

HSI1000 Finals Practice Paper

Block 1

Question 1

The current government of country X is trying to encourage its population to take medication Y. Y has been shown to be highly effective at protecting the population against a particular disease in well-respected peer reviewed scientific journals and has been highly recommended by the WHO. An online influencer urges his viewers not to take medication Y because it supports the corrupt government X and the big pharmaceutical company (big pharma). He claims that government X is receiving kickbacks from the big pharma supplier. When asked for evidence by several commenters, he scolds them and says how stupid and naive they are. “Everyone knows government X is corrupt,” he says. When asked why the science shows it protects people and WHO recommends it, he again says the commenters are very stupid and naive. He claims that, of course, the scientists and WHO have all been paid off to say these things. When asked for evidence of this he says that the big pharma company has eliminated all evidence. Which fallacy in the name of science is being most flagrantly exploited?

- A. Exploiting Uncertainty
- B. False Anomaly
- C. Illicit Causal Inference
- D. Unsupported Analogies and Similarities
- E. Untestable Explanations and Predictions**

Solution:

E: Untestable explanations and predictions.

His two statements “Everyone knows Gov X is corrupt” and “big pharma companies eliminate all evidences” positions his claim as a claim that cannot be supported by evidence and tests.

Question 2

Climate change deniers sometimes argue that long ago, before humans were around, the Earth underwent climate change, so climate change is quite normal and natural and therefore climate change today can't be due to us. Choose the best complication associated with causal links below that this conclusion overlooks, thus allowing it to potentially arrive at the wrong conclusion?

- A. A combination of causes can lead to an effect.
- B. An effect might not result from a given cause in every case.
- C. Causal explanations can be negative.
- D. Cause and effect can refer to groups.
- E. More than one cause can result in a specific effect.

Solution:

E: More than one cause can result in a specific effect

It is not A: a combination of causes because a combination means both cause X and Y *together* will cause climate change. Let cause X be humans, and cause Y be a natural cause. Since in the past, humans were not around, cause Y alone must have caused climate change. So it's *more* than one cause.

Question 3

Select two options from those given below that when combined provide the best/most accurate explanation for the following statement: "Science embraces skepticism, whereas pseudoscience tends to view skepticism as a sign of narrow-mindedness."

- A. In science when a valid and plausible alternative explanation to a phenomenon is discovered it is quickly accepted as being possible, then critically, it is tested to see if it can be falsified.
- B. Pseudoscience ignores or dismisses evidence contrary to the claim or explanation.
- C. Pseudoscientific claims rarely evolve and develop into a fully supported theory.
- D. Pseudoscience dismisses valid counter arguments to its claims or explanations on the basis that those criticizing it are not willing to consider the possibility that their claim or expectation is correct.
- E. In science, when evidence in the form of data and measurements are collected it is always done multiple times to ensure any errors in the measurements and data can be corrected.

Solution:

A and D are the answers.

The answer for the science is between A and E. E says nothing about skepticism.

The answer for pseudoscience is between B, C and D. Both B and C do not demonstrate anything related to *skepticism*. D discusses how pseudoscience dismisses a valid counter argument (i.e. skepticism) on the basis that those criticising it are not willing to consider a particular possibility (i.e. narrow-mindedness).

Question 4

We very briefly discussed miasma theory in this course (Lecture 3) which attributed diseases like the black death, cholera, and chlamydia to miasma, which was a noxious form of "bad air" caused particularly from the decomposition of organic matter. Choose the best option from below. Miasma theory is...

- A. ...a pseudoscience even during the time it was proposed because at that time, no one had the tools to observe this existence of this miasma.
- B. ...a pseudoscience now because it is wrong and obsolete and is superseded by germ theory.
- C. ...not a pseudoscience even though it is wrong and obsolete because there was a law-type explanation supporting this theory. Observations of disease clusters near sources of pollution gave evidence to this theory.
- D. ...a pseudoscience because there was only a law-type explanation supporting this theory, and not a causal relationship nor an underlying process. The observations of disease clusters near sources of pollution did not establish a causal link between miasma and the disease.
- E. ...not a pseudoscience because it has been disproven and superseded by germ theory

Solution:

E is the answer: A key distinguisher between pseudoscience and science is that pseudoscience is not self-correcting.

A is not the answer: Just because we don't have the tools to observe the existence of this miasma, does not imply it's a pseudoscientific claim. There are other ways to test/falsify a claim, not just direct observation.

B is not the answer: Whether a theory is pseudoscience is not determined by whether it is correct.

C is not the answer: While this statement is true, the distinction between pseudoscience and science is not about how one came to postulate the explanation.

D is not the answer: For the same reason as C.

Question 5

It was discussed in lectures that the amount of ^{14}C in the atmosphere rose dramatically due to atomic bomb testing in the 1950s to 1960s. Following the signing of the Limited Nuclear Test Ban in 1963, there was a rapid drop in ^{14}C concentration in the atmosphere. Which two explanatory steps are key to the causal mechanism explanation for this rapid drop?

- A. Fossil fuels are depleted/devoid of ^{14}C .
- B. Burning fossil fuels causes gaseous carbon dioxide to be released into the atmosphere.
- C. Fossil fuels are rich in ^{14}C .
- D. Burning fossil fuels causes atmospheric oxygen to be used up.
- E. Volcanic eruptions emit vast quantities of gases into the atmosphere causing dilution of ^{14}C .

Solution:

A and B. This is in lecture 6. This demonstrates Suess Effect, which argues that the dilution of ^{14}C in the atmosphere is an indicator that the carbon dioxide in the atmosphere is due to the burning of fossil fuels.

Question 6

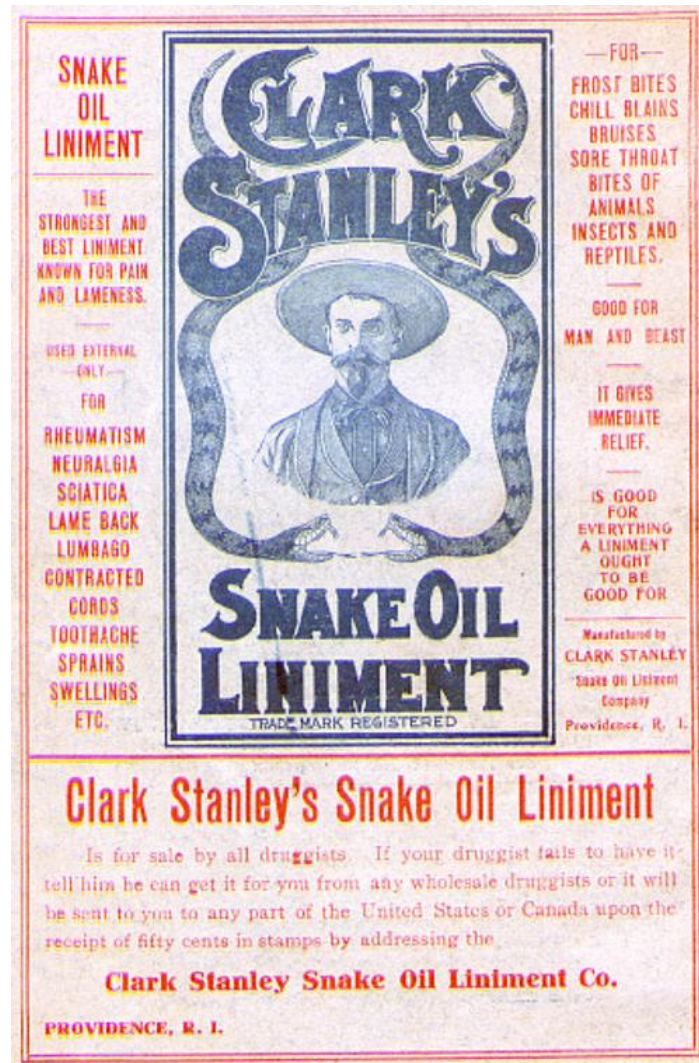
Karl Popper, one of the 20th century's most influential philosophers of science, put forth a theory called "potential falsifiability" as a means of telling the difference between science and non-science. We have discussed falsifiability several times in this course. Which tool of the Baloney Detection Toolkit (BDTK) could Karl Popper's theory come under?

- A. Tool 1: How reliable is the source of this claim?
- B. Tool 2: What is the source's perspective?
- C. Tool 3: Is the claimant providing positive evidence?
- D. Tool 4/5: Where do most of the evidence point?/Has the claim been verified by someone else?
- E. Tool 6: Does the claimant use flawed reasoning?
- F. More than one of the tools because the concept of falsifiability is central to the BDTK
- G. None of the tools because the concept of falsifiability is not really incorporated in the BDTK.

Solution

Answer is G. The concept of falsifiability is central to determining if a claim is scientific. The BDTK is not generally concerned with whether the claim is scientific. The BDTK is a toolkit that can be utilized to test if any "everyday" claim is *true* by utilizing the scientific method. Tool 3, 4 & 5 are about providing evidence for the claim – which is not the same as falsifiability however. The only way to pass tools 3, 4 and 5 is if evidence exists. But a claim can be falsified even if no evidence exists. As stated in Lecture 12 has this to say about potential falsifiability: 'We should always ask ourselves when accepting some explanation for something: "Under what conditions would we be willing to set aside the explanation on the grounds that it is false?" If you can't think of any such conditions, then the explanation you have isn't a scientific explanation.' It should be clear that this concern is different from providing positive evidence.

Question 7



Clark Stanley, Public domain, via Wikimedia Commons

Consider this advertisement from 1905 for snake oil, which, when analysed, was found to contain mineral oil, a fatty compound thought to be from beef, capsaicin from chili peppers, and turpentine, but containing no snake-derived substances whatsoever. This snake oil is claimed to be good for virtually everything (a panacea) and provides “immediate relief” for man and beast.

Clark Stanley claimed that, starting in 1879, after eleven years working as a cowboy, he studied for more than two years with a Hopi medicine man at Walpi, Arizona. This supposedly included learning the “secrets of snake oil”. With the help of a Boston druggist he began marketing his product at Western medicine shows.

Review the advertisement and the short extract of the career of Clark Stanley then select the scientific evidence presented for the effectiveness of this product.

A. There is zero scientific evidence for its effectiveness.

B. Expert opinion.

C. Wisdom and secret knowledge and expertise from a medicine man.

D. A druggist, aka a pharmacist, helped create the product.

E. The presence of capsaicin.

Solution:

The answer is A. Expert opinion and secret knowledge from a potential expert is not scientific evidence. Being created by a scientist (pharmacist) also does not constitute scientific evidence.

Question 8

Consider the following extract from a web site selling magnetic bracelets and copper bracelets. They claim magnetic bracelets help with arthritis pain, rheumatism, carpal tunnel syndrome, football and tennis injuries, period pain, RSI, poor circulation, migraine headaches, muscle soreness, and a long list of joint pain.

How does Magnetism work and what are the benefits?

One of the theories about how magnetism works with the body is that the fields surrounding the magnetic bracelets stimulate the field where the pain occurs. This is thought to trigger the release of the body's own painkillers, thereby providing natural relief for the person instead of having to take medications over long periods that may have bad side-effects.

It is also thought that because metals like iron, zinc and magnesium are essentially components already found in the human body. Magnetism is able to affect them in a way that brings about helpful change at the cellular level; in particular by impacting on particles in the blood and increasing oxygenation so that circulation is improved, and a person heals quicker. After all, everyone knows what happens when you put a magnet beside a metal: it attracts it.

Which two fallacies in the name of science is exploited in the explanations?

- A. Empty jargon
- B. Unsupported analogies and similarities
- C. Untestable explanations and predictions
- D. Questionable arguments by elimination
- E. False anomaly

Solution:

Answer is A and B.

Do note that the concept of empty jargon should not be dependent on what you consider jargon. In the context of this question, what constitutes jargon to a student from the arts would be quite different to what constitutes jargon to a professor in physics. Empty jargon is: "hijacking scientific language and stringing together a bunch of terms which means nothing, in order to try and convince you that something is scientifically established" (Quoted from Lecture 12). This extract definitely displays this fallacy.

It is clear that analogies and similarities are made between the effect of magnets on metals and the effect on it on components found in the body. It further goes on to say (completely unsupported) that it will affect them in a way that brings about helpful change at the cellular level. Whilst magnets do produce and interact with magnetic fields, there is no similar field where pain occurs.

Question 9

Citizen Science was utilized in this module. Where was/were it utilized, and what are benefit(s)? Choose three options.

A. It was utilized in data collection associated with differentiating between Nature Reserves and Nature Parks.

B. A benefit is the large number of observations which provides greater confidence in the results.

C. It was utilized in experiments conducted in a laboratory.

D. A benefit is greater immersion, appreciation and understanding of scientific inquiry.

E. A benefit is gaining hands-on experience and understanding of accuracy, precision, uncertainty, and trueness.

Solution:

C was definitely not when citizen science was used. Check in with WS3 material to recall what citizen science is.

E is not a benefit because mostly when you participate in citizen science, you do not discuss accuracy, precision, uncertainty and trueness. The people collecting the data generally does not analyse the data, and they do not have methods or tools to be able to determine the true value and discuss accuracy and things of the like.

Question 10

In a desperate attempt to explain why metals gained mass upon burning in air, adherents of phlogiston theory claimed that phlogiston must possess negative mass. Which tool from the Baloney Detection Toolkit most indicate that there's an issue with this explanation? Choose the best answer from the options below.

A. Tool 1: How reliable is the source of this claim?

B. Tool 2: What is the source's perspective?

C. Tool 3: Is the claimant providing positive evidence?

D. Tool 4: Where do most of the evidence point?

E. Tool 5: Has the claim been verified by someone else?

E. Tool 6: Does the claimant use flawed reasoning?

Solution:

Answer is B. The strongest reason for the adherents of phlogiston theory to *desperately* attempt to explain away the negative mass is because they already have a belief that it is true!

Block 2

The following six questions (Questions 1-6) can be answered using information from the following fictional conversation:

In a noticeable Australian accent, Ryan announced, “Professor, I found some people online who gave some pretty convincing arguments that climate change isn’t happening!”

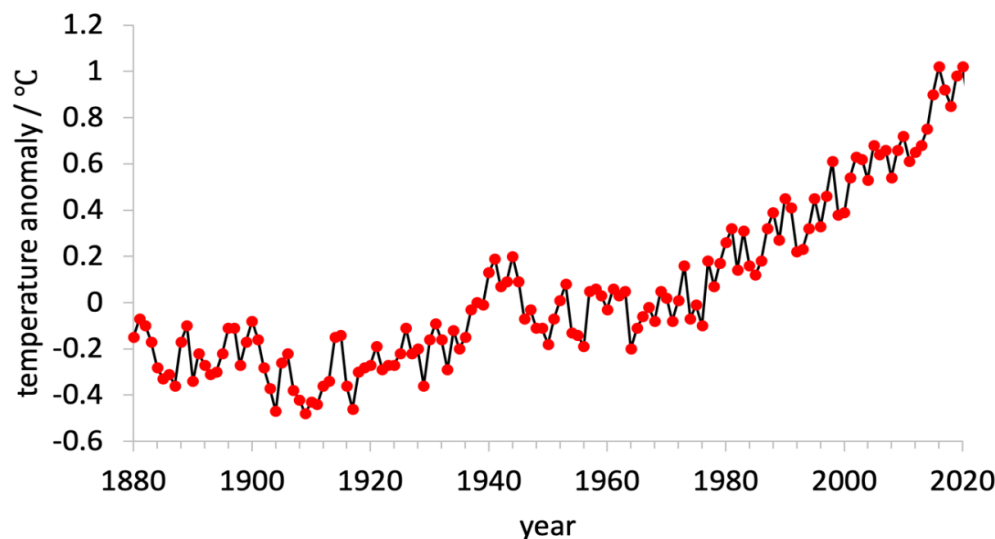
“Go on,” said the professor.

“They say that warming stopped in 1998. Since then, temperatures have cooled!” exclaimed Ryan showing the professor a graph on his phone.

“Hmmm, why does this time series stop in 2008? Don’t you think that’s a little fishy?” asked the professor.

“Well, I suppose it could be updated, but I’m sure it would tell the same story,” Ryan argued.

“This figure from our class notes suggests otherwise,” said the professor.



“There must be something wrong with the measurements. We have been having a lot of record cold weather lately. Texas had snow last winter. That’s unheard of. Climate change can’t still be happening,” replied Ryan.

“That snow was caused by a shift in the polar vortex. It was just weather not climate,” asserted the professor.

“Well, I still think there’s something wrong with the temperature record—thermometers are unreliable,” claimed Ryan.

“Ryan, we measure temperature in many ways. They all say the same thing—our planet is warming!” countered the professor, a little exasperated. “Just because measurements have uncertainty doesn’t mean it’s unknowable. The uncertainty is smaller than the measured global warming.”

"I don't know. It seems to me that this is all part of a natural cycle. It's been warmer in the past and it's been colder in the past. The current changes are nothing unusual. There's no way you can say it's due to humans! Current climate change is just natural!", claimed Ryan.

"How can you make such a claim?", asked the professor.

"It just makes sense. The climate's changed in the past through natural processes, and the climate's changing now," argued Ryan.

"That's not a valid argument. Just because climate changed naturally in the past doesn't mean that current climate change is natural now!", countered the professor.

"My point is that it's not necessary to explain current climate change by saying it's caused by humans," asserted Ryan.

"Ryan, the rate of current climate change is more than 20 times faster than natural climate changes. Human activity *is* necessary to explain *current* climate change!", reasoned the professor. "Now I have a class, so we will have to continue this discussion later."

Question 1

Which fallacy is used in the argument that climate change stopped in 1998? (1 option)

- A. Single cause fallacy
- B. Fallacy of incomplete data
- C. Jumping to conclusions fallacy
- D. Fallacy of impossible expectations
- E. Straw man fallacy

Question 2

Which of the following true statements are needed to refute the argument that current climate change is natural? (1 option)

1. Past climate change tells us climate is sensitive to the warming effect of CO₂
 2. The increase in atmospheric CO₂ since the industrial revolution is almost entirely due to the burning of fossil fuels
- A. Statement (1) ALONE is sufficient, but statement (2) ALONE is not sufficient
 - B. Statement (2) ALONE is sufficient, but statement (1) ALONE is not sufficient
 - C. BOTH statements TOGETHER are sufficient, but NEITHER statement ALONE is sufficient
 - D. EACH statement alone is sufficient
 - E. BOTH statements TOGETHER are NOT sufficient

Question 3

Ryan argued that the climate change has stopped because temperatures declined between 1998 and 2008. Which other time periods would also have shown a temperature decline? (2 options)

- A. 1880–1920
- B. 1900–1940
- C. 1920–1960
- D. 1940–1980
- E. 1960–2000

Question 4

Ryan argued that current climate change is natural. Which of the following climate change **myths** are also attempts to argue that current climate change is natural? (2 options)

- A. Human CO₂ emissions are tiny compared to that emitted by volcanoes
- B. CO₂ was much higher in the past, but the world didn't boil away so the greenhouse effect is weak
- C. Increases in solar activity explain the increases in Earth surface temperature
- D. Urban development is responsible for much of the global warming over the last century
- E. Current warming is just a continuation of the recovery from the Little Ice Age that ended around 1850

Question 5

The professor used the argument “the rate of current climate change is more than 20 times faster than natural climate changes” to refute the claim that current climate change is natural. What form of scientific explanation is the professor relying on? (1 option)

- A. Statistical law
- B. Causal mechanism
- C. Scientific law
- D. Underlying process
- E. Function

Question 6

Ryan made a single cause fallacy in arguing that current climate change is natural, because climate change has occurred naturally in the past. Which of the following climate change **myths** are also single cause fallacies? (2 options)

- A. Polar bear numbers have increased so they're in no danger from global warming
- B. CO₂ is plant food, so we have no worries about plant growth on a warming planet
- C. Water vapour is the strongest greenhouse gas so CO₂ doesn't matter
- D. In the 1970s, climate scientists were predicting an ice age
- E. Climate models' predictions have failed, making them unreliable

Question 7

What form of correlation do CO₂ concentrations and stratospheric temperatures exhibit? (1 option)

- A. Perfect positive correlation
- B. Positive correlation
- C. No correlation
- D. Negative correlation
- E. Perfectly negative correlation

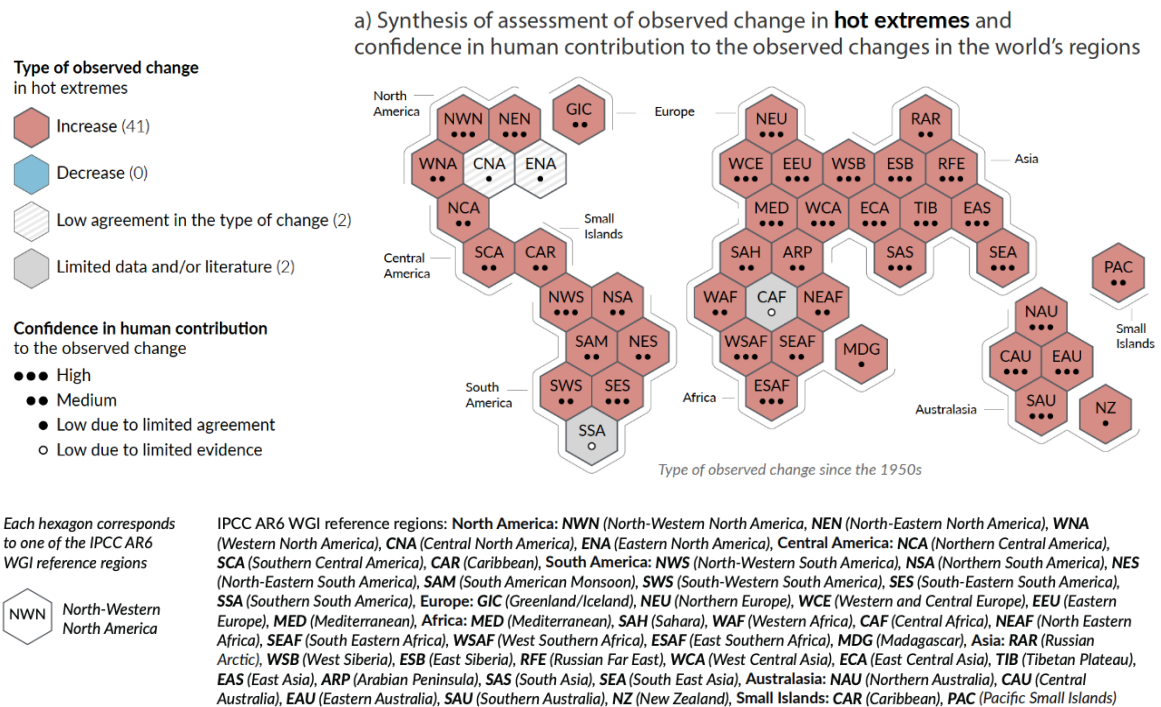
Question 8

Which two of the following shared socioeconomic pathways would give us the best chance to find mitigation solutions? (2 options)

- A. SSP1
- B. SSP2
- C. SSP3
- D. SSP4
- E. SSP5

Question 9

According to this figure, in which continents will there be an increase in hot extremes in every region of the continent with at least medium confidence that this increase has a human contribution? (2 options)



- A. Africa
- B. North America
- C. Australasia
- D. Asia
- E. Europe

Question 10

Which of the following true statements are required to be able to state that increases in volcanic emissions of sulphate aerosol causes decreases in global average surface temperature? (1 option)

1. Sulphate aerosol scatters some solar radiation back towards space before it can be absorbed by the atmosphere or by the Earth surface
 2. Increased sulphate aerosol is a negative radiative forcing
-
- A. Statement (1) ALONE is sufficient, but statement (2) ALONE is not sufficient
 - B. Statement (2) ALONE is sufficient, but statement (1) ALONE is not sufficient
 - C. BOTH statements TOGETHER are sufficient, but NEITHER statement ALONE is sufficient
 - D. EACH statement alone is sufficient
 - E. BOTH statements TOGETHER are NOT sufficient

Block 3

Question 1

Having explored some of the science behind climate change projections, what other areas must be considered to achieve climate change mitigation globally?

- a. Political stability, health of government
- b. Unemployment, economic growth rates
- c. Distribution of wealth, per capita income
- d. Innovation in industry, life cycle of technology, market awareness and acceptance
- e. All of the options apply

Question 2

Why have biodiversity experts been concerned about the national environmental road map in Singapore?

- a. Lack of biodiversity conservation as a priority during the early decades of rapid development.
- b. Failure of more recent urban planning to secure forest refugia and connectivity within and between developments.
- c. No retention of nature reserves.
- d. No establishment of nature parks.
- e. No mention of biodiversity conservation in the Singapore Green Plan 2030.

Question 3

The One Million Trees movement in Singapore is projected to sequester 78,000 tonnes of CO₂ per year. Will this be sufficient to offset Singapore carbon emissions?

- a. No, because Singapore's CO₂ emissions have exceeded 40 million tons/year.
- b. No, it will also require reductions in power consumption, construction, and transport sectors, amongst other things.
- c. Yes, this will allow us to relax on other measures like power consumption and transportation.
- d. Yes, but the shift to electric vehicles will increase carbon dioxide emissions.
- e. Yes, so the post-pandemic budget eases off on other sustainability efforts.

Question 4

What is climate resilient development?

- a. One which combines both mitigation and adaptation plans for climate change by various sectors and not just a single sector.
- b. It encourages development projects to plan for integrated solutions, such as reduction of CO₂ emissions, pollution and enhancement biodiversity
- c. It encourages each sector to specialise in CO₂ emission reduction.
- d. It requires the public to integrate CO₂ emission reduction in their daily lives.
- e. It ensures new developments will be built high enough to avoid impact from sea level rise.

Question 5

Can humans cope without healthy ecosystems?

- a. No, because healthy ecosystems ensure the habitability of the planet and sustain economies.
- b. No, because humans require the ecosystem services of biodiversity which provide raw materials and water, purify air, maintain soil integrity, regulate the climate and recycle nutrients.
- c. Yes, because technological solutions and innovations provide for all our needs now.
- d. Yes, as in the example of Singapore which has lost more than 99% of our original forests.
- e. Yes, wellness of urban dwellers only need to be provided with some plantings of trees, not ecosystems.

Question 6

Which is/are true of Singapore's landscape?

- a. During the colonial period, 90% of original forest had been cleared, and mainly for agriculture.
- b. Urbanisation accelerated from the point of self-governance in 1959.
- c. The period of greatest forest loss began from the 2000's.
- d. While the green visions of Singapore increased the area of managed vegetation of modern Singapore, it did not increase the area under nature reserves.
- e. Green spaces have not been connected with each other.

Question 7

What are critical steps in protecting core areas of high biodiversity in our nature reserves?

- a. Add buffer parks, i.e., green spaces directly connected with the nature reserves.
- b. Restore or enhance the forest in buffer parks and nature reserves.
- c. Increase the volume of visitors to these areas.
- d. Establish urban parks around Singapore.
- e. Clean up our waterways.

Question 8

Now that "City in Nature" is a key pillar of the SGP2030,

- a. Land allocated to nature parks will double.
- b. Accessibility to a park is guaranteed (within a 10-mins walk).
- c. All existing wooded areas in Singapore are protected from urban development.
- d. The number of nature reserves will increase.
- e. Connectivity of green spaces for all wildlife is achieved.

Question 9

What is the goal for ecological connectivity in Singapore?

- a. That parks and young forests will be connected with sources of greater biodiversity.
- b. That pollinating and seed-dispersing wildlife will be able to move between areas of source and sink.
- c. For wildlife to be directed towards urban areas to achieve a City in Nature.
- d. For aerial species alone to be able to move between forest patches.
- e. That all roads are eliminated between forest patches in Singapore.

Question 10

Why was Bukit Timah hill closed to the public in 2014?

- a. The ever-increasing number of visitors had led to soil erosion and compaction on trails.
- b. Sufficient political will by NParks to close the hill to visitors for at least six months.
- c. Central Catchment Forest Reserve is highly fragmented.
- d. Scientists had just recommended closure due to disturbances and the forest edge effect.
- e. The public had demanded for the hill to be recovered to a healthy state.

Question 11

What will the Ecological Profiling Exercise, announced in 2020, achieve?

- a. It will establish nature corridors by identifying and linking up source and sink habitats.
- b. It will evaluate green sites to understand their ecological profile and potential contribution towards ecological connectivity.
- c. It will eliminate all wildlife roadkills.
- d. It will be able to stop development of housing and transport where they conflict with nature.
- e. It will increase the area set aside as nature reserves.

Question 12

Where are our largest areas of native ecosystems in Singapore?

- a. The mature secondary forests of Bukit Timah and Central Catchment Nature Reserves
- b. The mangrove forests at Sungei Buloh Nature Park Network and Pulau Ubin
- c. The mangrove forests at Labrador Nature Reserve and Central Catchment Nature Reserve
- d. The old secondary terrestrial forests on Kent Ridge
- e. The rocky shores of the East Coast Park.

Question 13

How does “inherent inequities” factor into global climate change mitigation and adaptation?

- a. The countries and communities most at risk from climate change impact have contributed the least to greenhouse gas accumulation in the past and present.
- b. Through the emphasis that global solutions require richer nations to fund climate change adaptation and mitigation by poorer nations.
- c. The ecological footprint of developing countries is no different from that of developed countries.
- d. It does not factor in resolutions such as those at COP26, because these only examine current burdens to the environment.
- e. It does not as the past is not a factor in climate change negotiations.

Question 14

Which of the following is the highest source of global greenhouse gas emissions?

- a. Energy use in buildings
- b. Agriculture
- c. Deforestation
- d. Livestock
- e. Road transport

Question 15

Which of the following are challenges to becoming a self-sustained city which does not over-exploit the hinterlands?

- a. Citizens becoming complacent and not reducing their individual consumption patterns
- b. Lack of political will to invest in local food production
- c. The pandemic disrupting economies and key supply chains
- d. Lack of redundancy measures to ensure sufficient supply during resource shortage
- e. All of the options are relevant