1. What is **science**?
   A) A search for order and explanation of our physical surroundings.
   B) A method for gathering, categorizing, analyzing, and using information to explain the physical universe.
   C) A static collection of unchanging facts.
   D) A rigid set of unchanging rules.
   E) Both A and B, but not C and D.
   F) Both C and D, but not A and B.

2. ***Ben-Hur***, ***Titanic***, and ***LOTR: Return of the King*** are the three movies which have earned the most Academy Awards (11 Oscars each). Why were we even discussing this in a physical science class?
   A) The number of Oscars earned by a movie is an objective measurement of the quality of the film. Everyone agrees that these three movies are the best movies in the history of cinema.
   B) This is an example of a measurement which does not objectively quantify a property.
   C) No idea. Maybe the instructor just likes bad movies?

3. If I say (as I did in class), "Titanic is 195!", how do you respond? (Choose the response consistent with the context of our in-class discussion!)
   A) "Yes! 195 is the best possible number, and Titanic is the best possible movie, so I agree completely!"
   B) "Yes! 195 is divisible by 7, and Titanic has 7 letters. It can't possibly be a coincidence!"
   C) "No! A number is not a movie, and even if it was, it couldn't possibly be a ship as well. You're insane."
   D) "Maybe...it depends on what you mean by '195.' Without units, I don't understand your statement!"

4. In the English (or Imperial) system of units, length is measured in **feet**. What is the referent for this measurement?
   A) A foot is literally derived from the average length of a human foot.
   B) A foot is the approximate average length of a human stride.
   C) If you stand with your feet centered below your hipbones, the distance between them is a foot.
   D) The length of a roll of paper (or foolscap) was standardized during the late Renaissance to be 1 foot.

5. Who uses the English (or Imperial) system of units?
   A) Everyone; this is the agreed-upon standard system for all of the countries in the world.
   B) No one; this system fell out of favor in the late 1700s, and has not been used since.
   C) Hardly anyone; only the Unites States, Liberia, and Myanmar still use this system.

6. Metric (Système Internationale) units are based on
   A) the body measurements of Louis XVI, the king of France in the late 1700s.
   B) a mystery. The system dates all the way back to the ancient Greeks, and no one knows how it developed.
   C) the hexadecimal system: units are all multiples of powers of 16, which is actually $2 \cdot 2 \cdot 2 \cdot 2$, or 2^4.
   D) the decimal system: units are easily divided or multiplied by factors of 10 to convert (i.e., 100cm = 1m).

7. **True or false:** The Newton (unit of force) is a derived unit.

8. Which of the following is not a **fundamental unit**?
   A) length
   B) mass
   C) time
   D) velocity
   E) electric charge
   F) These are all fundamental!

9. How long is one **metric second**?
   A) A metric second is approximately 1/10 of an English (or Imperial) second.
   B) A metric second is approximately 1.1 times longer than an English (or Imperial) second.
   C) A metric second cannot be measured, so it cannot be compared to an English (or Imperial) second.
   D) Trick question! A second is a second. There is no difference between a "metric" or an "English" second!

10. If you are measuring the mass of a person, what units would be the most appropriate?
    A) nanometers = 10^{-9}m
    B) milligrams = 10^{-3}g
    C) centimeters = 10^{-2}m
    D) kilograms = 10^{3}g
    E) megatons = 10^{6}tons
    F) terabytes = 10^{12}bytes

11. A **longitudinal** data set consists of
    A) one piece of information collected one time from one subject (or experiment).
    B) one piece of information collected one time from a large number of subjects (or experiments).
    C) the same piece of information collected from the same subjects (or experiments), repeated over time.
    D) information collected from subjects who live (or from experiments performed) along the same line of longitude on the globe.

12. When you calculate a **ratio**, what are you actually doing?
    A) Comparing. A ratio, or fraction, just compares two quantities.
    B) Graphing. Calculating a ratio is the same thing as constructing a pie chart.
    C) Judging. By constructing a ratio, you are judging which of the quantities is actually better.
    D) Math. The calculation of anything is just math, and does not have any relationship to the actual physical world.

Trial	diameter d (cm)	circumference c (cm)	ratio c/d (unitless)
1	20	62.5	3.125
2	40	125	3.13
3	60	189	
4	80		

13. Complete the Trial 3 row of table above by calculating the ratio of circumference to diameter. Answer numerically, with two decimal places (and no units).

14. Using the above table as a reference, predict the circumference of a circle with diameter $d = 80$ cm. Answer numerically, rounding your answer to the nearest integer (no decimal places or units).

15. **True or false:** For any circle you decide to measure, the ratio c/d will be the same constant value.

16. A cube of aluminum has sides with length $l = 2$ cm. When measured on a balance, its mass is $m = 23.1$ g. Calculate the density of the cube.
    A) 2.89 g/cm^3
    B) 5.78 g/cm^3
    C) 11.6 g/cm^3
    D) 46.2 g/cm^3
    E) 92.4 g/cm^3
    F) 185 g/cm^3

17. The force of gravity follows an **inverse-square** law. Let's say you increase the distance between two masses, from r_1 = 1m to r_2 = 2m. What happens to the gravitational force between the masses as a result?
    A) Double the distance, ½ the force.
    B) Double the distance, ¼ the force.
    C) Double the distance, no change in the force.
    D) Double the distance, 2× the force.
    E) Double the distance, 4× the force.

18. Why do we care about this inverse-square behavior?
    A) We don't. It's a pointless math trick.
    B) This behavior is unique to gravity, and science is always interested in unique or unusual things.
    C) This behavior shows up all over physics, so understanding it for gravity means understanding it when we see it the next time.

19. Why do scientists use equations?
    A) They are just showing off, trying to impress us with their so–called Fourier transforms and fancy second–order partial differential equations. It makes them feel superior to confuse the rest of us with complicated math stuff.
    B) Science cannot be done without equations; the only way to find scientific answers is mathematically.
    C) Equations are a concise and convenient way to express ideas, and can be used to make precise predictions.
    D) Mostly because they are pretty geeky, and can't really communicate normally with words, like the rest of us

20. The steps of the **scientific method**
    A) are flexible; when science gets done in the real world, the steps may not be followed in order.
    B) are rigid: science cannot make progress except when the steps are followed precisely and in order.
    C) are unimportant: the important thing about science is that once an idea becomes established, it is
    D) immutable and does not ever change.
    E) are mysterious: nobody really knows what the scientific method is. When something important gets discovered, it's usually because the discoverer just got really lucky.

21. The steps of the **scientific method**
    A) are linear. Each step in the process must be followed in order, or you cannot expect to achieve reproducible results.
    B) are exhausting. There are so many steps involved that no one actually understands them or follows them.
    C) are iterative. When science gets done in the real world, the process of inquiry, experimentation, and revision may repeat itself many times.
    D) are imaginary. Scientists don't actually have a process they follow. Like artists, they create scientific theories with their imagination. The results are typically untested, because they are usually untestable!
    E) are random. Scientific progress almost always occurs randomly, when a scientist makes a discovery by accident while looking for something else.

22. An **hypothesis** is best defined as
    A) an untestable conjecture.
    B) an educated and testable guess that explains a phenomenon.
    C) a partially–tested set of ideas that explains some part of nature.
    D) a discarded set of ideas that explains some part of nature falsely or incorrectly.
    E) a well–tested set of ideas that explain some part of nature, and which everyone has accepted as true.

23. How does an hypothesis differ from a theory?
    A) An hypothesis is a wild, crazy guess. A theory is an informed, or educated, guess. Neither has been proven.
    B) An hypothesis is an educated guess that has been tested. A theory is a random idea that can't be proved.
    C) An hypothesis is an educated guess. It can become a theory after is has been well–tested and is not shown to be false.
    D) There is no difference; the words actually mean the same thing, but tend to be used differently. People typically say "hypothesis" when they mean a respected idea, but call something they think is crazy a "theory."

24. How does a scientist choose between competing hypotheses?
    A) Eenie, meenie, miney, moe: catch hypothesis by the toe. If it hollers, let it go and try another one. Maybe next time if you tap it on the shoulder politely instead of lunging at its feet it won't holler so much.
    B) A scientist usually chooses the hypothesis that fits best with his or her preconceived notions.
    C) He may not really have to choose; as more experiments or observations are performed, some of the competing hypotheses may be eliminated as they are shown to be false.
    D) A scientist should not ever choose, because all hypotheses are equally valid. The point of science is to keep an open mind, and you can't do that if you are eliminating some of the possibilities.

25. When presented with experimental evidence which contradicts or disproves his hypothesis, a scientist must
    A) always throw away the entire hypothesis and start over from scratch.
    B) continue to support his hypothesis without modifying it. Experiments are meaningless.
    C) resign from his research group. Scientists who can't prove their hypotheses are no scientists at all.
    D) examine both the evidence and the hypothesis. The experiment may need to be redesigned, or the hypothesis may need to be revised–or maybe both.

26. A **law of nature** is best defined as
    A) an untestable conjecture.
    B) an educated and testable guess that explains a phenomenon.
    C) a partially–tested set of ideas that explains some part of nature.
    D) a discarded set of ideas that explains some part of nature falsely or incorrectly.
    E) a well–tested set of ideas that explains some part of nature, and which everyone has accepted as true.

27. Why do we call it "Einstein's *Theory* of Relativity?"
    A) Because it has been tested repeatedly for over a hundred years, and never shown to be false.
    B) Because it's only a theory, and like all theories, nobody can really say if it's right or wrong.
    C) Because Einstein was brilliant, and almost everything he said is automatically true.
    D) Because it's an untested idea. Once someone figures out a way to test it, it can become an hypothesis (if it holds up to experiment).

28. People who are left-handed have a shorter average lifespan than their right-handed counterparts. This is an example of a(n)
    A) fun fact!
    B) unbiased opinion.
    C) scientific theory.
    D) testable hypothesis.
    E) unbreakable law of nature.

29. People born in September under the sign of Virgo are more analytical and scientific than average. This is an example of a(n)
    A) fun fact!
    B) unbiased opinion.
    C) scientific theory.
    D) testable hypothesis.
    E) un-testable guess.

30. Which of the following is not an indicator of pseudoscience?
    A) Using words that sound professional or scientific in a misleading or incorrect way.
    B) Substantial reliance on anecdotal evidence.
    C) Claims which cannot be proven false.
    D) Absence of adequate peer review.
    E) These are all hallmarks of pseudoscience!

31. Which of the following is an example of a pseudoscience?
    A) Astronomy
    B) Geology
    C) Biology
    D) Chemistry
    E) Physics
    F) Astrology

32. Which of the following is an example of genuine science (as opposed to pseudoscience)?
    A) Astronomy.
    B) Astrology.
    C) ESP.
    D) Reincarnation.