Question 1

One often hears scientists proclaim, “extraordinary claims require extraordinary evidence”. Select the 2 options below that best express why this is so.

A. Confirmation bias requires it.
B. If an extraordinary claim were to be true, then some aspect of well-established science would require revision.
C. Scientists always require extraordinary evidence for any claim, not just extraordinary ones.
D. Scientists have their own hypotheses for some unusual event or observation, so any claim to the contrary will require more than just evidence, but extraordinary evidence, to change their mind.
E. Such claims typically fly directly in the face of our current understanding of the world, an understanding obtained from an extraordinarily large body of evidence.

Question 2

When scientists gather empirical evidence to support a hypothesis, which role is observation best described to be taking on here?

A. Developing an explanation to an as yet mysterious and unexplained phenomenon.
B. Ensuring that the observations haven’t been contaminated by expectation or belief.
C. Help figure out what’s relevant to the phenomenon.
D. Testing.
E. All of the above options.

Question 3

In Copernicus’ model of the solar system, all the planets moved in perfectly circular orbits and with uniform speed around the sun. This resulted in predictions of planet positions no better than Ptolemy’s. Which 2 of the following concerns did Copernicus not properly address when producing his model of the solar system?

A. Do we have a clear sense of what the relevant phenomena are?
B. Do we know for sure what is based on fact and what on conjecture or assumption?
C. Have our observations been contaminated by expectation of beliefs?
D. Have we considered any necessary comparative information?
E. Have we found a way to ensure we have not overlooked anything in the process of making our observations?

Question 4

Choose the option below that produces an incorrect statement:

Anomalous phenomena are important in science because…

A. …their resolution can lead to entire new fields of scientific study.
B. …their resolution can lead to new insights and understanding of nature.
C. …their resolution can lead to new instrumentation or experimental methods to study nature, allowing further new discoveries to take place.
D. …their resolution demonstrates the infallibility of well-established scientific theories.
E. …their resolution provides an excellent test of what is generally accepted to be true.

Question 5

Question on the CRAAP test. Not examined in the current curriculum.

Question 6

Which invention had the greatest impact on society during the industrial revolution?

A. Blast furnaces (for iron production)
B. Steam engine
C. Steam power pumps to allow more coal to be mined
D. Steam powered machines used in factories
E. Steam powered vehicles for transporting goods

Question 7 (revised for consistency with the current BDTK)

Consider rule 3 of the Baloney toolkit: “Is the claimant providing positive evidence?”. Which statement best characterises what it means?

A. “Cherry picking” evidence supporting the claim.
B. Data, that clearly constitutes evidence, only comprising positive numbers.
C. No trace of any physical evidence indicating a coverup.
D. Undeniable physical evidence that refutes alternative explanations.
E. Undeniable physical evidence that supports the claim.

Question 8

Select the two options that make population predictions most uncertain.

A. How many adults will survive to become elderly
B. How many children will be born
C. How many children will survive to become adults
D. How the fertility rate will change moving forward into the future
E. Mortality rates

Question 9 (this question was for when video 2.5 was part of the curriculum, now it is optional)

We are seeing a pattern where science improves our understanding of the world, which leads to technological developments that makes life better for people. We also have noticed that there are "side effects" that, to date, have not been adequately addressed. Match the "side effect" with the development that improved the lives of people. The industrial revolution resulted in a drop in human mortality, the cost of this was _____(i)_____. The Haber-Bosch process, along with other innovations, resulted in crop yields high enough to, in principle, feed everyone. The cost of this was _____(ii)_____.

A. (i) Dependence on the application of pesticides, increasing toxins in the environment substantially.
   (ii) A substantial decline of atmospheric nitrogen (N2), completely altering the critical nitrogen-to-oxygen ratio all organisms depend on.
B. (i) Dependence on burning fossil fuels, increasing CO2 in the atmosphere substantially.
   (ii) Dependence on the application of synthetic fertiliser, increasing reactive nitrogen in the environment substantially.
C. (i) Dependence on burning fossil fuels, increasing CO2 in the atmosphere substantially.
   (ii) A massive overproduction of Bosch resonators, increasing heavy metal pollution in the environment substantially.
D. (i) Dependence on plastic manufacturing resulting in microplastic pollution globally.
   (ii) Human overpopulation.
E. (i) Massive deforestation resulting in an extinction level event.
   (ii) Global temperatures increasing resulting in sea level rise.

Question 10

A strong correlation has been found between (a) the number of people who drowned by falling into a pool in a particular year and (b) the number of films Nicolas Cage appeared in a particular year. The strong correlation was demonstrated for all the years from 1999 to 2009, inclusive. Can this relationship be used to predict the number of people who drowned by falling into a pool in (i) 2007, and (ii) 2022, from the number of films Nicolas Cage appeared in 2007, and will appear in 2022?

A. (i) No
   (ii) No
B. (i) No
   (ii) Yes
C. The correlation clearly demonstrates that Nicolas Cage's appearance in films causes people to fall into pools are drown.
D. (i) Yes
   (ii) No
E. (i) Yes
   (ii) Yes

Question 11

A clairvoyant claims to see the future, and shows you testimonials of his many satisfied customers. You come up with 6 quite different experimental tests of his ability, and each time he replies, “My ability doesn’t work that way, I can’t predict that.” You then ask him what test you could perform? He hesitates, then answers: “No test. My ability won’t work on you.” You then ask, can someone else test you? And he says: “No, my ability doesn’t work with tests.”

(i) Is this person clairvoyant?
(ii) Is his ability of clairvoyance scientifically established, and why?

A. (i) Definitely no.
   (ii) No, it isn’t scientifically established because his ability is untestable.
B. (i) No.
   (ii) No, testimonials can be faked, altered, embellished, cherry picked etc. Not being able to test him objectively has nothing to do with it.
C. (i) Unknown.
   (ii) No, it isn’t scientifically established because his ability is untestable.
D. (i) Yes.
   (ii) No, testimonials are not scientific evidence. Not being able to test him objectively has nothing to do with it.
E. (i) Yes.
   (ii) Yes, testimonials are clear evidence of his ability. Not being able to test him objectively has nothing to do with it.

Question 12

It is observed that the greater the pressure inside a can of coke, the greater the “fizz” you get when you open it and pour out the coke into a glass. This observation is explained by stating that the greater the pressure of a gas above a liquid, the more the gas dissolves into the liquid. We get more fizz with the higher pressure because more gas is dissolved in the coke. Which explanatory strategy best describes this explanation, i.e., when we state “the greater the pressure of a gas above a liquid, the more the gas dissolves into the liquid”?

A. Causal mechanism
B. Cause and effect
C. Function
D. Laws
E. Underlying processes

Question 13

You are home alone, and you suddenly wake up in the middle of the night by a very loud bang, similar to a door slamming closed. Use Occam's razor to choose two explanations for the phenomenon.

A. A person you were expecting to come home very late must have slammed a door.
B. The creepy person you saw earlier today at the MRT must have somehow followed you home without you noticing, got into your home, and banged a door very hard.
C. Your home is now, quite obviously, haunted, and this proves it.
D. You must have forgotten to close all the windows, so the wind blew shut an open door in your home.
E. Your neighbour's dog escaped from their home, clawed open a window in your home and got in, but the open window allowed the wind to blow shut an open door in your home.

Question 14

Although we defined physical models to be actual physical objects like a globe or a ball-n-stick chemical structure, sometimes scientists, using diagrams and figures accompanied with mathematics, describe these types of models as physical models if their diagrams and maths are being directly related to physical objects in the real world. However, according to lecture 3 we would classify this as a combination of two types of models. Select the two types below:

A. computer model
B. conceptual model
C. maths model
D. physical model
E. real world model

Question 15

(i) You find the keys to your home missing. You could have misplaced them in your home, or lost them on the way home. You speculate that you misplaced them at home, so you search it, but can't find them. You conclude that you lost them outside, so get new keys cut. A week later a family member finds them under the sofa, where you didn't check. This is an example of what type of error?

(ii) Sometimes an experiment produces amazing results with an equally fantastic explanation. However, upon further investigation by the scientific community the amazing results and explanation are proven wrong. This is an example of what type of error?

A. (i) false confirmation
   (ii) false confirmation
B. (i) false confirmation
   (ii) false rejection
C. (i) false rejection
   (ii) false confirmation
D. (i) false rejection
   (ii) false rejection
E. None of the options above.

Question 16

Of critical importance for published research papers in reputable scientific journals is that each paper has been thoroughly _____ by several world experts in the field.

A. heavily criticised
B. paid for
C. peer reviewed
D. praised
E. reworded

Question 17 (revised for consistency with the current content on accuracy and uncertainty)

An instrument was used to measure the level of toxic chemicals in water. The instrument was accurate, but had high uncertainty in its individual readings.

(i) Does this instrument possess a large systematic error?

(ii) Can a single reading from this instrument be expected to always give a result very close to the true value?

A. Incorrect question. Because the instrument possesses a high uncertainty, it can not possibly be accurate in the common definition of accuracy.
B. (i) No
   (ii) No
C. (i) No
   (ii) Yes
D. (i) Yes
   (ii) No
E. (i) Yes
   (ii) Yes

Question 18

Choose the 3 options that, when combined, best describe a randomised controlled double-blind trial.

A. Double-blinds are used to physically separate experimental and control groups.
B. The subjects do not know if they are in the experimental or control group.
C. The subjects are randomly picked.
D. The subjects are randomly picked to go into either the control or experimental group.
E. Those working with the subjects do not know if the subjects are in the experimental or control group.

Question 19

In the research article, "Maternal Intuition of Fetal Gender", McFadzen et al., *J. Patient Cent. Res. Rev.*, **4** (2017) 125 – 130, 53 pregnant women claimed they had strong intuition regarding the gender of their baby. Of these 53 women, 33 predicted their baby's gender correctly. The margin of error for this experiment is ±13% at the 95% confidence level. Can we conclude with 95% confidence that these women indeed possess intuition about the gender of their baby and why? Choose the correct answer (choose either yes or no) and reason (choose a percentage ±13% option).

A. 33% ±13% does not include 50%
B. 50% ±13% includes 50%
C. 62% ±13% includes 50%
D. No
E. Yes

Question 20

A randomised controlled double-blind trial was used to determine if people felt much happier after drinking water containing a "special" tasteless additive. The control group were given regular water to drink. The experimental group were given water with the "special" tasteless additive. There was 50 people in each group. 20 in the control group said they felt much happier, whereas 26 in the experimental group said they felt much happier. Does this experiment demonstrate, at the 95% confidence level, that the "special" tasteless additive makes people feel happier? Choose the correct answer (choose either of the options starting with "Yes…" or "No…") and the rule of thumb you applied.

A. No, the difference is probably not statistically significant at the 95% confidence level.
B. The overlap of the CIs is greater than one-third of the range covered by the two CIs.
C. The overlap of the CIs is less than one-third of the range covered by the two CIs.
D. There is no overlap between the CIs of the two groups.
E. Yes, the difference is statistically significant at the 95% confidence level.