His body was discovered in the mountains of Greece.
- D. He provided evidence that trading and specialization occurred in the Metal Age.
- E. The plant and animal material found with his body indicate that his main job was a farmer.

Solution: He provided evidence that trading and specialization occurred in the Metal Age. The Rational Optimist says, “Copper smelting was a practice that makes no sense for an individual trying to meet his own needs, or even for a self-sufficient tribe...”. It also said, “And yet there were things that Ötzi no doubt made for himself: ...directly consume between one-third and two-thirds of what they produce, and exchange the rest for other goods”. Thus, trading might have started in the metal age already, which allowed Ötzi to own such a number of tools. The other answers are wrong because the tools found on his body do not provide any evidence about his occupation, and the slides said he died about 5300 years ago in Italy.

(18) Which one of the following statements about the mummified iceman Oetzi is TRUE?

- A. He demonstrated that a single human possessed the knowledge to make many different tools.
- B. None of these
- C. He was a prehistoric hunter-gather with a collective brain that lived and died 100,000 years ago.
- D. He was a self-sufficient nomad who roamed the Serengeti and hunted Neanderthals.
- E. He took advantage of the specialised labour of other people and animals.

Solution: Oetzi was the mummified ‘iceman’ found in the Alps. He lived about 5,300 years ago in an Alpine valley, 2,000 years after agriculture reached southern Europe. Oetzi was carrying a diverse inventory of tools, and it would have been unfathomable for him to have possessed the knowledge or time to collect the raw materials and craft the items himself. This demonstrated that Oetzi consumed the specialised labour of other people and animals.

(19) Which does Ridley feel would pressure wilderness and threaten rainforests?

- A. limiting our carbon footprint
- B. growing food locally
- C. a vegetarian diet
- D. eating fish instead of beef
- E. farming on the Sun

Solution: In Chapter 4, Ridley says: “Should the world decide... that countries should largely grow and eat their own food ..., then of course a very much higher acreage will be needed. My country happens to be as useless at growing bananas and cotton as Jamaica is at growing wheat and wool. ... good night rainforests. But as long as some sanity prevails, then yes, my grandchildren can both eat well and visit larger and wilder nature reserves than I can. It is a vision I am happy to strive for. Intensive yields are the way to get there.”

(20) What are the main benefits of GM Crops

- A. Better-tasting crops, ability to use natural pesticides, lower toxicity to humans and animals.
- B. Decreased resistance to herbicides and pesticides, cheaper for farmers and consumers, and advanced nutritional delivery for human consumption.
- C. More nutritious, less herbicide and pesticide use, decreased resistance to herbicides and pesticides.
- D. Cheaper for farmers and consumers, more nutritious, less herbicide and pesticide use.
- E. Higher efficiency, better-tasting crops, and advanced nutritional delivery for human consumption.

Solution: GM crops can decrease the cost to farmers and consumers, and reduce the use of herbicides and pesticides by including genes in the crop that confers resistance to diseases, insects/pests and herbicides. Examples include Bt corn and cotton. Furthermore, GM crops can also improve nutritional value by containing additional nutrients that are lacking from diets of many people in developing countries. The most famous example of this is Golden Rice, which was modified to prevent vitamin A deficiency by containing enhanced levels of beta-carotene.

GM crops may increase, not decrease, risk of resistance to herbicides and pesticides. Improving taste has not yet been a demonstrable benefit of GMO crops.

IV. Questions from Quiz 4

- (1) What financial invention was least likely used before the last century?
- A. **cryptocurrency**
 - B. mortgages
 - C. mutual funds
 - D. loan forgiveness measures by government
 - E. compound interest

Solution: The slide titled “AN ANCIENT WALL STREET” said that 4 of these existed in ancient Ur. But cryptocurrency was not mentioned. (It was developed in the last few years. An example is Bitcoin.)

- (2) Which have the most urbanized population and will see the most growth of cities over the next several years: developed or developing regions?
- A. Developing regions are the most urban, and developed region cities will grow the most.
 - B. **Developed regions are the most urban, and developing region cities will grow the most.**
 - C. Developing regions are the most urban, and developing region cities will grow the most.
 - D. Developed regions are the most urban, and both developed and developing region cities will grow roughly equally.
 - E. Developed regions are the most urban, and developed region cities will grow the most.

Solution: The slide titled “URBANIZATION BY COUNTRY” shows that the most urbanized regions are developed areas such as North America, Western Europe, Australia, New Zealand, Japan, South Korea, and Saudi Arabia (though much of South America is also urbanized despite being less developed), while the least urbanized countries are in Africa and much of South Asia, which are among the least developed regions. The slide titled “Distribution of Cities” shows that most of the new large cities between 2014 and 2030 will be in South America, Africa, and South Asia, which are developing regions.

- (3) High tariffs tended to
- A. become more common in recent decades.
 - B. keep growth the same.
 - C. protect consumers.
 - D. speed growth.
 - E. **slow growth.**

Solution: High tariffs tend to slow growth. Chapter 5 mentions this in several places, for example: “Farm subsidies and import tariffs on cotton, sugar, rice and other products cost Africa \$500 billion a year in lost export opportunities - or twelve times the entire aid budget to the continent.”

- (4) In general, is city living better for the environment than is suburban living?
- A. No, because constructing cities requires deforestation and reclamation, which harm the environment.
 - B. **Yes, because cities tend to use less energy per person due to mass transit, smaller homes and shorter errands.**
 - C. Yes, because cities have greater population density, which promotes the development of renewable energy to protect the environment.
 - D. City living and suburban living have the same impact on the environment.
 - E. No, because the high population density in a city means greater production of waste products, like carbon dioxide and rubbish, as well as greater consumption of energy.

Solution: Slides: “15% rule”, “Are cities green?”, “Cities are green”.

- (5) Historically, what was most important in keeping city populations stable or increasing?
- A. **High immigration from rural areas**
 - B. Death rate less than in rural areas
 - C. Low emigration to rural areas
 - D. Birth rate higher than in rural areas
 - E. Both a higher birth rate and a lower death rate than in rural areas

Solution: In The Rational Optimist: “Since people have generally done more dying than procreating when in cities, big cities have always depended on rural immigrants to sustain their numbers.”

(6) According to Matt Ridley’s “The Rational Optimist”, which is the sequence of the urban revolution?

- A. intensification of trade → emperor → agricultural surplus
- B. emperor → intensification of trade → agricultural surplus
- C. emperor → agricultural surplus → intensification of trade
- D. agricultural surplus → emperor → intensification of trade
- E. intensification of trade → agricultural surplus → emperor

Solution: Matt Ridley suggests that the intensification of trade triggers agricultural surpluses (as farmers are motivated to turn their produce into valuable goods via trade), emperors then emerge as results of temptation to capture the gains of the society’s income: “To argue, therefore, that emperors or agricultural surpluses made the urban revolution is to get it backwards. Intensification of trade came first. Agricultural surpluses were summoned forth by trade, which offered farmers a way of turning their produce into valuable goods from elsewhere. Emperors, with their ziggurats and pyramids, were often made possible by trade. Throughout history, empires start as trade areas before they become the playthings of military plunderers from within or without.”

(7) What started in Uruk?

- A. Alcoholic drinks
- B. Cities over a million people
- C. Perfection of camels for moving cargo
- D. Trading beyond family members
- E. Writing as a long-lasting record using symbols

Solution: The slide “URUK” says that writing originated in Uruk. Alcoholic drinks were made for 9 ka in China, predating Uruk (slide: “CITY PROBLEMS: POLLUTION”). Uruk may have been the first city > 10,000 people, not 1 million. Trading beyond family members happened in the Ubaid period before Uruk (Rational Optimist: “Ubaid Mesopotamia, by exporting grain and cloth, drew its neighbours into exporting timber and later metal.”), and likely much earlier. Camels were perfected for cargo carrying much later (Rational Optimist: “The camel had been domesticated several thousand years earlier, but it was in the early centuries AD that it was at last made into a reliable beast of burden.”)

(8) Why were Phoenicians successful?

- A. They were effective warriors.
- B. Their land was rich in minerals.
- C. They had strong central government.
- D. They had excellent shipbuilding ability.
- E. They had religious motivation.

Solution: Chapter 5 says that Phoenicians built the best ships and used them to trade around the Mediterranean Sea.

(9) According to the 15% rule, which of the following is true?

- A. When the population of a city doubles, GDP and crime rise roughly 100%.
- B. When the population of a city doubles, GDP and crime rise roughly 85%.
- C. When the population of a city doubles, GDP and crime rise roughly 115%.
- D. When the population of a city doubles, GDP and infrastructure rise roughly 100%.
- E. When the population of a city doubles, GDP and infrastructure rise roughly 85%.

Solution: The correct answer is that when the population of a city doubles, GDP and crime rise roughly 115% (slide: 15% rule). Some things which are good, like GDP, and others which are bad, like crime, both increase 15% faster than the population when it comes to city living.

(10) According to the 15% rule discussed in Lecture 5, which of the following is most likely correct?

- A. Doubling population leads to a roughly 85% increase in the GDP and wages of a city.
- B. Doubling population leads to a roughly 115% increase in the traffic congestion in a city.
- C. Doubling population leads to a roughly 85% increase in crime in a city.
- D. Doubling population leads to a roughly 115% increase in the infrastructure of a city.

E. Growth rate for crime tends to be inversely proportional to population growth rate.

Solution: The correct answer is that traffic grows about 15% faster than the population (see slide “15% RULE”).

(11) What is/was the largest migration?

- A. The Partition of India
- B. Refugees fleeing Syria
- C. The Urbanization of China
- D. Mexicans moving to the US
- E. The Great Atlantic Migration

Solution: The slide titled “CHINA’S MIGRATION TO CITIES” has a table listing 200-500 million people in the Chinese Urbanization and says, “Largest migration ever”.

(12) Which of the following statements about the rise of towns and cities is most likely correct?

- A. The earliest towns developed as meeting points for buyers and sellers.
- B. The rise of empires resulted in the beginning of the urban revolution.
- C. The rise of Norte Chico civilization supports the idea that cereal stores and warfare made cities possible.
- D. Trade developed because trade agents were sent abroad to acquire things on behalf of a city.
- E. One of the earliest cities, Uruk, at its peak contained 1% of the world’s population of 50 million people.

Solution: Ridley said in the beginning of Chapter 4, “Cities exist for trade. They are places where people come to divide their labour, to specialise and exchange.” In the section titled “Cotton and Fish”, he asked, “So what was driving people together into these South American towns? The answer, in a word, is trade.” The slide titled “Main points of Chapter 5” says, “Trade creates cities”. Norte Chico towns had no evidence of large-scale hoarding of grain or construction related to warfare. Intensification of trade came before emperors. Ridley claimed in the section, “The flag follows trade”, “To argue, therefore, that emperors or agricultural surpluses made the urban revolution is to get it backwards. Intensification of trade came first.” Cities arose independently in at least some places because the Americas, which had no contact with Asia, developed cities. Trade did not develop due to empires acquiring things; it emerged from the interactions of individuals. People responded to the incentive of profits.

(13) In general, is suburban living better for the environment than is city living?

- A. No, because cities have greater population density, which promotes the development of renewable energy to protect the environment.
- B. Yes, because the high population density in a city means greater production of waste products, like carbon dioxide and rubbish, as well as greater consumption of energy.
- C. Yes, because constructing cities requires deforestation and reclamation, which harm the environment.
- D. City living and suburban living have the same impact on the environment.
- E. No, because cities tend to use less energy per person for transport and in buildings.

Solution: Slides: “15% rule”, “Are cities green?”, “Cities are green”.

(14) What does Matt Ridley claim is a key reason that the economy of Europe grew more than many other parts of the world during the last millennium?

- A. Alphabetic language
- B. Silver and gold from the Americas
- C. The spread of agriculture
- D. The spiritual direction provided by the Catholic church
- E. The absence of a unifying government

Solution: During the last millenium, lack of a unifying government differentiated Europe from other leading regions, such as China, thus aiding trade and exchange.

(15) Why were the people in and around Tyre successful?

- A. They had strong central government.
- B. They built large cities.
- C. They developed a sophisticated written language.
- D. They had excellent shipbuilding ability.

E. They had rich silver mines.

Solution: Chapter 5 says that Phoenicians (containing the city of Tyre) built the best ships and used them to trade around the Mediterranean Sea.

- (16) Money has the power to bring people together, but also to destroy humanity. Harari thinks the main reason is because
- A. People are inherently bad.
 - B. As people and organizations accumulate greater wealth, they can fund bigger and more dangerous weapons.
 - C. People trust money more than humans.
 - D. People enjoy their economic freedom.
 - E. People believe money is more important than knowledge and innovation.

Solution: In Sapiens Chapter 10, Harari wrote: “When everything is convertible, and when trust depends on anonymous coins and cowry shells, it corrodes local traditions, intimate relations and human value...”. He suggests that between transactions, trust is not invested in humans, but in the money itself.

- (17) The Phoenicians were a Mediterranean civilisation that originated from Lebanon and became extremely prosperous in the Ancient World. What was one of the main reasons for their success?
- A. They were resource-rich and relied on trading crustaceans and incense with Romans.
 - B. They built good quality ships that allowed them to raid other nations and cities and take their wealth.
 - C. They traded with many markets spread across the Mediterranean region.
 - D. They founded Uruk, the first known city, and benefited from taxing merchants.
 - E. They had a strong central government and emperor who guided commerce efficiently.

Solution: The Phoenicians were among the greatest traders of the ancient world and owed much of their prosperity to trade. They were skilled shipbuilders and created a strong navy that allowed them to trade across the Mediterranean. The Phoenicians were not ruled by any emperors, did not have a strong military (rarely fighting wars), and were not a resource-rich nation. Uruk was founded by the Sumerians in present-day Iraq, not by the Phoenicians.

- (18) According to David Hume, political fragmentation is often the friend, not the enemy, of economic advance. What does he mean by that?
- A. Democratic city states are the only places where economic progress can occur.
 - B. Establishing colonies all over the world can boost economic growth.
 - C. Political fragmentation lays the foundation for political unification.
 - D. Political fragmentation inhibits leaders from imposing excessive regulation.
 - E. Trade made possible the cross-fertilisation of ideas that led to great discoveries.

Solution: The correct answer is that political fragmentation prevents overregulation of citizens by leaders (the section titled “The Moloch state”).

- (19) Which is most accurate about sweatshops?
- A. Workers choose jobs with them due to the relatively high pay.
 - B. Their main attraction is good working conditions.
 - C. They force poor workers to move from farms.
 - D. Their spread during the Industrial Revolution provided affordable candy to the majority of the population: an example of the virtuous cycle of luxury spending that boosted the economy for everyone.
 - E. People work there mainly because they want to live in cities.

Solution: The pay of sweatshops is generally higher than for farming or other jobs (“SWEATSHOPS” slide).

- (20) According to Ridley, economic advancement after 5000 years ago was the result of
- A. the rise of Christianity, which facilitated trust in fellow humans and therefore trade.
 - B. strong central governments, facilitating trade across vast areas, like Greece under the leadership of Philip of Macedon.
 - C. the development of agriculture.
 - D. the invention of slavery, mobilizing large numbers of people to a common good.
 - E. trade among people living in relatively independent city-states.

Solution: The answer is trade among people living in relatively independent city-states. The answer is not “strong central governments, facilitating trade across vast areas, like Greece under the leadership of Philip of Macedon” because Ridley says that “as soon as Greece was unified into an empire by a thug - Philip of Macedon in 338 BC - it lost its edge.” Christianity developed much later. Ridley doesn’t mention slavery as producing economic advancement.

(21) Cities raise efficiency in several ways. Which of the following increases SLOWER than the population increases?

- A. Patents B. Job income C. The length of sewage pipes D. GDP E. Infectious disease

Solution: In the lecture slide titled “15% RULE”, I said that GDP, wages, patents, and crime increase 15% faster than population, but doubling the population only raises infrastructure 85%. I listed sewage pipes as an example. Infectious disease is not mentioned.

(22) History’s earliest known form of money, which was measured in silas, was which of the following?

- A. Barley B. Dutch guilders C. Dinosaur bones D. Cigarettes E. Lydian coins

Solution: Sapiens Chapter 10: “History’s first known money is the Sumerian barley money. It appeared in Sumer around 3000 BC, at the same time and place in which writing appeared.”

(23) The American economist Edward Glaeser proclaimed that “Thoreau was wrong. Living in the country is not the right way to care for the Earth. The best thing that we can do for the planet is build more skyscrapers.” What did he mean by this?

- A. Urbanisation has caused exponential population growth, but skyscrapers can act as a carbon storage system and trap carbon dioxide emissions within cities.
B. City dwellers consume significantly less food per capita than country dwellers and therefore cause less damage to natural ecosystems.
C. Despite the “nostalgia for mud” felt by many Westerners, city living is cleaner and more comfortable.
D. The downdraught effect from skyscrapers causes harmful toxins in air pollution to dissipate and has been empirically proven to be effective against climate change.
E. Per capita, urban residents have a smaller environmental footprint than do rural residents.

Solution: The world’s cities contain half of the world’s population, but they occupy less than 3 percent of the world’s land area and reduce the possibility of potential degradation to natural ecosystems. Living in cities also uses less energy, and city-dwellers are shown to usually have a lower carbon footprint per capita than country dwellers. While city living may be more comfortable than rural life, this was also not his point. The lecture and reading did not discuss skyscrapers as means to prevent air pollution or absorb carbon dioxide.

V. Questions from Quiz 5

- (1) How did the British escape the Malthusian trap in the 1800s and avoid the fate of Japan and other countries?
- A. For centuries the relatively rich in Britain had fewer and fewer children, reducing the demand for goods and keeping the population below the carrying capacity.
 - B. So-called “Ghost acres” providing food from other countries as well as emigration into America released the Malthusian pressure on British society.
 - C. As the industrial revolution started, an increase in rice production decreased the mortality rate.
 - D. The government set up family planning committees across the country to educate woman about the Malthusian trap.
 - E. By returning to self-sufficiency and only providing for their own family, British people created a stable society with enough supply.

Solution: Based on the section “British exceptionalism” in The Rational Optimist. So-called “Ghost acres” providing food from other countries as well as emigration into America released the Malthusian pressure on British society. The other answers are wrong since “the relatively rich had more children than the relatively poor”, self-sufficiency is characteristic for a poor economy and not an escape from the Malthusian trap, during much of the industrial revolution fertility was high in Britain, and there simply was no planning committee created by the government.

- (2) Which of the following factors may have helped the United Kingdom (UK) to escape the Malthusian Trap during the 1800s?
- A. Longer working hours, agricultural and industrial innovation, and increased immigration
 - B. Import of food, imported labour from colonies, and the discovery of oil
 - C. A rising number of workers to supply labor to factories, import of food, and government policies enforcing contraception
 - D. Agricultural and industrial innovations, import of food, and government policies conducive to business
 - E. Innovations in agriculture and industry that improved efficiency of workers in producing food, thus increasing self-sufficiency

Solution: The following factors may have helped the United Kingdom to escape the Malthusian Trap during the 1800s:

- Decreased price of food due to food imports that resulted in a decreased percentage of income people expended on food.
- Agricultural and industrial innovations made essentials (such as food, clothing) cheaper.
- Government policies were conducive to businesses (fewer monopolies compared to France or China).
- Britain’s control over the production of iron and coal helped in the widespread application of steam power.
- Emigration (not immigration) of excess population to North America and its colonies.

However, there is no evidence to suggest an increase in work hours or working efficiency (measured in food produced per hour).

- (3) Which of the following statements about the Malthusian trap is correct?
- A. Invention and innovation permanently improve humanity’s standard of living.
 - B. Population always exceeds food production.
 - C. Death rate remains constant.
 - D. Population changes due to changes in resources.
 - E. Carrying capacity remains constant.

Solution: Referring to the lecture slides “Carrying capacity” and “Malthusian trap”, when there are more resources available, the population increases. the rate of population growth exceeds the rate of food production, and famine occurs. Then, the population falls.

- (4) According to Ridley, what was the general trend of European economies from the 1300s through the 1400s?
- A. Wages fell because of disasters such as poor harvests and the Black Death.
 - B. Hands-off policies by central governments, affected by classical economist Adam Smith, leading to anarchism - a precursor to the Enlightenment movement.
 - C. Consolidation of power by the central government, gradually transitioning European economies into socialism.

D. Constant warfare and expansion, leading to the relief of overpopulation through emigration to the new colonies in the Americas.

E. A shift from labour-intensive economies toward capital-intensive economies.

Solution: In The Rational Optimist, Ridley argues that 14th century Europe “was on a trajectory towards a labour-intensive revolution.” However, by the 15th century, Europe had transitioned to a “labour- saving industrial trajectory instead,” and forming a capital-intensive economy. This trend is observed to have continued throughout the 17th century with “famine, plague, and war” reducing the European population.

(5) Which reason best explains why per capita income in England was higher in the 1400s than any later time until the Industrial Revolution?

A. greater economic freedom

B. insufficient labour supply

C. discovered new natural resources

D. developed advanced technology in agriculture

E. the introduction of electricity

Solution: The Rational Optimist: “the plague may have been one of the sparks that lit the Renaissance, because the shortage of labour shifted income from rents to wages as landlords struggled to find both tenants and employees. With rising wages, some of the surviving peasantry could once more just afford the oriental luxuries and fine cloth that Lombard and Hanseatic merchants supplied. ... Per capita income in England was probably higher in 1450 than it would be again before 1820.”

(6) Which of the following is most accurate regarding the Malthusian Trap?

A. Research shows that working longer hours helped the UK escape the Malthusian Trap.

B. Countries like India, Bangladesh, China and Peru adopted a purely voluntary approach to promote contraception.

C. Cheap food was one factor that helped the UK escape the Malthusian Trap during the Industrial Revolution.

D. The Malthusian Trap is a feedback loop in which income increases, causing population to rise to a new carrying capacity, inevitably leading income to rise further.

E. Malthus concluded that the power in the earth to produce subsistence for men is indefinitely greater than the power of population.

Solution: The correct answer is cheap food. Slides titled “More resources?” showed that Britain imported wheat from the US from the mid-1800s, leading wheat to get cheaper. Since people on average spent most of their income on food, cheaper food allowed more people to survive and even to buy luxuries.

(7) Which of the following factors may have contributed most to the demographic transition seen in the United Kingdom (UK) during the Industrial Revolution, when there was a decrease in the fertility rates of women (measured by children/woman) as income increased?

A. The increased cost of raising children, decreased child survival, advances in contraception

B. Pollution, vaccination, World-War I

C. Female literacy, urbanisation, vaccination

D. Vaccination, female literacy, women’s right-to-vote

E. Urbanisation, pollution, women’s right-to-vote

Solution: The correct answer is female literacy, urbanisation, and vaccination. Medical advances such as vaccination allowed child mortality to decrease, and, as a result, more children survived. This decreased the need to have more children to ensure the desired number survived. Urbanisation made the cost of raising children more expensive and decreased the economic benefit of children compared to agricultural societies. Female literacy allowed women to work in jobs, offering an alternative to being a housewife. Women in the UK did not get the right to vote until 1918, and World War I didn’t happen until 1914. and neither was discussed in the chapter or lecture. Pollution may have decreased child survival, which would have had the opposite effect.

(8) Which of the following about population growth is correct?

A. A decreasing rate of fertility is beneficial to nearly all industries in the world.

B. The percentage growth rate in world population is now close to the historical maximum.

C. Hong Kong has one of the highest rates of contraceptive use and lowest rates of fertility in the world.

D. The fertility rate was low before women could receive education.

- E. The high population growth rate of England in the preceding centuries made it favourable to start the Industrial Revolution.

Solution: From a graph of contraceptive use on one of the lecture slides titled “Birth control”, Hong Kong is the point with the highest contraceptive prevalence.

- (9) Which statement BEST summarises Matt Ridley’s principal argument regarding what has led to a decrease in the human population growth rate?
- A. An increase in the division of labour and trade led to a decrease in population growth.
 - B. As people increasingly learn about the population explosion and its effects on the environment and the economy, they increasingly decide to forego having traditional, large families.
 - C. Climate change has led to a stabilisation in the growth of the world food supply in calories per head, and the limited food has restricted human population growth.
 - D. Coercive contraception programs have decreased fertility in many, though not all, countries with the fastest growing populations.
 - E. In the most rapidly growing countries, high child mortality tends to discourage parents from having more children.

Solution: Ridley’s main argument is that an increase in the division of labour and trade leads to a decrease or halt in population growth. “It is somewhat distasteful to the intelligentsia to accept that consumption and commerce could be the friend of population control...The more interdependent and well-off we all become, the more the population will stabilise well within the resources of the planet.” The growth of the world food supply in calories per head has dramatically increased not stabilized. There is no evidence to suggest that carcinogens found in GMO crops have led to a decrease in male and female fertility rates.

- (10) What is the most important cause of the demographic transition?
- A. rising income B. better education C. not known D. female emancipation E. urbanization

Solution: “The Rational Optimist” says about the demographic transition: “Deliciously, nobody really knows how to explain this mysteriously predictable phenomenon... the best that can be said for sure about the demographic transition is that countries lower their birth rates as they grow healthier, wealthier, better educated, more urbanised and more emancipated.” Thus, we don’t know which, if any, of those causes is most important.

- (11) What was a major reason that the Industrial Revolution happened in England first and not China?
- A. China lacked a culture of invention.
 - B. Before the Industrial Revolution, China had been economically inferior to Europe.
 - C. England’s mild, wet climate yielded an ample supply of food.
 - D. The culture in Europe was more advanced.
 - E. Before the Industrial Revolution, English wages were among the highest in the world, while China had cheap labor.

Solution: According to the video on slide “Which one?”, wages in England were among the highest in the world, encouraging automation. In China, wages were lower.

- (12) How did America most contribute to England escaping the Malthusian Trap?
- A. America was the hub of innovation and new technologies which helped the Britishers.
 - B. America admitted migrants from Britain, which helped reduce the rapid rise in the British population.
 - C. America had a huge source of coal, which England imported in exchange for wheat.
 - D. America had no major role to play in England coming out of the Malthusian Trap.
 - E. Americans provided demand for British wool textiles, and thus England had an inflow of money.

Solution: The correct answer is that people emigrated to the USA, and food was exported from America to England. Both of these factors helped in removing the pressure on population. Thus, England did not fall into the Malthusian trap. Ridley says, “Two things, says the historian Kenneth Pomeranz, were vital to Europe’s achievement: coal and America... Not only did the Americas ship back their produce; they also allowed a safety valve for emigration to relieve the Malthusian pressure of the population boom induced by industrialization.”

Britain did earn from its wool textile exports, including to America, but cotton textiles were the major export (“It was cotton textiles that drove the early Industrial Revolution.”—Crash Course video on slide “Which one?”).

- (13) What helped Britain escape Malthus’ trap?

- A. big homeland:empire ratio
- B. low wages
- C. working longer hours
- D. importing people to Britain
- E. natural resources

Solution: Slide “Which one?” listed the factors. Coal and iron are one of the possible factors. The other choices here are the opposite of those listed or are not listed.

- (14) If improved health care and nutrition save children in the poorest regions from dying, what change is most likely to happen there within a generation?
- A. As people gain confidence that their children will survive, they will have more children.
 - B. Population decline
 - C. People will have fewer children.
 - D. A demographic transition, leading to a Malthusian trap
 - E. More children will survive, creating overpopulation, resulting in starvation.

Solution: A graph on lecture slide “Modern demographic transition” shows a strong correlation between infant mortality and fertility, and the video on the same slide explains that confidence in survival of children leads parents to have fewer. A common misconception, as described in *The Rational Optimist*, is that more children surviving leads to overpopulation: “Jeffrey Sachs recounts that on ‘countless occasions’ after a lecture a member of the audience has ‘whispered’ to him ‘if we save all those children, won’t they simply starve as adults?’ Answer: no. If we save children from dying, people will have smaller families.” / Within just one generation, the population is unlikely to decline. Even if fertility falls below the replacement level, population continues to rise for a long time as the generation born during the high fertility period grows and has their own children.

- (15) How did high wages and cheap energy most likely help trigger the Industrial Revolution in Britain?
- A. It led the government to tax energy sources and legislate lower wages, supplying abundant, cheap labor for factories.
 - B. It led to reduced mortality, increasing the population to supply abundant labor for factories.
 - C. It led British textile production to move to the largest British colony, India where wages were much lower and agricultural efficiency supplied abundant, cheap cotton. The profits flowed to Britain, leading people there to buy many more manufactured goods from other countries.
 - D. It led companies to create ways to replace workers with coal power or monetary investment.
 - E. It led consumers to buy large cars, stimulating the auto industry.

Solution: In the Crash Course video on lecture slide “Which one?”, John Green cited historian Robert Allen as saying that high wages and cheap energy led directly to the Industrial Revolution by motivating firms to develop ways to substitute money and energy for labor. Although Indian cotton and labor were cheap, British textile production mechanized instead of moving to India.

- (16) Of the following government policies to deal with a fast growing population, which would Ridley likely prefer?
- A. Governments should move urban workers to farms to raise food production until escape from the Malthusian trap is achieved.
 - B. Governments should do nothing on this issue.
 - C. Governments should delegate reproduction to the leader, like with social insects.
 - D. Governments should slow economic growth to decrease population growth to a sustainable level.
 - E. Governments should require abortions for parents having > 3 children.

Solution: The answer is nothing. The coercive policies are wrong. Ridley said, “Yet the tragedy is that this top-down coercion was not only counter-productive; it was unnecessary. Birth rates were already falling rapidly in the 1970s all across the continent of Asia quite voluntarily. They fell just as far and just as fast without coercion.” He also concludes by quoting Ron Bailey’s saying - “There is no need to impose coercive population control measures; economic freedom actually generates a benign invisible hand of population control.” / Self-sufficiency is wrong. Ridley says, “Human beings are a species that stops its own population expansions once the division of labour reaches the point at which individuals are all trading goods and services with each other, rather than trying to be self-sufficient.” Since he thinks that population expansions can be stopped by specialization and trading, people should not be self-sufficient. / Also, he says that “Probably by far the best policy for reducing population is to encourage female education.” So, governments should encourage females to receive education.

(17) Why did English wages fall roughly in half in the 1200s?

- A. self-sufficiency B. falling wool production C. plague **D. rising population** E. decreasing rents

Solution: “The Rational Optimist” says: “In the thirteenth century the population of England seems to have doubled... the population boom overtook the economy’s productivity. Rents inflated and wages deflated: the rich were bidding up land prices while the poor were bidding down wages.”

(18) Which is the most important cause of the demographic transition?

- A. Urbanization is the major reason why the birth rate decreases. This is because raising a child in cities is much more expensive than in rural area.
B. Female emancipation creates alternative productive uses of time and effort—jobs instead of childrearing—thus decreasing birth rates.
C. The increase in wealth allows people to afford more luxuries—diversions from having many children.
D. Successful government policy on birth control is the key to lowering birth rates.
E. There is no consensus on a single factor being the major cause of the demographic transition.

Solution: In the section titled “An unexplained phenomenon”, the book mentions that, “Deliciously, nobody really knows how to explain this mysteriously predictable phenomenon.” Later, Ridley says, “In other words, the best that” can be said for sure about the demographic transition is that countries lower their birth rates as they grow wealthier, more urbanized and more educated and emancipated.”

(19) What steps occur in the demographic transition?

- A. No observable pattern
B. Mortality falls, then population rises, then fecundity decreases.
C. Fecundity decreases, then population falls, then mortality falls.
D. Mortality increases, then population falls, then fecundity decreases.
E. Population rises, then mortality falls, then fecundity decreases.

Solution: The correct answer is that mortality falls, then population rises, then fecundity decreases, as discussed in the video on the slide titled “Modern demographic transition” and in the book: “The pattern is always the same: mortality falls first, causing a population boom, then a few decades later, fecundity falls quite suddenly and quite rapidly.”

(20) Just after economic expansions ended in crashes (before the Industrial Revolution), populations increased their

- A. literacy.
B. luxury spending.
C. specialization.
D. comfort.
E. self-sufficiency.

Solution: “The Rational Optimist” says, “Until 1800 this was how every economic boom ended: with a partial return to self-sufficiency”.

(21) Which of the following is an expected consequence of a demographic transition leading to lower population growth?

- A. A resurgence of childhood diseases
B. More business for toy stores
C. An increase in abandoned homes
D. Increased competition for jobs
E. Food shortages

Solution: An expected consequence of lower population growth is an increase in abandoned homes. Other consequences include more demand for elderly-related businesses (e.g., geriatricians, elderly care homes, and diaper manufacturers). The shrinking youth population should decrease, not increase, competition for graduate jobs.

VI. Questions from Quiz 6

- (1) Which of the following is the best method to estimate and compare the cost of living in different countries?
- A. Vast majority income
 - B. GDP expenditure method
 - C. GDP per capita
 - D. Gini coefficient
 - E. Purchasing power parity

Solution: Purchasing power parity can adjust GDP of different countries to make their respective cost of living comparable. See slides “Disadvantages of GDP growth rate” or “GDP correction”.

- (2) Which of the Millenium Development Goals was met?
- A. Have the proportion of people without safe water & sanitation decrease.
 - B. Allow all children to complete primary school.
 - C. Raise foreign development aid by rich nations to 0.7% of their economies.
 - D. Reduce the proportion of people who earn less than about HK\$300/month by half.
 - E. Decrease the child mortality rate to one-third.

Solution: The proportion of people living in extreme poverty was halved. Only a few countries—mainly around the North Sea—met the goal of raising foreign development aid to 0.7% of their economies.

- (3) Which of the following is a correct calculation regarding GDP? All values are within a period of one quarter year.
- A. In a country, workers gain \$10 billion as salary, companies gain \$25 billion as profit, and investors gain \$5 billion. Companies pay \$2 billion as profit tax to the government, which gains \$2 billion as tax revenue. The GDP of this country is \$44 billion.
 - B. Ken purchases \$10 million of raw materials from Company A. He produces jackets worth \$25 million. However, he finds that the jackets have quality problems, thus he destroys them. Ken’s contribution to GDP from these events is \$15 million.
 - C. In a country, expenditure is \$200 billion for private consumption, \$200 billion for government consumption, and \$150 billion for net investment. Imports are \$50 billion. Exports are \$50 billion. GDP is \$750 billion.
 - D. Ben has a toy factory which imports \$600 million of materials from Country A and purchases \$200 million of local materials. He exports the toys for \$2000 million to Country B and sells the rest of the toys in the local market for \$1000 million. Ben’s factory contributes \$2200 million to GDP.
 - E. In a country, Company A imported \$1 million of materials to produce clothes. Company B bought the clothes for \$2 million and resold them for \$2.5 million profit. The contribution to the GDP of this country is \$5.5 million.

Solution: The toy factory answer is correct. Using the production method, the sales of products and services minus the purchases are \$2 billion + \$1 billion – \$600 million – \$200 million = \$2.2 billion. The correct answer is: Ben has a toy factory which imports \$600 million of materials from Country A and purchases \$200 million of local materials. He exports the toys for \$2000 million to Country B and sells the rest of the toys in the local market for \$1000 million. Ben’s factory contributes \$2200 million to GDP.

- (4) Which one of the following statements is TRUE regarding extreme poverty?
- A. In the 20th century, extreme poverty only existed in Sub-Saharan Africa and the Asian region.
 - B. In the last 20 years, the ratio of people not living in extreme poverty versus people living in extreme poverty has remained stable.
 - C. In 2013, Sub-Saharan Africa had less % of its population living in extreme poverty in comparison to the world average.
 - D. In 2018, extreme poverty is defined as living below USD 49 per day.
 - E. In the last 30 years, East Asia and the Pacific region has experienced the greatest decline in extreme poverty as a percentage of its population.

Solution: East Asia and the Pacific region have experienced the greatest decline in extreme poverty as a share of the population compared to any other region in the world. In 2013, Sub-Saharan Africa had a greater % of its population living in extreme poverty (~40%) in comparison to the world average (~10%). The ratio of the world’s people not living in extreme poverty versus the world’s people living in extreme poverty, in fact, skyrocketed in the last century. Extreme poverty exists in all regions of the world, not just Sub-Saharan Africa and Asia. The definition of extreme poverty is living below USD1.90 per day in 2018 (as measured in 2011 international prices).

(5) DALYs show

- A. alternative ways to measure economic growth, besides GDP.
- B. which diseases affect people the most.
- C. a summary of conditions every 24 hours.
- D. a composite measure of national conditions.
- E. Trevor Noah.

Solution: See Slide “Health Adjusted Life Years”, and spend a few minutes playing with <https://vizhub.healthdata.org/gbd-compare/>, which may be useful for your poster if you are health minister.

(6) All of the following are problems with using GDP as a measure of the quality of life of a country’s citizens, EXCEPT

- A. GDP doesn’t necessarily reflect the working conditions or amount of effort required to produce the income.
- B. Due to income inequality, average income of a country gives limited insight into the quality of life of the poorest citizens.
- C. GDP doesn’t include government spending on large infrastructure projects that may or may not be of much benefit to the population.
- D. GDP only measures economic success and ignores important factors like happiness.
- E. Work is excluded from GDP if it is volunteering.

Solution: GDP does include government spending on infrastructure.

(7) Which key dimension is common to the calculations of all of the following: Human Development Index, Human Capital Index, and Social Progress Index?

- A. Child Mortality
- B. Education
- C. Happiness
- D. CO₂ Emissions
- E. Economic Freedom

Solution: Education is a common aspect measured by all three indices. Human Development Index (HDI) measures life expectancy (which is linked to health), education, and per capita income. Human Capital Index, developed by the World Bank, measures child mortality, schooling, and health. Social Progress Index contains 54 indicators, including education.

(8) A Human Capital Index value of 0.29 for a country means that

- A. the country is losing 29% of its potential income.
- B. the country ranks lower than 29% of countries in its composite score of health and education.
- C. the country ranks better than 29% of countries in its composite score of health and education.
- D. the country is losing 71% of its potential income.
- E. GDP per capita of the country is 0.29 times its happiness index.

Solution: On slide “Human Capital Index”, the video on the Human Capital Index explained that the value is the proportion of potential that is being used.

(9) What is the likeliest reason that world economic growth slowed in the last several decades?

- A. More and more countries are shrinking their economies to protect the environment.
- B. Countries that developed earliest now drag down growth.
- C. The global financial crisis around 2008 and COVID-19 more recently
- D. The fraction of not poor compared to poor people rose greatly, but the poor contribute much less to gross world product.
- E. Economic growth has returned to about the rate before the Industrial Revolution.

Solution: Slide “Gross World Product growth rate” says: “First countries to industrialize now grow slowly but are big and thus dilute growth rate of world?”

(10) Suppose the Gini coefficient of Hong Kong increased from 0.43 to 0.53 from 2000 to 2010. What can we most confidently conclude happened during that period in Hong Kong?

- A. Average income increased.
- B. The income gap widened.
- C. Income increased for high-income households but decreased for low-income households.
- D. Government reformed the tax system.
- E. Average standard of living rose.

Solution: The correct answer is that the income gap widened (1st slide titled “Gini coefficient”). We don’t know whether income increased for high-income households but decreased for low-income households; that’s because both rich and poor income might have decreased during the period, or both might have increased during the period.

- (11) Disability Adjusted Life Years (DALYs) are
- A. a measure of the quality of life, not life expectancy.
 - B. mainly related to chronic diseases (e.g., heart disease or cancer) in the poorest countries and diseases related to children (e.g., diarrhea) in the richest countries.
 - C. a measure of life expectancy, not quality of life.
 - D. one component in the calculation of the Human Development Index.
 - E. mainly related to chronic diseases (e.g., heart disease or cancer) in the richest countries and diseases related to children (e.g., diarrhea) in the poorest countries.
- (12) Neglecting other data that are not provided, in which of these countries will a person receiving the median national income have the highest quality of life?
- A. Airsealand: high GDP/person, low GDP growth rate, Gini coefficient = 0.2, life expectancy = 70 years
 - B. Yaheaia: low GDP/person, high GDP growth rate, Gini coefficient = 0.2, life expectancy = 70 years
 - C. Stanistan: high GDP/person, high GDP growth rate, Gini coefficient = 0.7, life expectancy = 70 years
 - D. Dictatorial Aristocrats’ Kingdom of Splunge: low GDP/person, high GDP growth rate, Gini coefficient = 0.2, life expectancy = 50 years
 - E. West Easter Island: high GDP/person, high GDP growth rate, Gini coefficient = 0.1, life expectancy = 40 years

Solution: High GDP/person and life expectancy generally produce a better quality of life than low GDP/person or life expectancy. For a person with median income, income would be higher in a country with more equal distribution of income, or a low Gini coefficient.

- (13) Which of the following ways would lead to the most happiness, according to Buddhism?
- A. Ignoring external conditions and focusing on retaining and extending pleasant inner feelings
 - B. Forming emotional bonds with those we value the most
 - C. Meditating at least thrice a day in order to experience nirvana and enlightenment on Earth
 - D. Detaching oneself from emotional cravings and accepting feelings, whether positive or negative
 - E. Finding a purpose to make one’s life more meaningful

Solution: Chapter 19 of Sapiens says that according to Buddhist teachings, happiness is (1) independent of external conditions, (2) also independent of our inner feelings, and that (3) we should let go of the pursuits of both external achievements and inner feelings (emotional cravings). The purpose of letting go is not to ignore all feelings, but to help us accept them and live in the present moment.

- (14) What is most notable about the Social Progress Index (SPI) and GDP per capita (GPC) of Costa Rica, New Zealand and Kuwait (as of several years ago)?
- A. Costa Rica had a particularly high SPI, given its GPC. New Zealand had about the highest SPI. Kuwait had a particularly low SPI, given its GPC.
 - B. Costa Rica had an SPI of 100%. New Zealand had about the highest GPC. Kuwait had a particularly low SPI, given its GPC.
 - C. Costa Rica had an SPI of 0%. New Zealand had about the highest SPI. Kuwait had a particularly high SPI, given its GPC.
 - D. Costa Rica had a particularly low SPI, given its GPC. New Zealand had a particularly high SPI, given its GPC. Kuwait had about the highest GPC.
 - E. Costa Rica had about the highest SPI. New Zealand had about the highest GPC. Kuwait had a particularly low SPI, given its GPC.

Solution: In the TED talk introducing the SPI, Costa Rica was a superstar, with an unusually high SPI for its GPC, New Zealand had the highest SPI, and Kuwait had a very high GPC but not a high SPI.

- (15) Which of the following is NOT one of Harari’s viewpoints on human progress and happiness?
- A. Modern humans will never be happier than their ancestors because the world is too corrupt.
 - B. We cannot know for sure if modern humans are happier than their ancestors since we don’t know much about the science of happiness.

- C. The pursuit of constant happiness is impractical since biology does not allow for humans to always feel happy.
- D. The acceleration of human progress has caused suffering of some other species.
- E. Human progress is undeniable and is shown through evidence such as medical advancements and lower child mortality.

Solution: In Sapiens Chapter 19, Harari posted several arguments against the notion that humanity has been improving through past centuries. He believes that humans are not necessarily happier now than then, since there are many factors to consider (the subjectivity of happiness, the wellbeing of other species, the biochemistry of happiness, and many others). Despite this, Harari also acknowledges that it is undeniable that humans have progressed in certain aspects of life; this is shown through the decrease in child mortality and other medical advances. Ultimately, Harari believes that it is too early to conclude that (1) humans are happier and better than our ancestors and (2) vice versa, due to our knowledge gap on happiness.

- (16) The World Happiness Report identified several key factors as important in happiness. Which of the following are key factors to happiness?
- A. Consumerism, low unemployment, entertainment, and press freedom
 - B. Freedom from corruption, support network, income, and lifespan
 - C. Health care availability, income, cultural achievements, and education
 - D. Generosity, income, the right-to-vote, cultural achievements, and lifespan
 - E. Income, freedom from corruption, press freedom, cultural achievements

Solution: The factors identified as important to happiness which are included in the list are: Having someone to count on (support network), income (in real GDP per capita), freedom from corruption, mental health, generosity, and lifespan. Other factors identified which are not in the list are: Mental health and perceived freedom to make life choices.

- (17) According to Sapiens, studies on wealth and subjective wellbeing found that:
- A. Higher-income individuals tend to be happier than lower-income individuals, but only for incomes in the top 0.01%.
 - B. Progressive taxes always lead to a greater subjective wellbeing for low-income individuals.
 - C. As income rises, happiness steadily decreases.
 - D. Income rise is positively associated with subjective wellbeing.
 - E. Money has no effect on subjective wellbeing.

Solution: Studies have found that happiness is positively correlated with wealth, especially for lower-income individuals. After it passes a certain threshold, findings suggest that the rise in happiness levels will not be as significant. However, there is no evidence that happiness levels will fall after this point (Sapiens Chapter 19: “If you’re a top executive earning \$250,000 a year and you win \$1 million in the lottery ... your surge is likely to last only a few weeks. According to the empirical findings, it’s almost certainly not going to make a big difference to the way you feel over the long run.”).

- (18) If Luxembourg and Angola have a monthly GDP per capita of US\$3,200 and US\$3,400, respectively. can you conclude that most people in Angola have a better quality of life than most people in Luxembourg? Why or why not?
- A. No, because Angola has an element of the economy that benefits only a small portion of the population.
 - B. Yes, because most people in Angola earn \$200 more than most people in Luxembourg.
 - C. No, because the inflation rate of Luxembourg is much lower than that of Angola.
 - D. Yes, because all countries have the same income distribution.
 - E. No, because European countries, such as Luxembourg, have among the world’s highest income inequality.

Solution: Angola has high inequality (slide “Inequality Adjusted HDI”) and abundant resources (slide “Disadvantages of GDP growth rate”). It is quite possible that the benefits of the high GDP/person are focused on a small group of people in Angola, unlike Luxembourg. Thus, no, GDP/person does not necessarily indicate quality of life. As for other options, we did not discuss either country concealing a relatively large portion of their wages and production.

- (19) Which one of the following Millennium Development Goals was met?
- A. Halve the spread of HIV/AIDS by 2015.
 - B. Halve the proportion of the population without access to the internet.
 - C. Between 1990 and 2015, reduce by two-thirds the under-five mortality rate.
 - D. Raise foreign development aid by rich nations to 0.7% of their economies.
 - E. Resolve the debt problems of developing countries.

Solution: The only Millennium Development Goal met on the list given was the resolution of debt problems of developing countries. The world fell short of the following goals: (i) Raise foreign development aid by rich nations to 0.7% of their economies; and (ii) Between 1990 and 2015, reduce by two-thirds the under-five mortality rate. Halving the proportion of the population without access to safe drinking water and sanitation was a goal that was met, but the goals did not mention improving internet connection. The goal for HIV/AIDS was to begin to reverse the spread, not to halve it.

- (20) In the last two decades, the world Gini coefficient
A. stayed the same. B. could not be estimated. C. rose. D. fluctuated up and down dramatically. E. fell.

Solution: Slide “Gini coefficient” showing the graph reveals that the Gini coefficient has fallen for the last 2 decades.

- (21) What is an advantage to using GDP growth rate?
A. GDP growth rate accounts for all economic transactions and activities within a country.
B. Unbeneficial production does not raise GDP.
C. GDP growth rate has some positive correlation with the quality of life in a country.
D. GDP growth rate is easy to measure and compare.
E. Accounts for increases in the quality of products and services over time.

Solution: GDP growth rate is easy to measure and compare. However, GDP growth rate does not accurately measure the well being of a country as it ignores activities such as the volunteer or underground economy, unbeneficial production raises GDP, and GDP does not take the increase in quality of products and services into account.

- (22) Listed below are several desirable goals for a country. If a country could raise any of these from a low rank to a high rank among countries, which one would MOST improve the average general life satisfaction of its people, according to findings from the World Happiness Report?
A. Low level of psychological disorders
B. Fair treatment in dealings among individuals and organizations, such as business and government
C. Percentage of children receiving free education
D. High level of education
E. Low level of air pollution

Solution: The correct answer is low level of psychological disorders because mental health is the biggest single factor in happiness according to the World Happiness Report (3rd slide titled “World Happiness Report”).

- (23) Harari believes that ... will lead to continuous happiness.
A. Being immortal
B. None of the above
C. Being free from illnesses
D. Having a lot of money
E. Getting married to the love of your life

Solution: None of the options above is correct, because Harari believes that (1) happiness depends on subjective expectations, (2) happiness mainly depends on happy hormones (serotonin, dopamine, oxytocin), and (3) we cannot be constantly happy.

- (24) What is a disadvantage of using GDP growth rate to determine the development level of a country?
A. GDP growth rate ignores quality changes of products, thus increasingly overestimating the standard of living.
B. GDP growth rate cannot reflect the income distribution of a country.
C. GDP growth rate includes black market transactions, and this may overestimate the real production of the country.
D. The effect of inflation on GDP growth rate cannot be adjusted.
E. Because imports are added to the GDP, the GDP growth rate may overestimate the standard of living.

Solution: The correct answer is that the GDP growth rate cannot reflect the income distribution of a country. The GDP growth rate lumps together everyone in a country.

- (25) According to the graph in the lecture, approximately what is the current ratio of the number of people in extreme poverty to the number of people not in extreme poverty?
A. 1000 B. 10 C. 0.001 D. 0.1 E. 1

Solution: Slide “Poverty: global” shows a little over half a billion people are extremely poor, and around 7 billion are not, giving a ratio around one tenth. This question was somewhat challenging because it required that, when you were reviewing the slide, you were curious enough to ask yourself, “I wonder how many people are in extreme poverty?” or to read the text on the slide, “World: ratio of not poor to poor has rocketed”, and wonder what the ratio is now, and try to estimate it from the graph.

- (26) Within a region, the number of people in extreme poverty divided by the population there is P . Where was P the largest in 1990?
- A. Latin America & Caribbean B. Central Asia & Europe C. N. America D. The world **E. E. Asia & Pacific**

Solution: Slide “Poverty: regional” shows that about 60% of people lived below the extreme poverty line in East Asia & Pacific then, much higher than in other regions.

VII. Questions from Quiz 7

- (1) What did Matt Ridley mean by “the secret of the industrial revolution was shifting from current solar power to stored solar power?”
- A. The invention of batteries allowed the storage of energy generated from solar panels.
 - B. The abolition of slavery was due to the widespread adoption of machinery.
 - C. The smog from industries decreased sunlight and caused severe environmental damage to forests.
 - D. Shifting energy sources from hay, timber, water, and wind to fossil fuels supplied energy to sustain the Industrial Revolution.
 - E. The Agricultural Revolution provided the biomass needed to power the Industrial Revolution and therefore escape the Malthusian trap.

Solution: Ridley was referring to the transition from the use of timber, hay, water, and wind (as current solar power) to the use of fossil fuels, especially coal (as stored solar power), which was key to sustaining the momentum of the industrial revolution.

- (2) Battery capacity is the amount of energy a battery can store. A news article reported that Tesla’s Gigafactory would soon “get to 35 GWh of battery cell production”, but the article did not say in what time interval that would be measured. How could the article better express the production rate of the battery factory?
- A. Battery capacity per length, using units of energy (not power)
 - B. Progress of the assembly line, using units of speed (not energy)
 - C. Battery capacity per time period, using units of power (not energy)
 - D. Progress of the assembly line, using units of speed (not power)
 - E. Using units of million kWh (not GWh)

Solution: Bigger batteries store more energy. A good way to express the production rate of a battery factory would be the energy-holding ability of the batteries it manufactures in a certain time, which you’d measure in units of energy/time, or power. The error in the article was that a GWh is a unit of energy, not power (because a Watt is a unit of power, and power multiplied by time is energy). That’s like saying that a soda factory has been upgraded to fill bottles with 20 liters of Coca Cola. Without saying how long it takes to fill those bottles, it doesn’t make much sense. 20 liters/second would make sense.

- (3) What is the biggest source of energy?
- A. Oil B. Nuclear power C. Coal D. Natural gas E. Hydroelectricity

Solution: The correct answer is oil (“Shares of primary energy use” slide). Coal is the biggest source of electricity only, not of all energy (“Electricity” slide).

- (4) According to Swanson’s Law, how will the price of electricity and the share of electricity produced by fossil fuels likely change in the next several decades?
- A. The price of electricity will likely rise, and the share of electricity produced by fossil fuels will likely fall.
 - B. The price of electricity will likely fall, and the share of electricity produced by fossil fuels will likely fall.
 - C. The price of electricity will likely rise, and the share of electricity produced by fossil fuels will likely rise.
 - D. The price of electricity will likely stay about the same, and the share of electricity produced by fossil fuels will likely stay about the same.
 - E. The price of electricity will likely fall, and the share of electricity produced by fossil fuels will likely rise.

Solution: Swanson’s law states a consistent relationship between the cost of solar panels and the deployment of solar panels. The likely consequence of this trend in the future is a fall in the cost of electricity produced by solar panels, resulting in an expansion in the use of solar energy, causing a fall in the overall price of electricity, and decreased reliance on fossil fuels as a share of electricity produced.

- (5) Which is true about non-renewable energy sources?
- A. The U.S. government once predicted that U.S. oil would run out by 1924.
 - B. Since the UK passed the period of peak coal in the 1800s, many coal mines were shut because worldwide coal reserves are running out.
 - C. We could use up all of the proven reserves of oil in the world within three decades.
 - D. Civilizations throughout history eventually decayed because non-renewable energy sources were depleted.

- E. If not for fossil fuels, for half of the world's population to maintain the world's average lifestyle, the other half would need to serve them as slaves.

Solution: Governments and other experts have predicted repeatedly over the last century that oil would run out soon. See slide "Finite fossil fuels finishing?"

(6) What does Wright's Law state?

- A. The cost to produce each unit of a product tends to be directly proportional to the amount spent on research to improve the product.
- B. The cost to manufacture a mass-produced item falls with time.
- C. By increasing their wages, workers will devote more effort, thus reducing the cost of production by roughly the same as the amount spent on increased wages.
- D. Through trade and exchange, an invention, such as airplanes, multiplies its benefit to the rest of the economy by a value that is roughly constant for each invention.
- E. The cost to produce a product falls with the cumulative amount of the product that is made.

Solution: See slide "Solar: getting cheaper".

(7) News articles often use units for electricity that are wrong or not meaningful. For example, an article said that 200 million megawatt hours (MWh) of electricity is wasted, but didn't state the time period—let's assume one year—or express the number in terms that are familiar to people, such as the number of typical power plants that generate that much energy in a year. Estimate how many traditional power plants generate that much energy in a year. Consider the capacity factor. You shouldn't need a calculator because the numbers are simple. To easily estimate in your head, round the number of days in a year to 400 and the number of hours in a day to 25 = $\frac{1}{4}$ of 100.

- A. About 40-100 B. About 4000-10,000 C. About 200,000 D. About 40,000-100,000 E. About 20

Solution: How many hours in a year? $\sim 400 \text{ days/yr} \times \sim \frac{1}{4} \times 100 \text{ h/day} = 100 \times 100 \text{ h/yr} = 10\text{k h/yr}$ $\frac{200 \text{ million MWh/yr}}{10\text{k h/yr}} = 20 \text{ thousand MW} = 20 \text{ GW}$ A typical power plant is 1 GW, and capacity factor is around $\frac{1}{5}$ to $\frac{1}{2}$ (Capacity Factor slide), so a typical power plant produces a long-term average of around $\frac{1}{5}$ to $\frac{1}{2}$ GW. Thus, you'd need around 40-100 typical power plants.

(8) What is the Jevons paradox?

- A. Rising total energy use lowers energy efficiency.
- B. Rising energy efficiency lowers total energy use.
- C. Rising energy efficiency raises total energy use.
- D. New energy reserves more than replace those being used.
- E. Rising total energy use raises energy efficiency.

Solution: Rising energy efficiency raises total energy use. Ridley quotes Jevons: "new modes of economy will lead to an increase of consumption".

(9) Were energy sources mostly renewable or non-renewable? What about now?

- A. 300 years ago and now, they are mostly renewable.
- B. 300 years ago and now, they are mostly non-renewable.
- C. 300 years ago they were mostly renewable, but now they are a roughly even mix of renewable and non-renewable.
- D. 300 years ago they were mostly renewable, but now they are mostly non-renewable.
- E. 300 years ago they were mostly non-renewable, but now they are mostly renewable.

Solution: Slide 3 and 7 showed that we used renewable energy in the past and mostly fossil fuels now. The Rational Optimist discusses a huge rise in coal use in Britain from around 1750 through the 1800s, and not much coal use in China in the 1700s.

(10) Which of the following is the correct description of the history of power generation?

- A. Several centuries ago, we used mostly renewable power (PAWW power). Now we use mostly non-renewable power, and in the future non-renewables (e.g., oil) will likely continue to dominate.
- B. Several centuries ago, we used mostly renewable power (PAWW power). Now we use mostly non-renewable power, and in the future renewables (e.g., solar and wind) will likely dominate.
- C. Humans have always been consuming mostly non-renewable power and will continue to consume mostly non-renewables in the future. Renewable power will likely have a relatively small stake in the market.

- D. Several centuries ago, we used mostly non-renewable power. Now we continue to use mostly non-renewable power, and in the future other renewables (e.g., solar and wind) will likely dominate.
- E. Several centuries ago, we used mostly non-renewable power. Now we use mostly renewable power (PAWWW power), and in the future other renewables (e.g., solar and wind) will likely dominate.

Solution: In the past, we used renewable power (PAWWW power). Now we use mostly non-renewable power, and in the future renewables (e.g., solar and wind) will likely dominate (see slide “A short history of energy”).

- (11) In his TEDx talk, what did Professor David MacKay consider as the three major categories of energy sources to replace fossil fuels in the UK?
- A. Onshore wind, offshore wind, and solar, because these take the least area.
 - B. He did not advocate for or against particular sources, but he considered renewables in the country, renewables outside the country, and nuclear.
 - C. Solar, wind, and biomass. Nuclear uses the least area, but he didn’t recommend it because it has popularity problems.
 - D. Concentrating solar, photovoltaic solar, and wind, because these take the least area.
 - E. Nuclear, solar, and wind. He doesn’t recommend biomass because it takes too much area, as illustrated by his story about biofuels grown on the road verge.

Solution: In his talk “A reality check on renewables”, MacKay listed ‘6 levers to pull’, 3 of which discussed the alternative energy sources for replacing fossil fuels. He didn’t specify or exclude particular sources, but he considered the possibility of increasing renewables inside the country, increasing renewables outside the country (for example in places like Australia, Canada, Russia, Libya, Kazakhstan), and nuclear power.

- (12) Which of the following statements is TRUE?
- A. Compared to forests and streams, coal, as non-renewable energy, suffered more from diminishing returns and rising prices.
 - B. Daniel Defoe in 1728 stated that a rich demand from a few people is more important than a low demand from each of many people.
 - C. Nylon was the fiber on which the British textile boom was built because of the UK’s warm, wet climate for growing nylon.
 - D. According to the Jevons paradox, energy consumption falls after the energy efficiency rises.
 - E. Like Britain, China also had a vibrant textile industry by 1700, but the industry didn’t become mechanized because it was far from the coalfields.

- (13) Which is TRUE of current world energy use?
- A. Nuclear power constitutes about 15% of world energy use.
 - B. Oil contributes a bigger share of world energy use than it did a decade ago.
 - C. Natural gas makes up about a quarter of world energy use.
 - D. Hydroelectricity contributes about 15% of world energy use.
 - E. Fossil fuels make up about 95% of world energy use.

Solution: Slide “Shares of primary energy use” shows that natural gas is about a quarter.

- (14) World oil reserves are ~1.7 trillion barrels. The world uses ~37 billion barrels of oil per year. Based on past experience with fossil fuels, when is it most likely that the world will run out of oil?
- A. In about 2-4 decades, partly because use is slowly growing
 - B. Within 2 decades, partly because developing countries are rapidly increasing their use of oil
 - C. In about 6-10 decades, partly because renewable energy sources are being used more and more
 - D. Not within a century, partly because new reserves will be found
 - E. In about 4-6 decades, partly because use is almost constant

Solution: Slides “Finite fossil fuels finishing?” and “Why don’t we run out?” showed that reserves tend to keep increasing, despite use also increasing.

- (15) According to Ridley, who are the modern slaves?
- A. Money in all its forms
 - B. Machines and the power that runs them

- C. Animals who raise our food and provide our entertainment and companionship
- D. Medical treatments that improve and prolong our lives
- E. Memes, or facts that serve the collective brain

Solution: The answer is machines and the power that runs them. Referring to the last paragraph of Chapter 7 of *The Rational Optimist*, Ridley claims, "...we will need the watts from somewhere. They are our slaves. Thomas Edison deserves the last word: 'I am ashamed at the number of things around my house and shops that are done by animals human beings, I mean - and ought to be done by a motor without any sense of fatigue or pain. Hereafter a motor must do all the chores.'"

- (16) How does Ridley refute the claim that the Industrial Revolution drove down most living standards and contributed to poverty, inequality, child labour and pollution?
- A. Children working in factories were not only labourers, but they received a valuable, hands-on education in the leading edge technologies.
 - B. He admits that living standards did worsen during the Industrial Revolution, but argues that that was because workers then were lazy, and they deserved it.
 - C. The Industrial Revolution improved agricultural efficiency, reducing the need for farm land. This freed up land for housing and recreation, thus improving living conditions.
 - D. Poverty, inequality, child labour and pollution had often been even worse before the Industrial Revolution.
 - E. With technological advance, smog decreased in industrial cities, so in fact, the environment was improving.

Solution: In Chapter 7 of *The Rational Optimist*, Ridley says,

"Is it really necessary to point out that poverty, inequality, child labour, disease and pollution existed before there were factories? In the case of poverty, the rural pauper of 1700 was markedly worse off than the urban pauper of 1850 and there were many more of him. In Gregory King's survey of the British population in 1688, 1.2 million labourers lived on just £4 a year and 1.3 million 'cottagers' - peasants - on just £2 a year. That is to say, half the entire nation lived in abject poverty; without charity they would starve. During the industrial revolution, there was plenty of poverty but not nearly as much as this nor nearly as severe. Even farm labourers' income rose during the industrial revolution.

"As for inequality, in terms of both physical stature and number of surviving children, the gap narrowed between the richest and the poorest during industrialisation. That could not have happened if economic inequality increased.

"As for child labour, a patent for a hand-driven linen-spinning machine from 1678, long before powered mills, happily boasts that 'a child three or four years of age may do as much as a child of seven or eight years old.'

"As for disease, deaths from infectious disease fell steadily throughout the period. As for pollution, smog undoubtedly increased in industrial cities, but the sewage-filled streets of Samuel Pepys's London were more noisome than anything in Elizabeth Gaskell's Manchester of the 1850s."

- (17) Which statement is most accurate?
- A. Biofuels produce much more energy than the energy (other than solar) it takes to produce them.
 - B. Swanson's law refers to the observation that, as more solar panels are made, their cost per watt rises.
 - C. Energy is power divided by time.
 - D. Early energy was completely renewable, using trees, hydropower, wind, domesticated animals, and human labor.
 - E. The long-term real price of oil has risen as reserves have decreased.

Solution: The correct answer is that early energy was completely renewable (see slide "A short history of energy"). Power is energy divided by time. The long-term real price of oil has not consistently changed (slide titled "The long-term price of oil did not change much"), and reserves have grown (slide titled "Finite fossil fuels finishing?"). Swanson's law refers to the observation that, as solar panel production increases, the cost of each watt made by each new panel decreases (slides titled "Solar"). The energy to grow biofuels roughly equals energy from them ("Biofuels" slide).

- (18) How do energy intensity (joules per dollar of GDP) and total energy use change as the economy of a region develops?
- A. First, energy intensity and total energy use fall. Then, energy intensity and total energy use fall.
 - B. First, energy intensity and total energy use rise. Then, energy intensity falls, but total energy use doesn't fall.
 - C. First, energy intensity and total energy use rise. Then, energy intensity rises, but total energy use falls.
 - D. First, energy intensity falls, but total energy use rises. Then, energy intensity and total energy use fall.
 - E. First, energy intensity and total energy use fall. Then, energy intensity and total energy use rise.

Solution: As Matt Ridley explained in “The Rational Optimist,” industrialization first raises energy intensity and energy use. As energy efficiency rises, energy intensity falls, but people find new uses of energy, thus keeping total energy use from falling: Jevon’s paradox.

- (19) What was a major point of David MacKay’s video about getting off of fossil fuels?
- A. Nuclear is not the most cost-effective energy source.
 - B. Renewables are not good choices for supplying energy.
 - C. Because fossil fuels supply 90% of energy, it is impossible to replace them.
 - D. Trying to conserve energy cannot help much.
 - E. Land area is important to consider when choosing energy sources.

Solution: The correct answer is “Land area is important to consider when choosing energy sources.” He discussed a graph of population per land area and power per person to compare different energy sources based on power per area. He said he likes renewables. He didn’t discuss cost of nuclear energy. Even though fossil fuels supply 90% of energy, he said, “We need big action because we get 90% of our energy from fossil fuels, and so you need to push hard on most, if not all, of these levers.”, implying the alternatives to fossil fuels are feasible, if they are used heavily and in concert. He showed how he saved a large fraction of his energy use, implying that he thinks conserving energy can help significantly.

- (20) Based on Harari’s views, in today’s world,
- A. Rich people are more likely to suffer a shorter lifespan than poor people.
 - B. The rich are deprived while the poor splurge on luxuries.
 - C. Poverty is no longer a problem anywhere in the world due to the abundance of affordable food and resources.
 - D. Middle class people are more likely to spend beyond their means than are wealthy people.
 - E. We have successfully solved wealth inequality between the rich and the poor.

Solution: Sapiens Chapter 17: “Today, the tables have turned. The rich take great care managing their assets and investments while the less well-heeled go into debt buying cars and televisions they don’t really need.”

- (21) In the last decade or so, electricity use has been
- A. rising only in developing countries.
 - B. falling only in developing countries.
 - C. falling similarly in developed and developing countries.
 - D. rising only in developed countries.
 - E. rising similarly in developed and developing countries.

Solution: Slide “Electricity” said that electricity, from 2006 to 2016, grew 3%/yr in world, 8%/yr in China, 0%/yr in US, 7%/yr in India, 0%/yr in Hong Kong. no growth in developed countries. Since electricity use hasn’t been changing in developed countries, but the world is using more electricity, all the growth must be from developing countries.

- (22) What did Ridley say was a shocking irony?
- A. Originally, we used renewable energy.
 - B. Past civilizations fell due to depletion of non-renewable energy.
 - C. Fossil fuel cost keeps rising, but the economy keeps growing.
 - D. Non-renewable resources are infinite.
 - E. Energy from non-renewable sources made economic growth sustainable.

Solution: In the Introduction to the chapter, Ridley said: “This leads to a shocking irony. I am about to argue that economic growth only became sustainable when it began to rely on non-renewable, non-green, non-clean power.”

- (23) What is the biggest source of electricity, other than fossil fuels?
- A. Hydro B. Geothermal C. Wind D. Nuclear E. Solar

Solution: Slide “Electricity” shows it as hydroelectricity.

- (24) Fossil fuel
- A. saves land that would otherwise be used to produce renewable energy.
 - B. will likely run out by 2050.
 - C. is increasingly used now to replace renewable power sources, whose cost has been rising over the long term.

- D. production stopped rising early in the Industrial Revolution in England.
- E. helped China lead the world in iron production in the 1700s.

Solution: Fossil fuel is underground and uses little land to extract, while solar and wind power are collected over a wide area of the surface. We will not run out of fossil fuel because we will switch to other sources of energy before using up all fossil fuels.

- (25) Based on Sapiens, why did Britain initially turn to coal as their energy source, prior to the Industrial Revolution?
- A. British inventors were inspired by the invention of gunpowder in China, which successfully converted heat energy into movement.
 - B. The government owned most coal mines, giving it a financial incentive to promote coal over other energy sources.
 - C. The population increase had used up much of Britain's supply of wood, forcing the use of an alternative energy source.
 - D. Government tax incentives
 - E. The scarcity of coal in the world would help 17th century Britain achieve greater power and dominance over rivaling countries.

Solution: Sapiens Chapter 17: "As the British population swelled, forests were cut down to fuel the growing economy and make way for houses and fields. Britain suffered from an increasing shortage of firewood. It began burning coal as a substitute."

- (26) Based on The Rational Optimist, which of the following is the major reason biofuels are promoted nowadays in the U.S.?
- A. Biofuels are cheaper than fossil fuels.
 - B. Biofuels are needed to fill the gap in supply due to a shortage of fossil fuels.
 - C. Large corporations persuaded the politicians and provided political funding.
 - D. Growing biofuels is environmentally friendly as it consumes less water and fertilizer than does extracting fossil fuels.
 - E. Burning biofuels will generate a pleasant aroma that is much preferred to coal smoke.
- (27) *Unknown Question (This question could not be displayed due to a system error of Moodle.)*
- A. The cost of transporting coal overland was minimal.
 - B. Britain had no other renewable energy sources available.
 - C. Coal was effectively limitless in supply and easily accessible.
 - D. It was significantly cheaper than water power.
 - E. Coal was the primary source of fuel for iron production from the start.

Solution: Coal became a crucial energy source for Britain's industrial revolution not because it was initially cheaper than alternatives like water power, but because it was effectively limitless in supply and easily accessible. This abundance and accessibility allowed for sustained industrial growth without the diminishing returns that water power and timber experienced. Additionally, Britain's coal fields were close to the surface and navigable waterways, facilitating cheap transportation, which made it even more crucial as an energy source.

VIII. Questions from Quiz 8

- (1) Electric car sales in 2018 were ~ 1.5 million/yr and have recently been doubling every 1.5 yr. $2^{10} \approx 1000$. Most likely, by when will everyone buy an electric car each year on average?
- A. 2050-2070
 - B. 2030-2035
 - C. 2040-2050
 - D. 2035-2040
 - E. Never, because it would be absurd for every person to buy a car every year.

Solution: Slide “Acceleration can’t continue”, says: “For those examples, there are limits. Doubling can’t go on. May slow to linear increase, no increase (S-curve), decrease.” Common sense should tell that we’re not all going to buy a car every year because that would be far too expensive, would waste an enormous amount of resources, and would totally jam streets and parking. Imagine Hong Kong with 8 million new cars each year! Thus, without even doing any math, it’s obvious that the likely answer is “never”. This seems like a trick question, and in a way it is. But a key point of both the chapter and the lecture is that trends often don’t continue.

- (2) The greatest number of people were/are/will be added to the middle class (US\$11-110/day) annually around
- A. 2040
 - B. 2000
 - C. now
 - D. 1980
 - E. 1960

Solution: Slide “Consumer explosion: Middle class growing” says, “Fastest growth in middle class is this generation.”. I also emphasized this by saying in the lecture something to the effect that the middle class will grow the most around these few decades.

- (3) What is the Fermi Paradox?
- A. The chain reaction in nuclear bombs should continue until the world is destroyed, yet it stops before then.
 - B. There are many Great Filters, yet we developed a civilization.
 - C. This statement is false.
 - D. If many places could develop life, why haven’t we contacted aliens?
 - E. One can know something’s position or velocity, but not both.

Solution: If many places could develop life, why haven’t we contacted aliens? This was from the video on the last slide.

- (4) Ridley feels that the most important factor in the long-term acceleration of economic development has been
- A. more research into basic phenomena of nature.
 - B. accelerating efforts by countries to foster innovation in key industries.
 - C. rising legal protection of new knowledge.
 - D. higher rate of mixing of various concepts.
 - E. the increasing amount of money invested.

Solution: Ridley asks if innovation driving the world is from expansion of science, application of money, granting of intellectual property or something more bottom-up. He rejects all as major factors except the last: exchange, or mixing.

- (5) What is likely the most important reason for the rapid advance of civilization in the last few centuries?
- A. The communication implosion
 - B. Malthusian Trap
 - C. Fermi Paradox
 - D. The demographic transition
 - E. Moore’s Law

Solution: The common cause for the producer and consumer explosion is the demographic transition. The producer and consumer explosion (together with the communication explosion and increase in the development of tools) were the biggest factors in the accelerated innovation post-1800s.

- (6) What does Ridley feel is most remarkable about the last 2 centuries?
- A. nuclear bombs
 - B. compounding success
 - C. advances in science
 - D. Moore’s law
 - E. vastly better health

Solution: In The Rational Optimist, Ridley says: “The most fundamental feature of the modern world since 1800 - more profound than flight, radio, nuclear weapons or websites, more momentous than science, health, or material well-being - has been the continuing discovery of ‘increasing returns’.”

- (7) The increased ability of people to buy goods and services over the last couple of centuries is
A. the Consumer explosion. B. the Singularity. C. Moore's law. D. the Producer explosion. E. Wright's law.

Solution: Consumer explosion (see slide "Consumer explosion: many more people")

- (8) Which is most accurate about intellectual property?
- A. When patent thickets exist, they draw away profits of new inventions to the last patent holder to relent during negotiation.
 - B. Without patents, inventors are not motivated to invent.
 - C. Intellectual property is most beneficial to the inventor if she protects it and keeps it to herself.
 - D. Intellectual properties can explain why some places are more innovative than others.
 - E. Patent trolls are firms that obstruct the patent system by failing to sue others infringing on their patents.

Solution: A patent thicket occurs when each step in a metabolic pathway is subject to a patent, When encountering a patent thicket, according to The Rational Optimist, "a medical inventor can find himself negotiating away all his rewards before he even tests his idea. And the last patent holder to yield commands the highest potential pay-off."

- (9) Which one of the following statements concerning government funding for research is FALSE:
- A. The US government created Sematech to improve American competitiveness in the memory chip market.
 - B. Since the mid-20th century, annual US government spending on research and development has been consistently greater than that of the private sector.
 - C. Government funded GPS.
 - D. Government funding resulted in the creation of the internet.
 - E. Government funding led to human exploration of the moon.

Solution: It is false that, since the mid-20th century, total US government spending on R&D has been greater than that of the private sector. Slide "Government? US R&D funding" clearly shows that private sector R&D funding as a % of GDP has been greater since the 1980s.

- (10) How has the producer explosion accelerated innovation?
- A. It sped the flow of information.
 - B. It started a second demographic transition.
 - C. It broke through the Great Filter.
 - D. It increased the time and resources for invention.
 - E. It created demand for a greater variety of inventions, and a greater number of each invention.

Solution: Slide "Producer explosion"

- (11) According to Matt Ridley, what was the major factor that made economists' predictions about the eventual stagnation of the economy wrong?
- A. Experts predicted that fossil fuels would soon be depleted, stopping economic growth. However, more and more fossil fuels have been discovered.
 - B. Economists predicted that the future economy will be conquered by monopolies, but the idea of open competitive markets eventually spread over the world and thus made their predictions wrong.
 - C. Economists assumed that an equilibrium state exists, but innovations make the steady-state impossible and thus made their predictions wrong.
 - D. Economists thought that trade would be heavily concentrated locally, but nowadays trade often crosses the world.
 - E. Economists like Adam Smith foresaw that every government will eventually seize control of every market, but it turned out that a free economy had become the mainstream.

Solution: The answer is that economists assumed that an equilibrium state exists, but the possibility of new knowledge and innovations make the steady-state impossible and thus made their predictions wrong. The introduction to Chapter 8 of The Rational Optimist: "Nobody predicted this. The pioneers of political economy expected eventual stagnation. Adam Smith, David Ricardo and Robert Malthus all foresaw that diminishing returns would eventually set in, that the improvement in living standards they were seeing would peter out...The possibility of new knowledge makes the steady state impossible. Somewhere somebody will have a new idea and that idea will enable him to invent a new combination of atoms both to create and to exploit imperfections in the market."

The other choices are logically correct and related to the course, but they do not cover Ridley's main point of view in Chapter Eight of The Rational Optimist.

- (12) For your group presentation, you want to show the global distribution of your country's oil export destinations, emphasizing comparisons of amounts among the 8 countries you export to. Which graph/chart should you use?
- A. Pie chart
 - B. Bar graph
 - C. None. A table would be better so that you can state the exact amounts.
 - D. Line graph
 - E. Scatter plot

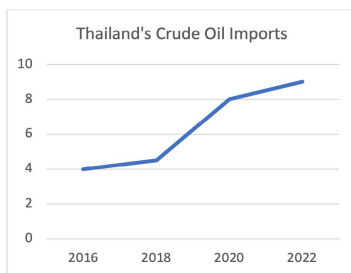
Solution: A bar graph would work best because you can readily compare amounts. It would be harder to compare amounts on a pie chart because each slice starts in a different position; also trying to distinguish 8 colors to read the pie chart would waste time. A table just shows text, which is harder to comprehend at a glance, and showing so many digits would be uninformative and distracting. Scatter or line plots are better for comparing 2 quantitative dimensions, not 1 quantitative and 1 categorical dimension.

- (13) Early copper axes were as thick as stone axes, and only later were made thinner, which Ridley mentions to illustrate that
- A. violence was more common then, requiring more sturdy weapons.
 - B. they were decorative.
 - C. as technology progresses, design still follows the human form.
 - D. ideas often come from other ideas.
 - E. agriculture supported a richer, denser population than did hunting and gathering.

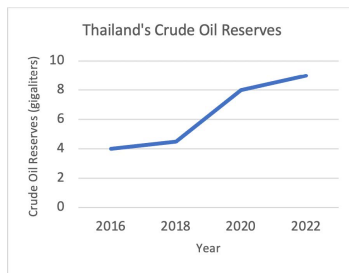
Solution: In Chapter 8 of *The Rational Optimist*, Ridley said that “objects betray in their design their descent from other objects: ideas that have given birth to other ideas. The first copper axes of 5,000 years ago were the same shape as the polished stone tools then in common use. Only later did they become much thinner as the properties of metals became better understood.”

The answer, “after a revolution in innovation, evolution then improves on it”, makes sense, but is not why Ridley mentioned this observation about early copper axes.

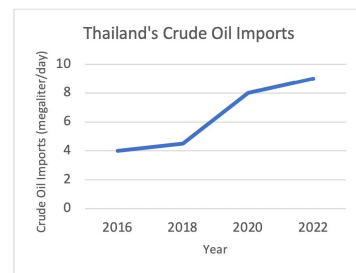
- (14) Which of the following graphs is most effective in supporting the following information: “Thailand is an oil-producing country, yet it increasingly relies on crude oil imports due to high demand”?



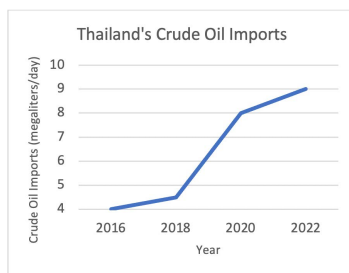
(1)



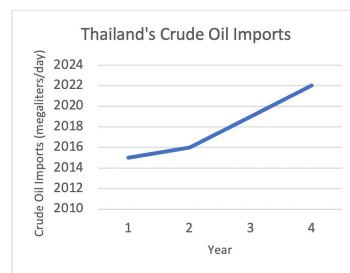
(2)



(3)



(4)



(5)

- A. (1) B. (2) C. (3) D. (4) E. (5)

Solution: When displaying information on a graph, pay attention to the presence of units, consistency of time interval, usually starting the vertical axis at zero, and the accuracy of the graph title.

- (15) Which statement is most accurate?

- A. In the video, “Connections”, Burke said that his favorite influence for change is deliberate search.
- B. Moore’s Law is a lot more accurate than Wright’s Law.
- C. The hype cycle is a feedback loop in which AI hyper-accelerates innovation.
- D. The internet was the biggest factor accelerating innovation during the 1800s.
- E. Wright’s Law is a little more accurate than Moore’s Law.

Solution: The correct answer is that Wright’s Law is a little more accurate than Moore’s Law (slide “Is Moore’s Law unique to chips?”).

Burke said (14:26 in “Connections” video) that his favorite influence for change is surprise use of one thing in another field, not deliberate search (which he said was a bore in the case of Edison’s light bulb).

Most innovations have come from the private sector. The hype cycle is not an AI feedback loop (“Hype cycle” slide).

The biggest factors in innovation acceleration are the producer explosion and customer explosion, not communication (slides titled “Why has change increased?”).

The internet didn’t exist in the 1800s.

(16) According to the lecture, why do we sometimes reject innovation?

- A. Innovation sometimes violates the Fermi Paradox.
- B. Acceleration can’t continue.
- C. Innovation increases income inequality (the 4 “I”).
- D. People may want to maintain their traditions.
- E. Results of innovation can only be enjoyed by the upper class in society.

Solution: The answer is that we want to maintain traditions. See slide “Anti-change” and video “Tradition!”.

(17) What is Matt Ridley trying to explain with “Thomas Jefferson’s candle”?

- A. The improvement of lighting by Jefferson’s time illustrated that everyone could live like the rich of centuries past.
- B. Knowledge spreads easily.
- C. Electricity produced new knowledge.
- D. Discoveries about the physics of combustion have led to the industrial revolution.
- E. Only rich people like Jefferson could afford candles.

Solution: “Thomas Jefferson’s candle” can light other candles without darkening itself. This is a metaphor showing that old knowledge is shared and used to produce new knowledge without being destroyed.

(18) Which of these statements concerning Moore’s law is most accurate?

- A. Moore’s law is more accurate than Wright’s law.
- B. Moore’s law was proposed by the founder of Microsoft.
- C. Moore himself has outlived his law.
- D. Moore’s Law states that the price of electronic chips will increase exponentially every year.
- E. Moore proposed the law in the 1960s, and a more general form of the law has lasted over a century.

Solution: Moore proposed the law in the 1960s. But by another measure, a form of the law has lasted over a century (slide “Are there always limits?”). Not all mass-produced items follow Moore’s Law. The video mentioned one obvious example, cars, saying that if cars had followed Moore’s Law, they’d now cost only \$.04.

(19) Compared to now, how would the end of the demographic transition and the beneficial effects of the technological singularity likely affect the rate of innovation?

- A. The singularity would lower it, but the end of the demographic transition would not.
- B. The singularity would raise it, but the end of the demographic transition would not.
- C. They would not affect it.
- D. The singularity would not affect it, while the end of the demographic transition would lower it.
- E. Both would lower it.

Solution: “Artificial intelligence” and first “Future rate of change” slides

(20) What were the major, direct causes of the Consumer Explosion?

- A. The population rose, and the proportion of people outside of extreme poverty increased.

- B. The fraction of people working outside farming rose, and more people received an education.
- C. The amount of time people spent at work in companies increased, and the amount of time people spent at leisure rose.
- D. The speed of information travel increased, and connectivity rose.
- E. The fraction of people working outside farming rose, and the population increased.

Solution: More people, and a larger fraction of people not being in poverty, increased the number of people who could afford to buy things (other than just food to survive).

- (21) How has the producer explosion (in contrast to the consumer explosion) most directly accelerated innovation?
- A. It created demand for a greater variety of inventions, and a greater number of each invention.
 - B. It increased the effort devoted to invention.
 - C. It generated revenue from the purchase of various inventions.
 - D. It sped the flow of information.
 - E. It drove science and engineering professionals to become commercial entrepreneurs.

Solution: Slide “Producer explosion”

- (22) Which is most accurate about Moore’s Law?
- A. Moore’s Law is a more general version of its predecessor, Wright’s Law.
 - B. The general principle behind it, that manufacturing efficiency rises with time, does not apply to products that operate mechanically (like cars or wind turbines).
 - C. Because Moore’s Law is improving electronics so quickly, cars will eventually become much cheaper.
 - D. The general principle behind it is that manufacturing experience leads to improvements in tools and methods, allowing goods to be made better and faster, with costs falling as the cumulative number of items produced rises.
 - E. The general principle behind it is that manufacturing experience leads to improvements in tools and methods, allowing goods to be made better and faster, with costs falling over time.

Solution: The answer is that manufacturing experience leads to improvements in tools and methods, allowing goods to be made better and faster, with costs falling over time. See slide “Is Moore’s Law unique to chips?” Wright’s law states that costs fall with cumulative production, rather than over time.

- (23) You want to include a dot plot in your group presentation, but some of the dots are clustered tightly near a value of zero in the vertical direction. How can you best make all the data easier to read?
- A. Convert the data to a pie chart.
 - B. Convert the data to a bar graph.
 - C. Expand the vertical dimension of the graph so that all the points are distinct from each other, and cut off any points that are too high.
 - D. Convert the vertical dimension to a log scale.
 - E. Start the vertical axis above the cluster of dots.

Solution: Converting to a log scale will generally spread out points that are bunched up near zero, while letting you still show points that have high values, making it unnecessary to omit points. Pie or bar charts would not generally be suitable alternatives to dot plots.

- (24) An innovation has the biggest effect when it
- A. attracts the first users.
 - B. first appears.
 - C. has not yet appeared.
 - D. greatly increases cost.
 - E. greatly decreases cost.

Solution: In The Rational Optimist: “Note that the greatest impact of an increasing-return wave comes long after the technology is first invented. It comes when the technology is democratized...It is not the speed but the cost - in terms of hours of work - that counts.”

- (25) What is the mystery explored in the first half of the animated video included in Lecture 9?
- A. The chain reaction in nuclear bombs should continue until the world is destroyed, yet it stops before then.

- B. This statement is false.
- C. Many places could develop life, but we haven't contacted aliens.
- D. Why did we successfully pass through all the Great Filters, guaranteeing our future survival?
- E. One can know something's position or velocity, but not both.

Solution: If many places could develop life, why haven't we contacted aliens? This is the Fermi paradox, discussed in the video on the last slide.

- (26) According to "The Rational Optimist", what is the primary relationship between scientific discovery and technological invention?
- A. The majority of significant technological inventions have come directly from university research labs.
 - B. Scientific discoveries are always the direct precursors to technological inventions.
 - C. Government funding in science always leads to technological advancements.
 - D. There is no relationship between invention and discovery.
 - E. Technological inventions often precede and drive scientific discoveries.

Solution: The book argues that technological innovations historically arise from practical experimentation and tinkering rather than scientific theories. It states that technology often leads science, with scientists later explaining how these inventions work, rather than discoveries directly leading to new technologies.

- (27) In preparing your group presentation as health minister aiming to treat tuberculosis, you find a report that tuberculosis killed 2,488 people last year, out of your country's population of one million. How can you best show the extent of this problem?
- A. A bar chart with y-axis ranging from 2000 to 3000, showing the number of TB deaths last year
 - B. A bar chart with y-axis ranging from zero to one million, showing the number of TB deaths last year
 - C. Text saying TB kills 0.2488% of people annually
 - D. A pie chart with two slices: the number of TB deaths (2488) and the number who didn't die of TB (about 997,500)
 - E. Text saying TB kills 1 out of 400 people annually

Solution: The best method of these options is text saying TB kills 1 out of 400 people annually. A pie chart is redundant to show just one number. On a bar chart from 0 to 1 million, 2488 would be so low that you could barely see it. 0.2488% has too many significant digits. Vertical axes should generally start at zero.

- (28) A student said in their group presentation that country X ranks 37th in poverty. How could they state that more clearly?
- A. Country X is 37% richer than the poorest country.
 - B. Country X ranks 37 in poverty (where 1 is the poorest).
 - C. Country X is at the 37th percentile in poverty.
 - D. Country X is 37% poorer than the richest country.
 - E. Country X is 37th in terms of poverty.

Solution: We don't necessarily know whether a rank of 1 is the highest or lowest for the particular measure, so you should specify that.

IX. Questions from Quiz 9

(1) Which of the following are major reasons that non-renewable resources aren't depleted?

1. Increasing cost induces users to buy less.
2. Since known reserves cannot increase, producers ration them to meet anticipated future needs.
3. New reserves are discovered.
4. Decreasing cost induces users to buy less.

A. 1 and 3 B. 2 and 3 C. 1 and 2 D. 2 and 4 E. 3 and 4

Solution: Slide "Resources: why don't we use up?" says we don't use up finite resources because we continually discover more, and if price rises, demand falls.

(2) According to Matt Ridley, which of the following is most accurate regarding the pessimistic predictions about the future of humanity?

- A. People should never listen to such pessimists as these apocalypses profits from the natural pessimism of human nature.
- B. Apocalypses, on average, are right in their predictions and thus are showered with awards and honors and are rarely challenged.
- C. Pessimists are accurate about their predictions as they incorporate the strategy of extrapolation in their methodology.
- D. People are often pessimistic about their own future life whereas they are optimistic about the future of society.
- E. The pessimistic predictions are often accepted and the optimistic ones are criticized.

Solution: Even though apocalypses profit from the pessimistic tendency of people, Ridley never really says that people should never listen to them. Therefore, option "People should never listen to such pessimists as these apocalypses profits from the natural pessimism of human nature." is wrong.

(3) Based on past decades, global grain production will likely _____ this century.

- A. rise and then fall B. fall and then rise C. stay about the same D. fall E. rise

Solution: Slide "Food supply: rice" shows steadily rising rice production.

(4) The pessimists' error is

- A. ignoring tipping points.
- B. obfuscation.
- C. seeing a future with totally new technologies.
- D. rejecting current trends by developing new technologies.
- E. extrapolationism.

Solution: The introduction of Chapter 9 in The Rational Optimist says, "The pessimists' mistake is extrapolationism: assuming that the future is just a bigger version of the past. As Herb Stein once said, 'If something cannot go on forever, then it will not.'"

(5) In 1962, more American children were dying of cancer than any other disease because

- A. chemicals in the environment as a result of modern manufacturing processes were at an all-time high in the US.
- B. of radiation from nuclear bomb testing.
- C. of secondhand exposure to cigarette smoke.
- D. of the increasing use of DDT to kill mosquitos in the US.
- E. rates of other childhood diseases declined in the 20th century.

Solution: Other childhood diseases decreased, leaving cancer as the biggest cause of death in children. See Cancer section of Chapter 9 of The Rational Optimist.

(6) Coffee and cabbage contain many carcinogens

- A. at dangerous levels from synthetic pesticides.
- B. produced by biofuel farming.
- C. at dangerous levels from nuclear bomb tests.
- D. made by the plants, and should be avoided.
- E. whose doses are safe.

Solution: Cancer section of Chapter 9 of The Rational Optimist: “As Bruce Ames famously demonstrated in the late 1990s, cabbage has forty-nine natural pesticides in it, more than half of which are carcinogens. In drinking a single cup of coffee you encounter far more carcinogenic chemicals than in a year’s exposure to pesticide residues in food. This does not mean that coffee is dangerous, or contaminated: the carcinogens are nearly all natural chemicals found in the coffee plant and the dose is too low to cause disease, as it is in the pesticide residue. Ames says, ‘We’ve put a hundred nails in the coffin of the cancer story and it keeps coming back out.’ ”.

- (7) Which of the following statement is most accurate?
- A. Natural pesticides are less dangerous than synthetic pesticides.
 - B. The reasons for the pessimistic view of the world are mainly pessimism bias on oneself, extrapolation, romanticism, illusion of control, and negative news bias.
 - C. One reason why extrapolation may be wrong is that technology may change.
 - D. Pessimism is better than optimism because it helps to generate better policies to prevent complacency and disasters.
 - E. Extreme environmentalists advocate that a sustainable solution to protect the environment is to steadily expand the economy.

Solution: The other answers are wrong because extreme environmentalists advocate that a sustainable solution to protect environment is to shrink the economy, many unregulated natural pesticides far more dangerous than synthetic pesticides, and the reasons for the pessimistic view of the world are mainly pessimism bias on the world, extrapolation, romanticism, illusion of control, and negative news bias. Also, pessimism may prevent complacency and disasters but it may also lead to bad policies (“Summary” slide). We cannot easily say whether pessimism or optimism is better.

- (8) What is NOT an example of eugenics?
- A. The forced sterilisation of people with negative genetic abnormalities.
 - B. Parenting classes to help all parents raise better children.
 - C. Subsidies rewarding more intelligent people when they have more children.
 - D. Killing targeted groups to keep them from having children.
 - E. Prohibition against breeding by criminals and feeble-minded persons.

Solution: Eugenics is the manipulation of breeding of people to increase characteristics regarded as desirable. Parenting classes to help all parents raise better children is not an example of eugenics because it aims to improve the family environment and parenting behaviours, and not to encourage selective breeding to engineer children with “better” genes.

- (9) Governments have generally become _____ democratic since 1900, and _____ democratic since 1980.
- A. less; more
 - B. no more and no less; no more and no less
 - C. more; more
 - D. less; less
 - E. more; less

Solution: The correct answer is that governments have generally become more democratic since 1900, while becoming more democratic since 1980 (graph on “Democracy” slide).

- (10) DDT
- A. killed millions of people.
 - B. reduced the Earth’s protective ozone layer.
 - C. greatly reduced polio cases until its use was banned.
 - D. was harmless to birds.
 - E. saved millions of human lives.

Solution: The Cancer section of Chapter 9 of The Rational Optimist says, “DDT’s miraculous ability to halt epidemics of malaria and typhus, saving perhaps 500 million lives in the 1950s and 1960s (according to the US National Academy of Sciences), far outweighed any negative effect it had on human health.”

- (11) We may prefer negative news
- A. due to confirmation bias.
 - B. to alert us to risks and learn, aiding our survival.
 - C. since bad things always happen (at least somewhere).
 - D. due to our tendency to extrapolate in faulty ways.
 - E. for a sense of control.

Solution: Slide “Negative news bias” says that bad news is more newsworthy because people pay more attention to it, and it’s more important to our survival.

- (12) According to the lecture, the human tendency to focus on problems may
- A. explain why we tend to analyze and reject negative forecasts.
 - B. explain why we tend to be optimistic about the world.
 - C. help us identify obstacles so that we might overcome them.
 - D. explain why the actual proportion of deaths from suicide is much higher than the share of attention that suicide gets in the media.
 - E. explain why we tend to be pessimistic about ourselves.

Solution: The summary slide says, “Such pessimism may prevent complacency and disasters...”

- (13) Which is most likely to happen with renewable or non-renewable resources in the long run as people get richer?
- A. Rising food consumption will, over the long run, almost totally deplete the supply of wheat, a renewable resource, by the end of this century.
 - B. Global supplies of gold, a non-renewable resource, will run out by the end of this century.
 - C. Rising human interference in animal habitats will cause multiple species of animals, a renewable resource, to become extinct during this century.
 - D. Rising construction will raise the long-term, real price of copper, a non-renewable resource, to at least ten times its current level by the end this century.
 - E. Rising energy use will lead us to run out of one or more types of fossil fuel, a non-renewable resource, by 2050.

Solution: The slides showed that over the long term non-renewable resources (like copper, iron, and coal) do not become totally depleted and don’t rise in price, and that food (like rice) production tends to rise over the long term. But I showed several animals that have become extinct. Thus, it’s most likely that some animals will become extinct.

- (14) According to Tali Sharot, the happiest people have
- A. abilities below the average of the population.
 - B. low income.
 - C. high expectations.
 - D. no expectations.
 - E. realistic expectations but act pessimistically.

Solution: See TED talk (Explanation: by Tali Sharot).

- (15) According to the lecture, history suggests that real costs of non-renewable resources in this century will likely
- A. rise steadily and slowly.
 - B. fluctuate in the short run but not change very much in the long run.
 - C. rise exponentially.
 - D. fall steadily and slowly.
 - E. fall exponentially.

Solution: Slides “Resources: Iron”, “Resources: Copper”, and “Resources: Coal” show that prices of non-renewable resources didn’t change dramatically in the long run.

- (16) Which of the following are major reasons that non-renewable resources aren’t depleted?
- 1. Increasing cost induces users to buy less.
 - 2. Since known reserves cannot increase, producers ration them to meet anticipated future needs.
 - 3. New reserves are discovered.
 - 4. Decreasing cost induces users to buy less.
- A. 1 and 3 B. 1, 2 and 3 C. 1 and 2 D. 2 and 3 E. 3 and 4

Solution: Slide “Resources: why don’t we use up?” says we don’t use up finite resources because we continually discover more, and if price rises, demand falls.

- (17) We may prefer bad news

- A. for a sense of control.
- B. due to confirmation bias.
- C. since bad things always happen (at least somewhere).
- D. due to extrapolation.
- E. to learn and alert us to risks, helping us survive.

Solution: Slide “Negative news bias” says that bad news is more newsworthy because people pay more attention to it, and it’s more important to our survival.

- (18) According to the lecture, history suggests that, in the long run, real costs of non-renewable resources in this century will likely
- A. fall exponentially.
 - B. not change very much.
 - C. fall steadily and slowly.
 - D. rise steadily and slowly.
 - E. rise exponentially.

Solution: Slides “Resources: Iron”, “Resources: Copper”, and “Resources: Coal” show that prices of non-renewable resources didn’t change dramatically in the long run.

- (19) The flush toilet is used as an example in Pinker’s video to illustrate that
- A. most of us acknowledge that the flush toilet is important in our everyday life.
 - B. the flush toilet reduces the transmission of cholera.
 - C. people often neglect that what is basic in their life could affect their well-being.
 - D. we should return to traditional ways of doing things.
 - E. the flush toilet is accessible for almost 95% of the population in the world.

Solution: The example of the flush toilet is used by Pinker to explain how people who overlooked the basics in their lives could affect their well-being.

- (20) In the foreseeable future, which is more likely to occur?
- A. The development of renewable energy will be arrested
 - B. Multiple animal species will near extinction.
 - C. Rare earth elements, which are used in electric car batteries and wind turbines, will be used up.
 - D. Multiple non-renewable resources will run out.
 - E. Pesticides will greatly increase cancer rates.

Solution: See slide “Resources”. Somewhat ironically, non-renewable resources tend not to run out (they may get more scarce, but that raises their price, driving more extraction and less consumption). By contrast, renewable resources (living species) may become extinct. Some animal species become extinct every year.

- (21) According to Matt Ridley, which of the following is most accurate regarding the pessimistic predictions about the future of humanity?
- A. Pessimists are accurate about their predictions as they incorporate the strategy of extrapolation in their methodology.
 - B. The pessimistic predictions are often accepted and the optimistic ones are criticized.
 - C. Apocalypses, on average, are right in their predictions and thus are showered with awards and honors and are rarely challenged.
 - D. People should never listen to such pessimists as these apocalypses profits from the natural pessimism of human nature.
 - E. People are often pessimistic about their own future life whereas they are optimistic about the future of society.

Solution: Even though apocalypses profit from the pessimistic tendency of people, Ridley never really says that people should never listen to them. Therefore, option “People should never listen to such pessimists as these apocalypses profits from the natural pessimism of human nature.” is wrong.

- (22) Which of these diseases killed the most people since 1900?
- A. vCJD
 - B. Flu
 - C. SARS
 - D. COVID-19
 - E. Ebola

Solution: H1N1 flu possibly caused 50 million deaths in 1918 (“Plague” section of The Rational Optimist, Chapter 9). From recent news, COVID-19 killed many people, but far fewer than H1N1 flu. All the other answer choices contributed to much lower death tolls, according to The Rational Optimist.

- (23) Which of these diseases killed the most people since 1990?
A. Ebola B. Smallpox C. COVID-19 D. H5N1 flu E. vCJD

Solution: The correct answer is COVID-19. H1N1 flu possibly caused 50 million deaths in 1918 (“Plague” section of The Rational Optimist, Chapter 9). From recent news, COVID-19 killed many people, but far fewer than H1N1 flu. All the other answer choices contributed to much lower death tolls, according to The Rational Optimist. However, since the question asks about the period **since 1990**, the answer is COVID-19.

- (24) Which one of the following infectious diseases has affected the fewest people in the last 30 years?
A. Mad-cow disease B. Smallpox C. Bird flu (H5N1) D. AIDS E. Ebola

Solution: “it is now more than forty years since smallpox was exterminated” (The Rational Optimist).

- (25) According to the lecture, the human tendency to focus on problems may
- A. explain why we tend to be pessimistic about ourselves.
 - B. explain why we tend to be optimistic about the world.
 - C. explain why we tend to analyze and reject negative forecasts.
 - D. explain why the actual proportion of deaths from suicide is much higher than the share of attention that suicide gets in the media.
 - E. help us identify obstacles so that we might overcome them.

Solution: The summary slide says, “Such pessimism may prevent complacency and disasters...”

- (26) Which one of the following statements is TRUE regarding the current state of the world over the long term?
- A. Forests are declining within North America due to acid rain.
 - B. More than 10% of people globally believe the world will end in this century.
 - C. In the face of falling supply, real grain prices rose by at least 10 times in approximately the last 100 years.
 - D. Rising demands of population growth will soon outweigh the world’s food production.
 - E. Democracies are dying and autocratic governments are on the rise.

Solution: Over the last century, rice production has increased while grain prices have fallen. Democracy is on the rise and autocratic governments are becoming fewer. Studies show there is no decline in forests in the United States and Canada due to acid rain. Fears of starvation due to a narrowing margin between food production and population growth are simply untrue. Food production has grown, while fertility rates have dropped due to the demographic transition. Large percentages, but less than 50% of people think the world will end in their lifetime.

- (27) Based on long term trends, several decades from now global grain production will likely _____.
- A. continue rising
 - B. remain at about current levels
 - C. continue falling
 - D. no longer keep up with rising demand
 - E. come to a turning point at which it stops rising and begins to fall

Solution: Slide “Food supply: rice” shows steadily rising rice production.

- (28) To give us perspective, Steven Pinker feels that journalists should
- A. give quantitative and historical background over the last decade or so.
 - B. ask a citizen for an opinion and an expert to suggest how to feel.
 - C. interview a balanced number of people on both sides of an issue.
 - D. give only current facts.
 - E. express their opinions.

Solution: On slide “Pessimism bias” at 8:42 in the video, he says: “I think our intellectual and journalistic culture has to become more evidence based, data oriented, quantitative. The current practice of journalism—report a story, ask a person on the street their comments on the story, and then a columnist or pundit tells people how to emote with regard to the story—that’s not a way to give people an accurate understanding of the world. Stories, events of the day, should be put into historical context. By historical context I don’t mean the Roman Empire. I mean like the last 10 years, the last 20 years. And they should be put in quantitative perspective.”

(29) Which resource is LEAST likely to ever be completely depleted?

- A. Tuna fish B. Polar bears C. Avocados D. Rhinoceroses E. Rare-earth metals

Solution: The answer is rare-earth metals. No non-renewable resource has ever been fully depleted, while some living species have become extinct. See slide “Resources”.

X. Questions from Quiz 10

IMPORTANT NOTICE: In the previous years, quizzes 10 and 11 were held as one single quiz. The author has did his best to separate the questions from previous years' question bank into quiz 10 and quiz 11. However, there is still a chance that some questions from quiz 10 will appear in quiz 11, and vice versa. You are advised to revise both sections when preparing for these two quizzes.

- (1) In *The Rational Optimist*, Matt Ridley argued that climate change has been doing more good than harm. Which of the following were one of his stated reasons for his argument?
- A. Warmer weather can make unbearably cold winters more bearable for everybody.
 - B. Climate change has been increasing global temperatures, increasing the stretch of tropic regions which support huge biodiversities. The speciation rate may outweigh the extinctions partly caused by climate change.
 - C. There are many concrete pieces of evidence that species have been wiped out due to climate change, and the resulting simplification of ecosystems is better for the environment.
 - D. The melting of ice caps means more free water enters our global water cycle and thus places experiencing overly dry climates may experience more pleasant weather at nobody's expense.
 - E. The increased level of carbon dioxide boosts crop growth, as well as the growth of wild vegetation, so climate change is not necessarily bad.

Solution: "Not only will the warmth improve yields from cold lands and the rainfall improve yields from some dry lands, but the increased carbon dioxide will itself enhance yields, especially in dry areas." (*The Rational Optimist*)

- (2) Which of these statements about climate change is most accurate?
- A. The degree of climate changes and the expense and impact of methods to prevent them are difficult to measure, thus it is hard to tell whether mitigation is a good investment.
 - B. The Copenhagen Consensus assessed climate change action as higher priority than health action.
 - C. Sea level will continue to rise up to a decade or so after CO₂ emissions stop.
 - D. Domesticated crops such as wheat were bred at the pre-industrial CO₂ level of around 270 ppm, thus their yields will fall as CO₂ level rises above that level.
 - E. Because electricity has come to play such a large role in the economy, and since it relies heavily on coal, the electricity sector is responsible for the majority of greenhouse gas emissions.

Solution: Whether mitigation is cost-effective is complicated as warming, effects, and cost-effectiveness of solutions are hard to measure. See slide "Is mitigation cost-effective?"

- (3) Why does the increase of carbon dioxide in the air lead to global warming?
- A. Carbon dioxide provide plants a material for photosynthesis, an exothermic reaction.
 - B. Carbon dioxide in air absorbs ultraviolet light from the Sun, heating the carbon dioxide, which then bumps into other air molecules, transferring the heat to them.
 - C. Carbon dioxide in air refracts ultraviolet light from the Sun, causing more heat to transfer to the land.
 - D. Carbon dioxide absorbs infrared light coming from the Earth and re-emits the light, which heats other molecules.
 - E. Carbon dioxide in air dissolves in water, where it forms small bubbles which inhibit formation of ice. Water is darker than ice, so it absorbs more sunlight and thus gets warmer.

Solution: See slide "Greenhouse effect".

- (4) What communist ideal does Matt Ridley predict will be at least partly realized in the near future?
- A. We'll get what we need and give what we can.
 - B. Profit will no longer drive commerce.
 - C. Religion will disappear.
 - D. Economic class differences will vanish.
 - E. Countries will merge into a world government, which he suggests be named Utopimistan.

Solution: Chapter 11 of *The Rational Optimist*: "People are willing to share their photographs on Flickr, their thoughts on Twitter, their friends on Facebook, their knowledge on Wikipedia, their software patches on Linux, their donations on GlobalGiving, their community news on Craigslist, their pedigrees on Ancestry.com, their genomes on 23andMe, even their medical records on PatientsLikeMe. Thanks to the internet, each is giving according to his ability to each according to his needs, to a degree that never happened in Marxism."

- (5) In The Rational Optimist, which of these factors did research find explained most of the variation in economic growth among different countries throughout the world?
- A. secure rights to property
 - B. fossil fuel reserves
 - C. the number of hours per day that people work
 - D. diversity of large animal species
 - E. a history of strong colonial rule

Solution: In the “Bound to fail?” section of Chapter 10 of The Rational Optimist: “When Daron Acemoglu and his colleagues compared property rights with economic growth throughout the world, they found that the first explained an astonishing three quarters of the variation in the second”.

- (6) Which of the following best enhanced economic growth of African countries?
- A. good property rights
 - B. strong colonial rule
 - C. rich mineral wealth
 - D. government planning of the economy
 - E. AIDS from other countries

Solution: The answer is good property rights. In the “Bound to fail?” section of Chapter 10 of The Rational Optimist: “When Daron Acemoglu and his colleagues compared property rights with economic growth throughout the world, they found that the first explained an astonishing three quarters of the variation in the second”.

- (7) If the Hong Kong government gives the Global Fund HK\$150 from each of its 7.5 million people, about how many lives would it save?
- A. 100,000 B. 10,000 C. 100 D. 10 E. 1,000

Solution: $\text{HK\$}150 \times 7.5 \text{ million}$ is about $\text{HK\$}1100 \text{ million}$. The Global Fund saves lives for about $\text{HK\$}11,000$ each (“Current problems” slide). $\text{HK\$}1100 \text{ million} \div \text{HK\$}11,000 = 100,000$.

- (8) How may African governments follow the path of East Asian economic development, according to The Rational Optimist?
- A. Setting up free-trade areas
 - B. Converting to a pictographic language
 - C. Providing free education
 - D. Funding industrial research grants to promote innovation
 - E. Growing rice

Solution: In the section “The world is your oyster” in Chapter 10 of The Rational Optimist: “In 1978 China was about as poor and despotic as Africa is now. It changed because it deliberately allowed free-trading zones to develop in emulation of Hong Kong. So, says the economist Paul Romer, why not repeat the formula? Use Western aid to create a new ‘charter city’ in Africa on uninhabited land, free to trade with the rest of the world, and allow it to draw in people from the surrounding nations.”

- (9) Which of the following statements is most accurate?
- A. The amount of fossil fuel used is not consistent with CO_2 added to the atmosphere.
 - B. To motivate mitigation, governments can implement CO_2 dividends.
 - C. An advantage of the global priorities method to solve problems is that it requires little estimation of effects and costs to mitigate the problems.
 - D. Over half of greenhouse gas emissions are from electricity generation.
 - E. The rise of sea level will stop when CO_2 emissions stop.

Solution: See slide “How can we motivate mitigation?”

- (10) From the lecture, which world sea level rise is in the range forecast by 2100?
- A. 1 dekameter B. 50 cm C. 250 cm D. 10 cm E. 2 cm

Solution: Slide “Sea level” says that a 3-10 dm rise is predicted in the 21st century. 50 cm, or 5 dm, is in that range. The amount of sea level rise is very important to know because a large rise could affect billions of people and trillions of dollars of infrastructure.

(11) Which statement is most accurate?

- A. Earth has warmed 2.5-3.5 °C since 1850.
- B. Electricity generation causes most of the greenhouse gas emissions.
- C. The sea may rise 5 m by 2100.
- D. Sea level rise will stop when CO₂ emissions stop.
- E. Carbon dividends can motivate mitigation.

Solution: (“How can we motivate mitigation?” slide). The sea may rise 3-10 dm by 2100, not 5 m (“Sea level” slide). The rise of sea level will not stop when CO₂ emissions stop; the rise will continue for centuries after CO₂ emissions stop (“Sea level” slide). There is no single sector responsible for most greenhouse gas emission; electricity generation accounts for 25% of greenhouse gas emission (“Sources” slides). Earth has warmed only about 1 °C since 1850; I estimate that Earth will warm 2.5-3.5 °C by 2100 (“How much has Earth warmed already?” and “How much will Earth warm?” slides).

(12) How would redistributing some money from rich people to poor people affect overall happiness or satisfaction in a population?

- A. There would be an overall increase in happiness because, as income rises, additional money has less and less effect, until it decreases happiness.
- B. There would not be much overall effect because the decrease in happiness of the rich would roughly balance the increase in happiness of the poor.
- C. There would be an overall fall in happiness due to the 100x multiplier effect, in which rich people, through stimulating economic activity, can create up to approximately 100x as much happiness as do poor people.
- D. There would be an overall decrease in happiness because the life satisfaction of rich people is much higher than for poor people.
- E. There would be an overall increase in happiness because each unit of money affects poor people far more than rich people.

Solution: As shown in the lecture, “Each dollar raises life satisfaction ~100x more for someone in extreme poverty than for someone earning HK\$33,000/month.” There would be an overall increase in happiness because each unit of money affects poor people far more than rich people.

(13) Why did the Copenhagen Consensus prioritise health problems over the problem of climate change?

- A. Because there is almost no solution to the problem of climate change
- B. Because solving health problems is much more efficient than solving the problem of climate change
- C. Because people have more difficulty understanding long-term problems, like climate change, than short-term problems, like health
- D. Because health problems affect the environment more than does climate change
- E. Because environmentalists are exaggerating the negative impact of global warming

Solution: The Global Priorities video in the lecture presents climate change as a real and major problem that has solutions. But health problems are also big and have solutions, and these can be accomplished much more cheaply, thus helping many more people with the same amount of money.

(14) If changes in fossil fuel use continue the trends of the last 7 decades for the next 7 decades, what level will atmospheric CO₂ likely be in 2100?

- A. 300-400 ppm B. >600 ppm C. <300 ppm D. 500-600 ppm E. 400-500 ppm

Solution: Slide “What will CO₂ level be?” shows that a freeze in the rate of CO₂ emission would lead to a level of about 770 ppm in 2100. Since CO₂ emission has been rising for the last 7 decades, a continuation of that trend would lead to an atmospheric level even higher than 770 ppm.

(15) Ridley feels that the biggest cause of Botswana’s economic success was

- A. a higher education level among citizens than in other African countries.
- B. good institutions and property rights.
- C. abundant resources: cattle and diamonds.
- D. efficient, one-party government.
- E. an abundant labor force.

Solution: “But its biggest advantage is one that the rest of Africa could easily have shared: good institutions. In particular, Botswana turns out to have secure, enforceable property rights that are fairly widely distributed and fairly well respected.” (Chapter 10, section “Bound to fail?”)

- (16) Which of the following statements about climate change is TRUE?
- A. Replacing fossil fuels with renewable energy is the optimal strategy to slow down global warming because electricity generation contributes the majority of our greenhouse gas emissions.
 - B. The three largest sources of greenhouse gas are electricity generation, manufacturing and transportation.
 - C. In recent years, the contribution of natural gas to carbon dioxide emission has exceeded that of coal.
 - D. Compared with health action, the Copenhagen Consensus generally puts a lower priority on climate change action.
 - E. If we could stop increasing the rate of fossil fuel burning, and just keep it at the current rate, carbon dioxide in the air would quickly return to the pre-industrial level.

Solution: The Copenhagen Consensus generally was that climate change action is important, but that other action, such as giving Vitamin A supplements to prevent blindness, or preventing HIV transmission, helps people more for lower cost.

- (17) What does Ridley suggest is the best way to raise Africa’s life quality in the long run?
- A. Reduce population growth by education.
 - B. Build government-operated factories to boost industrialization.
 - C. Replicate the success of Europe’s early growth by raising trade barriers to divide the largest countries into 10,000 mini- nations to enhance competition and improve the conditions for entrepreneurs.
 - D. Standardize informal laws and make the legal system more accessible.
 - E. Provide social welfare benefits to help equalize income.

Solution: In the section titled “The world is your oyster”, he said, “It is this kind of institutional reform that will in the end do far more for African living standards than dams, factories, aid or population control.”

- (18) Since money is limited, Bjorn Lomborg suggested in his TED talk that _____ should prioritize _____ to improve the world.
- A. scientists; solutions to problems
 - B. scientists; problems
 - C. economists; solutions to problems
 - D. economists; problems
 - E. scientists; research

Solution: Scientists provide solutions to the problems within their fields of interest but are not trained to compare the costs and benefits of solutions in different areas. That is what economists do. We should not prioritize problems because many are big but insoluble, like aging. Instead we should prioritize solutions to problems.

- (19) According to Bjorn Lomborg’s talk about prioritizing, which project came first in the priority list drawn up by the Copenhagen Consensus in 2004?
- A. Deal with malaria
 - B. Manage climate change
 - C. Deal with HIV/AIDS
 - D. Eliminate barriers to trade
 - E. Solve global obesity

Solution: According to the Global priorities video, dealing with HIV/AIDS was the first priority.

- (20) According to the video of political scientist Bjorn Lomborg, which one of the following was the lowest priority problem we should tackle, in terms of cost-effectiveness?
- A. Barriers to Free Trade B. HIV/ AIDS C. Climate Change D. Malaria E. Malnutrition

Solution: Lomborg stated that the resources required to address the problem of climate change could be more cost-effectively diverted to programs for HIV/AIDS treatment and prevention, micronutrients for malnutrition, promoting free trade, and for treatment and prevention of malaria. He did not deny the problem of climate change but suggested that resources should be prioritised to tackle problems in the most cost-effective way to yield the greatest benefit to humankind.

- (21) Which one of the following is NOT an effect of human-induced greenhouse gas emission?

- A. Increase in sea alkalinity
- B. Changes in global weather patterns
- C. Opening of some new shipping routes
- D. Increased growth of some plants
- E. Increased species extinctions

Solution: Increasing carbon dioxide in the air dissolves in the sea, decreasing sea alkalinity, not increasing it.

(22) Which one of the following is NOT an effect of human-induced greenhouse gas emission?

- A. Increased species extinctions
- B. Increased growth of some plants
- C. Decrease in sea acidity
- D. Changes in global weather patterns
- E. Opening of some new shipping routes

Solution: Increasing carbon dioxide in the air dissolves in the sea, increasing sea acidity, not decreasing it.

(23) In The Rational Optimist, which of these factors did research find explained most of the differences in level of growth in economies of countries throughout the world?

- A. trust in ownership
- B. a history of strong colonial rule
- C. number of patents
- D. natural resources
- E. the number of hours per day that people work

Solution: Trust in ownership, or property rights. In the “Bound to fail?” section of Chapter 10 of The Rational Optimist: “When Daron Acemoglu and his colleagues compared property rights with economic growth throughout the world, they found that the first explained an astonishing three quarters of the variation in the second”.

XI. Questions from Quiz 11

IMPORTANT NOTICE: In the previous years, quizzes 10 and 11 were held as one single quiz. The author has did his best to separate the questions from previous years' question bank into quiz 10 and quiz 11. However, there is still a chance that some questions from quiz 10 will appear in quiz 11, and vice versa. You are advised to revise both sections when preparing for these two quizzes.

- (1) In the last 4 decades, the number of people born each day has
- A. roughly doubled and then roughly halved.
 - B. stayed about the same.
 - C. fluctuated between about 130 million and 145 million.
 - D. fallen roughly in half.
 - E. approximately doubled.

Solution: A Demographics in 2050 slide shows the number of annual births not varying much, but remaining within a narrow range from about 130 million to 145 million per year for the last 40 years. That's per year, not per day. Therefore, the answer that is most correct is that the number has stayed about the same.

- (2) What may most likely happen to the world population in 2050?
- A. Population will roughly double in size due to the demographic transition.
 - B. Longevity will remain at the current level of about 80 years.
 - C. The ratio of the number of elderly to the number of children will grow much bigger.
 - D. People will no longer experience illnesses and major disease outbreaks.
 - E. It will increase gradually until 2035 and remain steady after.

Solution: It is likely that elderly people will make up a higher percentage of the population in the future. The other statements are possible, but unlikely.

- (3) Which of the following is incorrect concerning dematerialization?
- A. Dematerialization will predominate in 30 years' time.
 - B. Dematerialization occurs mainly in developing countries.
 - C. Transitioning from using CD to Spotify for music is an example of dematerialization.
 - D. Dematerialization is facilitated by innovation and technological advancement.
 - E. There will be an adverse trend of dematerialization in poor countries.

Solution: Dematerialization is defined as the provision of a product or a service with the reduction of material used. The process of dematerialization is facilitated by technological advancement and is the major trend in developed countries. Poor countries, as mentioned in the lecture, would need to use more materials, especially when they are getting through industrialization to improve their economic condition (see slide Income and Environment).

- (4) Though the economies of the poorest countries now almost all grow slower than 7%/year, why may the Sustainable Development Goal of economic growth $>7\%$ /year in the poorest countries eventually be achieved?
- A. The poorest countries may become more civilized and take more initiatives to protect the environment, offering more opportunities to women, youth and people with disabilities.
 - B. Rising wages in other countries will drive employers to hire from the shrinking pool of low-cost workers, driving up income in the poorest countries.
 - C. The poorest countries may develop world-leading technology.
 - D. Growth fluctuates over time.
 - E. People with talent may migrate to the poorest countries.

Solution: The slides showing GDP/capita yearly growth for poor countries says, "But in future, cheap labor scarcer, boosting growth in the last poor countries."

- (5) Based on Sapiens, what does Harari think would replace the laws of natural selection in the future?
- A. Evolution
 - B. Memes
 - C. Conscious design of life
 - D. The laws of physics

E. Decisions by extraterrestrial life

Solution: Harari thinks that the laws of natural selection will be replaced by the laws of intelligent design: in other words, conscious design of life.

- (6) What major category of death and disability is likely to happen more frequently per person by 2050?
- A. Cancer (including lung and stomach cancer)
 - B. No major category
 - C. Accidental injuries
 - D. Diarrhea
 - E. Stroke

Solution: The Health in 2050 slide says, “Almost every disease will fall.” The light colors on the graph show that all major categories have decreased over the last few decades (HIV grew, but it’s falling now, as we learned earlier in the course.)

- (7) Arthur C. Clarke stated 3 laws. What is their meaning?
- A. Supernatural phenomena are sometimes real.
 - B. We will increasingly explore space.
 - C. Ignore old scientists.
 - D. The future is often too amazing for us to predict.
 - E. It’s tough to make predictions, except about the future.

Solution: Clarke’s first law states in part that if a respected scientist predicts that something is impossible, he is very probably wrong. In other words, many things that seem beyond achieving now will eventually be achieved because technology will make advances too great for us to foresee.

- (8) What does Clay Shirky think are the two main things that have led to today’s cognitive surplus?
- A. Free time and high IQ
 - B. TV and education
 - C. Internet memes and the media
 - D. Internet memes and TV
 - E. Free time and the media

Solution: Clay Shirky stated that there are 2 parts that make a cognitive surplus: (1) The cumulative free time and talent in the developed world, and (2) the media landscape that allows us to work cooperatively and cumulatively together.

- (9) Which is not an example of biological engineering, as mentioned by Harari?
- A. The potato with a gene of an Arctic fish in its genetic makeup
 - B. The genetically modified E. coli that is used to produce biofuel
 - C. The voles who are in monogamous relationships
 - D. The Vacanti mouse with an ear grown on its back
 - E. The green fluorescent rabbit Alba

Solution: The species of voles that he mentioned are naturally monogamous. All other examples are biologically engineered. (see the introduction and Of Mice and Men of Sapiens)

- (10) Which is/are the most cost-effective way(s) to improve happiness in developed and poor countries respectively?
- A. Improve poverty in both developed and poor countries.
 - B. Treat mental illness in both developed and poor countries.
 - C. Treat mental illness in developed countries and cut poverty in poor countries.
 - D. Facilitate economic development in both developed and poor countries.
 - E. Treat physical illness in developed countries and cut poverty in poor countries.

Solution: Treating mental illness (e.g., anxiety and depression) is the most cost-effective way to improve happiness for developed countries while cutting poverty would be the most crucial for poor countries (see slide Happiness).

- (11) By 2050, the people not in extreme poverty will likely

- A. rise in absolute number but fall as a proportion of the population.
- B. rise in absolute number and rise as a proportion of the population.
- C. remain about the same in absolute number.
- D. fall in absolute number and fall as a proportion of the population.
- E. fall in absolute number but rise as a proportion of the population.

Solution: The slides showing “World population living in extreme poverty” says “Far fewer people in extreme poverty.” Since the overall population will rise by 2050, the proportion in extreme poverty will also fall. Thus, the number and proportion of people not in extreme poverty will both rise.

- (12) What is the main implication of Harari’s “Frankenstein Prophecy”?
- A. Scientists have a long way to go until they can successfully create a new life form.
 - B. Technological advancements will vastly improve human lives.
 - C. Interfering with nature’s creations will likely lead to suffering and catastrophe.
 - D. Future scientific engineering may lead to the extinction of our own species.
 - E. Aliens from outer space may colonize our civilization.

Solution: Harari thinks that in the future, scientists may be able to engineer life forms superior to us, which may eventually lead to the extinction of our own species. He wrote: “The pace of technological development will soon lead to the replacement of Homo sapiens by completely different beings with not only different physiques, but also very different cognitive and emotional worlds.”

- (13) Ridley feels that in the future
- A. The world will be more top-down, as corporations and governments become larger and stronger.
 - B. Predators and parasites will quickly disappear.
 - C. Humans will live on the Sun.
 - D. The flame of innovation will decline occasionally in some places.
 - E. Most wilderness will disappear.

Solution: In Chapter 11 of “The Rational Optimist”, Ridley says, “However reactionary and cautious Europe and the Islamic world and perhaps even America become, China will surely now keep the torch of catallaxy alight, and India, and maybe Brazil, not to mention a host of smaller free cities and states.” Thus, innovation will fluctuate and will decline from time to time in some places. He says that predators and parasites will still cause problems and that human nature (instincts) won’t change for better or worse, but most likely things will go well, including the expansion of wilderness.

- (14) By 2050, the size of the middle class will most likely be closest to
- A. 2 billion
 - B. 0.5 billion
 - C. 14 billion
 - D. 7 billion
 - E. 1 billion

Solution: The slides showing the graph of the middle class says: “Huge growth of middle class.” and “From 4 billion now to 7 billion.” 7 billion is near the entire human population now.

- (15) In the next two decades, compared to the four before 2020, the global number of people dying each month is forecast to
- A. fall faster.
 - B. rise faster.
 - C. rise from about 600 million to about 900 million.
 - D. remain about the same.
 - E. fall at about the same rate.

Solution: A Demographics in 2050 slide shows global deaths. They are forecast to rise from about 60 million to 90 million annually, not monthly. That is a much faster rise than in the four decades before the COVID-19 spike in deaths. Thus, the answer is “rise faster”.