

Earth Science Today

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Earth Science Today, Final Exam

This exam is not about how much you know. Rather, it is about being scientifically literate. Scientific literacy means that you can read and understand science, you can interpret the results of experiments or observations, and you can predict what will happen in various situations given your understanding of earth science. Do you *understand* how things work, how we know things, and what things mean?

Thus, for this exam, you need to *use* what we discussed in lecture to solve new problems in earth science or predict various outcomes of events. The questions often require, not that you know what I said in lecture, but that you understand what it means and can identify its significance in a new situation.

1) In the laboratory, you melt a granitic (coarse grained) rock and a rhyolitic (fine grained) rock at the same temperature. Then you cool them both slowly, at the same rate, over a period of a few minutes or hours. The result is that

- a) both will now resemble the granite
- b) both will now resemble the rhyolite
- c) the granitic rock will once again look granitic and the rhyolitic rock will look like rhyolite
- d) the granitic rock will look like rhyolite and the rhyolitic rock like granite

2) Two catastrophes common on Earth are Hurricane and Earthquake. Which pair below are the correct basic energy sources for each (Hurricane:Earthquake)

- a) sun:remnant kinetic energy
- b) sun: radioactive decay
- c) remnant kinetic energy: radioactive decay
- d) radioactive decay: radioactive decay

3) Convection in the Earth's mantle

- a) is what makes the Earth's interior hot, by friction
- b) contributes to motion that causes earthquakes
- c) is caused by earthquakes
- d) generates radioactive heat, a fundamental source of energy

4) Gases cause volcanoes to be explosive because

- a) gas burns, generating energy
- b) gases are hotter than rock, causing explosive eruptions
- c) gases can compress and then reexpand, expelling magma from the earth
- d) gases are very poisonous, killing many people

5) Which most correctly describes where gases in a volcanic eruption come from

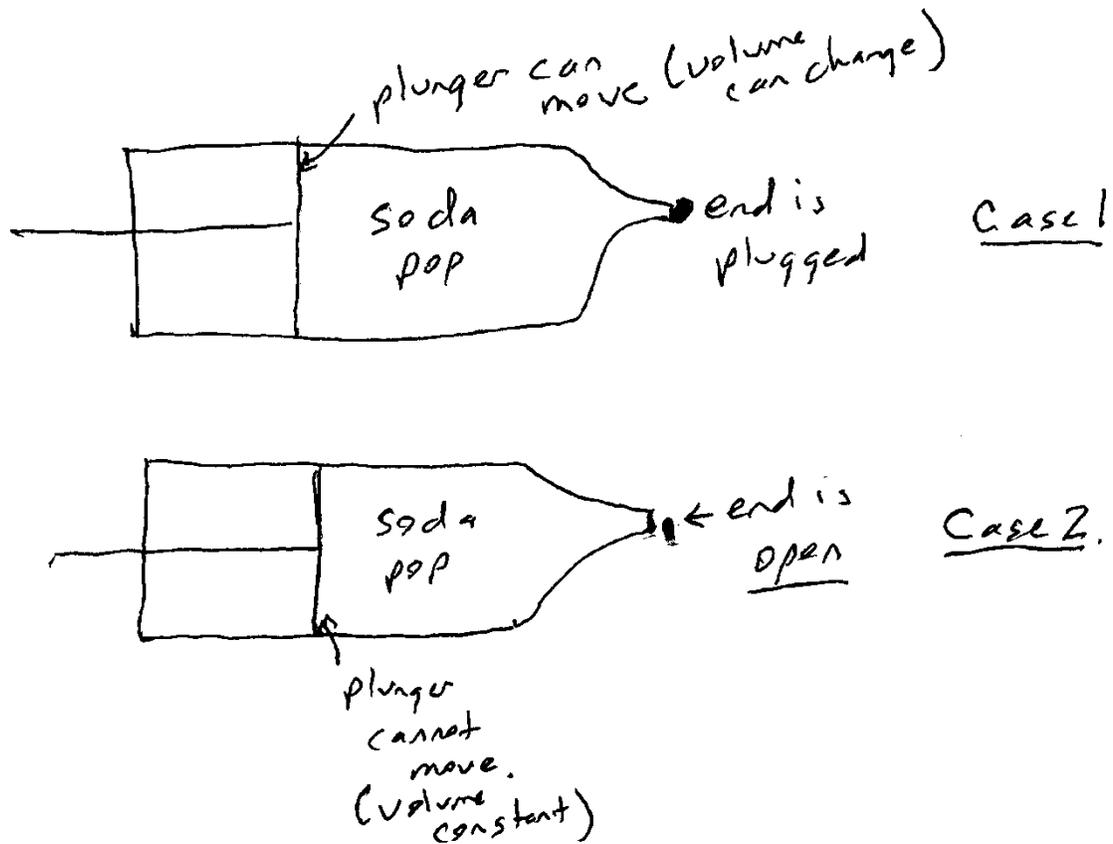
- a) gases are present as part of the magma, then bubble out as a gas
- b) gases come from deeper in the earth than the magma
- c) gases come from less deep in the earth than the magma
- d) gases come from the combination of baking soda and vinegar deep in the volcano

6) People did not always agree that basalt had formed from a volcanic eruption because most basalt was old and no one had ever seen it when it was molten. Also, the volcano the basalt came from may have eroded away and not be visible any more. Which of the following would best suggest that basalt indeed was once molten material?

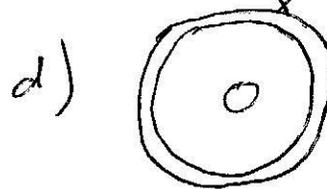
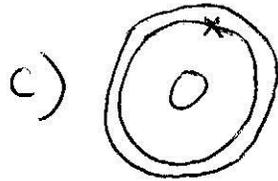
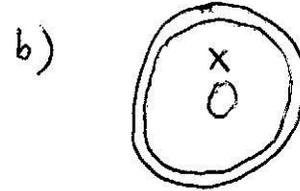
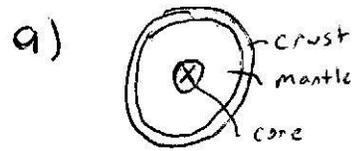
- a) layers above and below the basalt which contain fossils of sea creatures
- b) bubbles in the basalt
- c) basalt is made of many different types of minerals
- d) basalt sometimes contains fossil tree imprints

7) Examine each figure below. Consider that in each case the soda pop is agitated so that carbonation exsolves (undissolves). What will happen in each case?

- a) case 1: The plunger moves to the right case 2: no liquid is expelled
- b) case 1: The plunger moves to the left case 2: liquid is expelled
- c) case 1: The plunger moves to the right case 2: liquid is expelled
- d) case 1: The plunger moves to the left case 2: no liquid is expelled



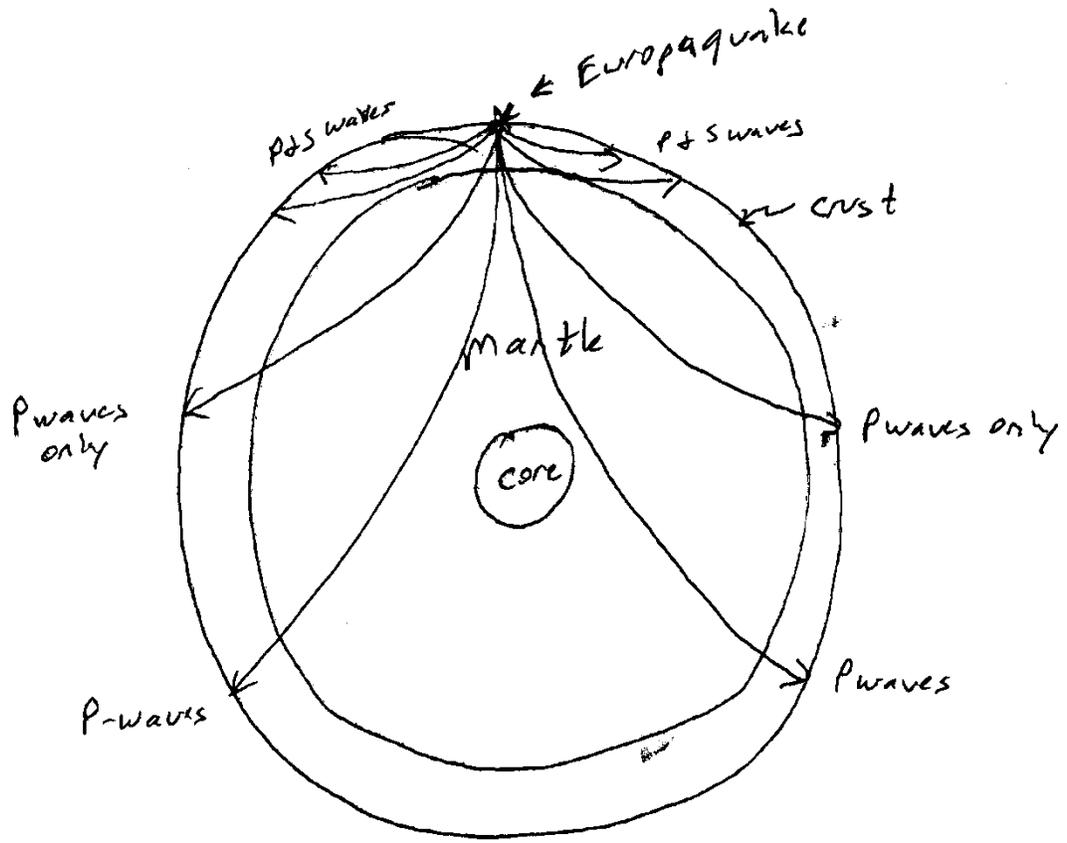
8) Examine each figure below (each is a cross-sectional view of the Earth). Which most accurately illustrates where lava comes from (at the X)?



- 9) Which of the following conditions are beneficial to earthquake occurrence
- a) little regional movement, hot, high pressure
 - b) little regional movement, cold, low pressure
 - c) significant regional movement, hot, high pressure
 - d) significant regional movement, cold, low pressure

10) Suppose that the following data was derived by a seismograph network set up on the Jovian moon Europa. What is one clear difference from Earth illuminated by the seismic data?

- a) Europa is larger
- b) The European Mantle is solid
- c) The European Mantle is liquid
- d) Earthquakes produce different waves on Europa



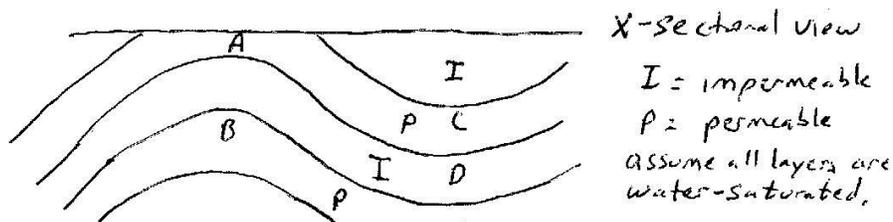
11) Consider the separation of glass and wooden marbles by adding water to them in a beaker. The *property* that allows them to be separated is

- when water is added, one of them floats and the other doesn't
- they have different densities
- The two materials have different chemical properties and react differently with water
- adding water causes the two materials to chemically react differently and separate

12) Consider the separation of salt from sand by adding water to salt+sand in a beaker. The *process* that separates them is

- when water is added, one of them floats and the other doesn't
- they have different densities
- The two materials have different chemical properties and react differently with water
- adding water dissolves the salt and it can then be poured off with the water

13) Oil is less dense than water. Liquids can move through permeable but not impermeable rocks. Where would oil most likely accumulate in the illustration below?

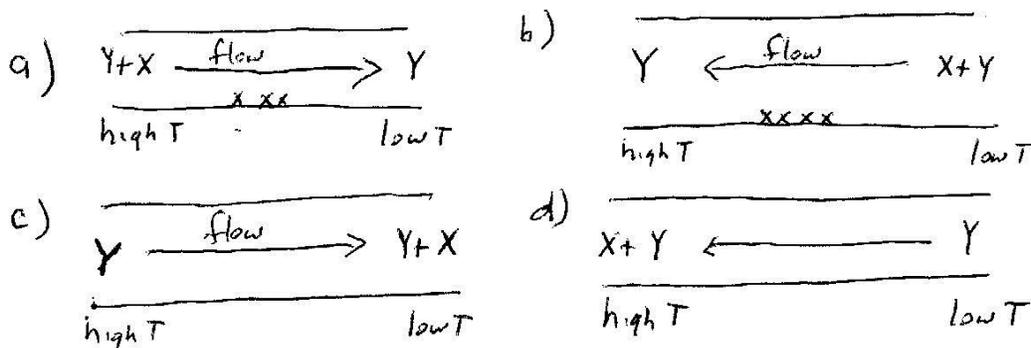


- a) A
- b) B
- c) C
- d) D

14) Infer the necessary chemical relationship from actual observations: At depth in a water-well conditions are typically lower-oxygen than at the surface. With less oxygen, iron is in the form FeO, with more oxygen, iron is in the form Fe₂O₃. There is lots of iron in my well water (out in the country). I can tell because of all the iron that accumulates on the screen in my hose where it comes in contact with air.

- a) FeO dissolves in water and is therefore found on the screen of the hose
- b) Fe₂O₃ dissolves in water and is therefore found on the screen of the hose
- c) FeO dissolves in water, and Fe₂O₃ is found on the screen of the hose
- d) Fe₂O₃ dissolves in water, and FeO is found on the screen of the hose.

15) Y is dissolved in a magma at a given temperature. X also dissolves in the magma at higher temperatures. Which of the following would allow X to be separated from a magma in which it was dissolved (consider that the magma is moved through a tube in which the temperature at different points in the tube can be controlled)?



16) Partitioning is represented as the percent of a chemical component in material X/percent of that same component in material Y. For example, suppose that you have an ice cube in equilibrium with water. Suppose that only 0.01% of the ice cube was salt, but 10% of the water was salt. The partitioning for salt between ice and water would be 1/1000 (this is not its actual value which is even lower).

You add 10 grams of salt to 1000 grams of water. You freeze 10 grams of the water. How much salt (about) will be left in the liquid water?

- a) about 10 grams salt
- b) about 9 grams salt

- c) about 5 grams salt
- d) less than one gram of salt

17) Considering the same scenario as above, the concentration of salt in the original water is 10/1010, or 0.99% salt. If you froze half of the water, the concentration of salt in the remaining liquid water would be most close to:

- a) 0.1%
- b) 1%
- c) 1.1%
- d) 2%

18) A pollutant has a low partition coefficient between clay (clay is present in soil and sediment) and water, such that concentration in clay/concentration in water is a very small number. The pollutant is spilled in an area above an aquifer (water underground in the rock). There is a thick layer of clay-rich permeable sediment between the surface and the aquifer. The pollutant

- a) will not reach the aquifer because it will become chemically attached to the clays
- b) will reach the aquifer because it will not become chemically attached to the clays
- c) we cannot predict whether the pollutant will stay with the water or the clay

19) The Earth's core is thought to be mostly Iron. It is believed to have separated from the rest of the Earth during and early chemical differentiation of the Earth. We know from laboratory experiments that the partition coefficient for potassium (K) between iron and the silicate (rocky) material the rest of the Earth is made of is very low. %K in iron/%K in silicate is <0.1 . This means we should expect that

- a) The concentration of K in the mantle is greater than both that in the Earth's core and that in the original undifferentiated Earth
- b) The concentration of K in the mantle is less than both that in the Earth's core and that in the original undifferentiated Earth
- c) The concentration of K in the mantle is greater than that in the Earth's core but less than that in the original undifferentiated Earth
- d) The concentration of K in the mantle is less than that in the Earth's core but greater than that in the original undifferentiated Earth

20) On a separate sheet of paper, identify the **2 properties** that permit the following differentiation that produces Chromium ore: A magma is cooling at depth. As it cools, one of the first materials to solidify is chromite, a mineral rich in chromium. Chromite is denser than the magma, and sinks, forming a layer of Chromite at the bottom of the magma chamber.

21) A fine-grained sedimentary rock indicates

- a) a high-temperature high-pressure environment of formation
- b) rapid cooling (like lava from a volcano)
- c) slow cooling (like magma deep in the earth)
- d) a high-energy environment of deposition (like a swift river)
- e) a low-energy environment of deposition (like a deep lake)

22) A fine-grained igneous rock indicates

- a) a high-temperature high-pressure environment of formation
- b) rapid cooling (like lava from a volcano)
- c) slow cooling (like magma deep in the earth)
- d) a high-energy environment of deposition (like a swift river)
- e) a low-energy environment of deposition (like a deep lake)

- 23) A coarse-grained metamorphic rock indicates
- a) a high-temperature high-pressure environment of formation
 - b) rapid cooling (like lava from a volcano)
 - c) slow cooling (like magma deep in the earth)
 - d) a high-energy environment of deposition (like a swift river)
 - e) a low-energy environment of deposition (like a deep lake)

- 24) Which of the following best describes why there is sand at a beach
- a) The sand is just what happened to be in that area
 - b) Beaches can only form in areas where there is sand
 - c) The waves wash the sand up on the beach but don't wash other stuff up there
 - d) The waves wash mud and other small sediment away, leaving the sand

- 25) With respect to sedimentary rocks, the phrase "the present is the key to the past" means
- a) We study rocks formed in the past in order to know what has happened in the past
 - b) Sediments present in modern environments can give us clues to the kind of sediments likely deposited in past environments
 - c) If we don't understand the past, we are doomed to repeat it
 - d) Since we can't go back into the past with a time machine, we need to look at things that have been preserved until the present time to figure it out

- 26) Many creatures eat by filtering food out of sea water (for example, some Echinoderms do this). If we find abundant fossils of filter feeders in a rock, what might we most confidently infer about the environment in which that rock formed?
- a) It was terrestrial (land environment such as river, lake, etc)
 - b) It was cold
 - c) It was warm
 - d) It was not turbid (muddy) water

27) Pick 1 of the following phyla, and draw a picture of one representative of that phylum, labeling the drawing appropriately (giving the name of the phylum you chose). Do your drawing on a separate sheet of paper. Echinoderms, Arthropods, Molluscs, Brachiopods, Cnidaria, Bryozoa, Porifera

28) Pick a second of the phyla in question 27 and draw a picture of it on a separate sheet of paper.

Rock layers tell the story of sequences of events that affected a particular region. Some of the rock layers of western North America in which we find dinosaur fossils are the following, with the oldest being shown on the bottom:

Pierre Shale (rock formed from mud with mosasaurs, ammonites, and other sea creatures)
Dakota Sandstone (well sorted sandstone with symmetrical ripple marks)
Morrison Formation (sandstones and siltstones with petrified wood and dinosaur bones)
Sundance Formation (marine sandstones and shales with sea fossils in them)

- 29) The presence of shale on top of the Dakota sandstone tells us that
- a. an ocean was advancing across the land during this time
 - b. an ocean was retreating from the land during this time
 - c. an ocean was present during this time and mostly unchanging in its extent
 - d. the ocean was gone from the land during this time

30) The presence of Morrison on top of Sundance tells us that

- a) An ocean retreated during this time
- b) An ocean advanced during this time
- c) There was no ocean during this time
- d) There was only ocean during this time

31) The sequence of sediments beneath the Red River Valley is as follows:

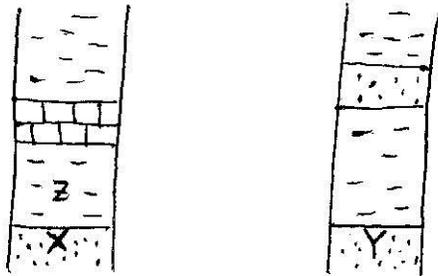
on top	Fine mud
	sandy, silty sediments with wood fragments and beetles
	fine mud
	poorly sorted mixture of mud, sand, and gravel
	fine mud
on bottom	poorly sorted mixture of mud, sand, and gravel

The sequence of events recorded by this sequence is (with oldest being listed first)

- a) glacier, lake, glacier readvances, lake again, lake retreats, lake returns
- b) Glacier, lake, lake retreats, lake again, glacier readvances, lake again
- c) lake, glacier, lake readvances, glacier again, glacier retreats, glacier again
- d) lake with beach, lake retreats, glacier advances where lake was, glacier melts and forest forms, lake returns

Consider the two stratigraphic columns below.

32) The sequences (story) of ocean advances and retreats affecting the regions of both columns is



- a) advance then retreat
- b) advance, retreat, advance
- c) retreat then advance
- d) retreat, advance, retreat

33) Still considering the columns in question 32, which is older:

- a) X is older than Y
- b) Y is older than X
- c) Y and X are the same age
- d) one can't tell which is older

34) Still considering the columns in question 32, which is older:

- a) Y is older than Z
- b) Z is older than Y
- c) Z and Y are the same age

d) one can't tell which is older

Pierre Shale (rock formed from mud with mosasaurs, ammonites, and other sea creatures)

Dakota Sandstone (well sorted sandstone with symmetrical ripple marks)

Morrison Formation (sandstones and siltstones with petrified wood and dinosaur bones)

Sundance Formation (marine sandstones and shales with sea fossils in them)

35) The sequence of events recorded by these rocks is

- a. mountains were built, then eroded away, then more mountains came
- b. an ocean over North America gave way to land, then the sea returned
- c. First there was an ocean, then there was a forest, then, after the forest came the dinosaurs
- d. First there was an ocean, then there was an ocean with dinosaurs, then there was land

36) A key feature of mountain ranges that is consistent with the theory of plate tectonics is

- a) circular shape
- b) linear shape
- c) found mostly on old continents
- d) occur mainly in the deep interiors of continents

37) On a separate piece of paper, draw in cross-sectional view a convergent plate tectonic boundary, showing mountains (if present), trench (if present), subducted slab (if present), and volcanoes (if present).

38) You look up in the sky and see 2 objects one night:

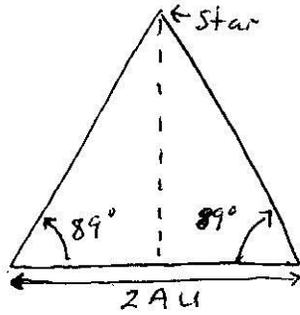


Several months later you only see one object:



- a) the square is farther away than the circle
- b) the circle is farther away than the square
- c) they are the same distance away
- d) one can't tell which is farther away.

39) Consider the diagram showing the methods of triangulation. Suppose that the parallax angle to a star

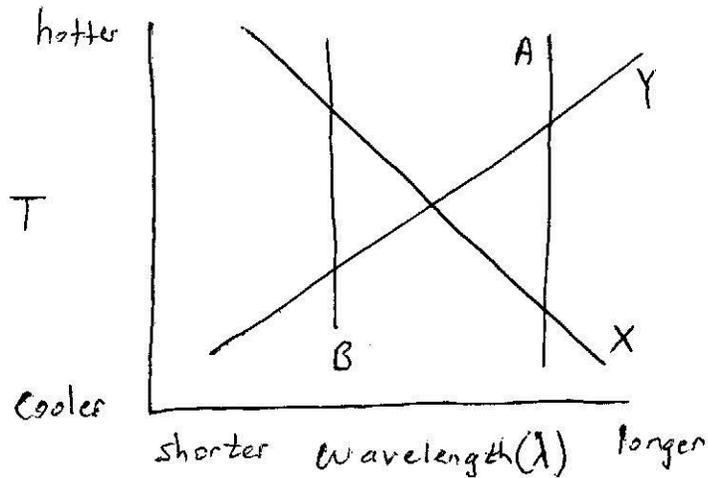


yields the illustrated angles. The distance to the star is about

- a) about 2 AU
- b) about 4.5 AU
- c) about 57 AU
- d) about 89 AU

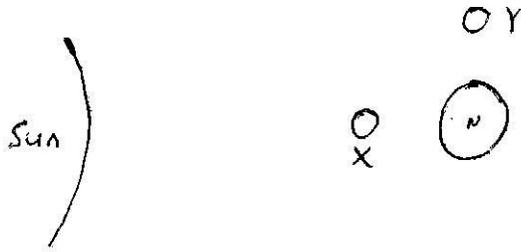
40) Cepheid variables allow us to determine distances to stars that are too far way to measure a parallax angle (the angle is too small to measure). What is the relationship that allows us to determine the stars true brightness?

- a) brightness is proportional to distance
- b) apparent brightness is proportional to distance
- c) brightness is proportional to the rate at which the brightness varies
- d) brightness is proportional to temperature



41) Which is the correct illustration of blackbody radiation. (hint, visible light has a wavelength (λ) that is shorter than infrared radiation).

- a) curve X is the correct curve, A is Earth, B is the Sun
- b) curve X is the correct curve, B is Earth, A is the Sun
- c) curve Y is the correct curve, A is Earth, B is the Sun
- d) curve Y is the correct curve, B is Earth, A is the Sun



42) Consider the diagram showing the Sun and Earth, with the Moon in two different locations. The Moon will be

- a) full Moon at X, half disk lit (quarter moon) at Y
- b) full Moon at Y, half disk lit (quarter moon) at X
- c) New Moon at X, half disk lit (quarter moon) at Y
- d) New Moon at X, 3/4 disk lit at Y

43) Continuing to consider the diagram for question 42, how much of the Moon is illuminated by the Sun?

- a) 1/2 at Y, all at X
- b) 1/2 at Y, none at X
- c) 1/4 at Y, none at X
- d) 1/2 at Y, 1/2 at X

44) Continuing to consider the diagram for question 42, the time that passes between position Y and X is about how many "Moon days"?

- a) 1/4
- b) 1/2
- c) 1
- d) 2

45) Continuing to consider the diagram for question 42, the time that passes between position Y and X is about how many "Earth days"?

- a) 1/4
- b) 1
- c) 2
- d) 7

46) The Northern Hemisphere is colder in the Northern Hemisphere winter than in the summer because

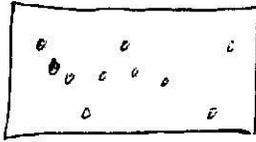
- a) the Earth is farther from the sun
- b) The sun is more directly overhead
- c) the length of the period of daily insolation is less
- d) the sun cools off in the winter time



47) Consider the configuration of the Earth and Sun shown (the Earth's axis of spin is also shown, the Earth's plane of orbit about the Sun is horizontal in this picture).

- a) This illustrates the N. Hemisphere winter, days at the North Pole are 12 hours long
- b) This illustrates the N. Hemisphere summer, days at the North Pole are 12 hours long

- c) This illustrates the N. Hemisphere summer, days at the North Pole are 0 hours long
 d) This illustrates the N. Hemisphere summer, days at the North Pole are 24 hours long



48) Meteorites fall on the region shown below at a rate of about 1 meteorite per 100000 years. How old is the surface shown?

- 100000 years
- 1000000 years
- 2000000 years
- the age cannot be determined this way

49) When looking at an image of Mars, you notice that some areas have many craters and others have very few. This tells us that

- a. Mars was not all created at the same time, but some parts were created first and then the parts were put together later
- b. The number of craters cannot be used to tell us the age of the surface of different areas on Mars
- c. The different areas have been affected by resurfacing processes at different times in Mars' history
- d. Meteorites come from different parts of the sky and so hit some parts of Mars more often than others

50) Which one of the following has not affected both the Earth and the Moon?

- a. meteorite impacts
- b. erosion from running water
- c. shifting and moving of rock due to gravity
- d. eruptions from volcanoes

51) The average density of undifferentiated solar system material (excluding gases) is about 40 kilograms per cubic meter (simplified for this problem). Based on visual analysis, you measure the volume of one asteroid and find it to be 12 cubic meters. The mass of the asteroid is 960 kilograms as determined from gravity measurements. A 2nd asteroid is 36 cubic meters in volume and has a mass of 1440 kilograms. Which of the following is correct. (Note: Larger planetesimals got hot enough to chemically differentiate, smaller ones did not. Then later, the larger ones got smashed apart and the differentiated segments became their own asteroids.)

- a) Both of the asteroids are undifferentiated and have never been part of a larger planetesimal
- b) Both of the asteroids are differentiated and were part of larger planetesimals
- c) The first asteroid is differentiated and was part of a larger planetesimal but the 2nd asteroid is undifferentiated and was not part of a larger planetesimal
- d) The second asteroid is differentiated and was part of a larger planetesimal but the 1rst asteroid is undifferentiated and was not part of a larger planetesimal

52) Which of the following is evidence that there was catastrophic planet-wide volcanism on Venus about 300-500 million years ago

- a) There are fewer craters near volcanic regions than elsewhere on the planet
- b) The number of impact craters per unit area is roughly the same all over the planet
- c) The age of most rocks, as determined by radioactive dating techniques, is about 300-500 my all over Venus
- d) The number of craters on the surface changes rapidly with time suggesting it is 300-500 my old

53) With your super-duper planet dicer, you collect a cube of "average planet" that is 1 cm on each side. The mass of the cube is 8 grams. The planet you sampled is

- a) a terrestrial planet
- b) a gas giant
- c) an icy planet
- d) some weird planet unlike those in our solar system

For the next three questions, use the following list of possible multiple choice answers (don't worry about "which a" you choose, if the correct answer is "a", then it's "a"):

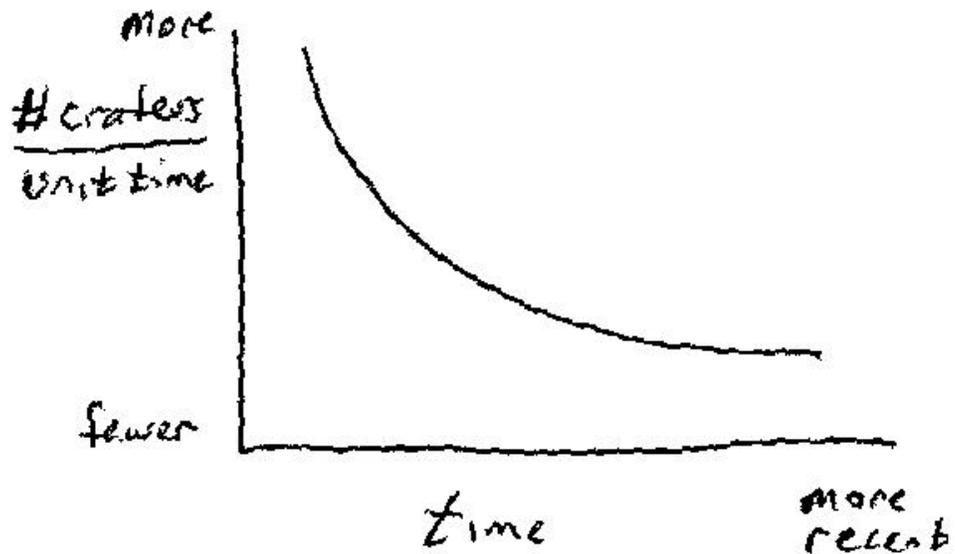
- a) Sunlight
- b) Weather on Mars
- c) linear or curved features
- d) momentum
- a) volcanism on Triton
- b) bright rayed craters
- c) radioactive decay
- d) Faulting on Europa
- a) Sand Dunes
- b) tidal interactions
- c) weathering on the Moon
- d) large areas with no craters

For Each of the next three questions, fill in the missing item with one of the 12 options above.

	Energy	Process	Evidence
54)	Tidal	Tectonics on Ganymede	?
55)	?	Volcanism on Io	few or no impact craters
56)	Sunlight	?	Dust covering up craters

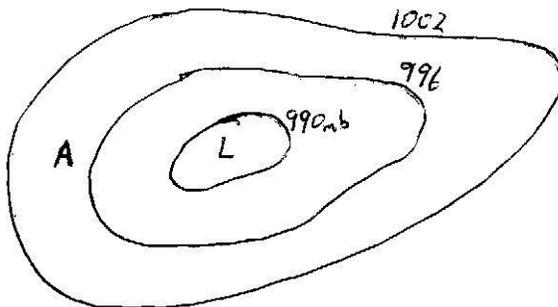
57) Consider the graph shown, illustrating how impact cratering varies with time, due to the progressive loss of asteroids from the solar system (they only get to run into a planet once!).

- a) The number of craters per unit time is decreasing with time, and is decreasing faster today than in the past
- b) The number of craters per unit time is decreasing with time, and is decreasing slower today than in the past
- c) The number of craters per unit time is increasing with time, and is increasing faster today than in the past
- d) The number of craters per unit time is increasing with time, and is increasing slower today than in the past



58) Considering the diagram, winds at point A will mostly likely be

- a. Easterly
- b. Northerly
- c. Southerly
- d. Westerly



(note: an Easterly wind is one that comes out of the East and blows toward the West)

59) Air at 30° C and 50% relative humidity drops 10° C, to a final temperature of 20° C. Its relative humidity will

- a) double to 100%
- b) remain unchanged since the moisture content didn't change
- c) halve, to about 25%
- d) we can't know what the humidity will do under these circumstances

60) In temperate storms (storms in our neck of the woods) temperature and pressure are related to each other. This is best and most generally summarized by

- a. Higher temperatures result in higher pressures
- b. Lower temperatures result in higher pressures
- c. A temperature gradient (change in temperature from one place to another) results in a pressure gradient

61) winds are related to pressure gradient. Which is most generally true

- a. the velocity of the wind is highest where the pressure is highest
- b. the velocity of the wind is highest where the pressure is lowest
- c. the velocity of the wind is highest where the pressure is changing the most with location
- d. the velocity of the wind is highest where the pressure is changing the least with location

62) On Earth, winds are influenced by the coriolis effect (the merry-go-round effect). In the northern hemisphere this results in

- a. winds spiraling counter-clockwise around a low pressure system
- b. winds spiraling counter-clockwise around a high pressure system
- c. winds going directly from low pressure to high pressure
- d. winds going directly from high pressure to low pressure

For questions 63 and 64 consider the following scenario. You put two different batches of air into two balloons. Balloon #1 contains dry air (0% humidity). Balloon #2 contains humid air (close to 100% humidity).

63) You heat the two balloons at constant pressure.

- a) Balloon number 1 will expand but number 2 will contract
- b) Balloon number 2 will expand but number 1 will contract
- c) Both balloons will contract
- d) Both balloons will expand

64) You put the two balloons in a vacuum chamber and remove part of the air from the chamber, thus decreasing the pressure in the chamber and in the balloons.

- a) The air in balloon number 1 will decrease in temperature, that in balloon number 2 will increase
- b) The air in balloon number 2 will decrease in temperature, that in balloon number 1 will increase
- c) Temperature in both will increase
- d) Temperature in both will decrease

65) Looking out your window one day, you see a puffy cloud with a flat bottom. Now, you know that the humidity out today is 50% and the temperature is 21 degrees Celsius. You also know that in general the temperature of air decreases upward by about 1 degree Celsius for each 100 meters. The bottom of the cloud is probably about how high?

- a) 100 meters
- b) 500 meters
- c) 1000 meters
- d) 5000 meters

66) Consider two batches of air. Air #1 is very cold, about 10 degrees below 0 Fahrenheit. Small crystals of ice are crystallizing from the air as it cools further. Air #2 is warmer, about 50 degrees Fahrenheit. There is a fog. Now considering only the air itself, not the ice crystals or fog in it, which **two** of the following are

correct:

- w) there is more water in air #1 than air #2
- x) the humidity in air #1 is the same as that in air #2
- y) the humidity in air #2 is greater than in air #1
- z) there is less water in air #1 than in air #2

- a) both w and x
- b) both w and y
- c) both x and z
- d) both y and z

67) On a separate sheet of paper, illustrate a Low Pressure center (with an "L") and a high pressure center (with an "H") showing isobars around each.

68) On the same figure that you drew for question 66, draw arrows around both the low and the high to show the direction of wind at different locations around each if the low is in North America.

69) A quantitative experiment measures how changing one variable affects another variable quantitatively. Which of the following fits this definition of a quantitative experiment?

- a. hot water is placed in a box and the velocity of the air movement that results is measured
- b. The temperature of water in a box is changed and the length of time it takes for a puff of smoke to move 5 inches from the water is measured at each temperature.
- c. Hot water is placed in a box then taken out of the box and whether smoke in the box circulates like a tornado is observed for each case
- d. A tornado in a box is made by placing a pan of hot water in the box and the temperature of the air in the tornado is measured several times.

70) **On a separate sheet of paper**, draw and label a graph showing the relationship between two variables as might be measured in a laboratory experiment. Label the axes. Make sure that the relationship between your variables is correct and reasonable.

Going outside one day, you notice that the clouds in a jet trail are patchy, with cloudy patches occurring in narrow bands perpendicular to the direction the jet is traveling. You conclude that the backwash from the jet exhaust has caused the cloud formation (with the shock wave from the exhaust causing the ripples in the clouds). For each of the following 3 questions indicate whether the observation stated, if made, would support the conclusion, be inconsistent with the conclusion, or be immaterial to the conclusion.

71) In an experiment with shock waves like those behind a jet, you observe that clouds are unaffected by the shock wave

- a) support conclusion
- b) inconsistent with conclusion
- c) immaterial to conclusion

72) After watching clouds over an entire season, you notice that you never again see clouds like those you saw behind the jet except once when another jet passes over.

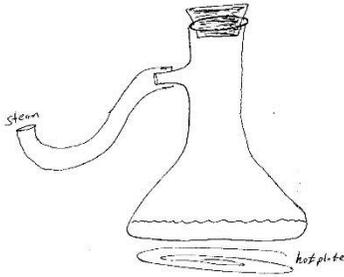
- a) support conclusion
- b) inconsistent with conclusion
- c) immaterial to conclusion

73) You go to the library to research weather and find that over the past 3 years, rain has been slightly more common in areas with warmer temperatures.

- a) support conclusion
- b) inconsistent with conclusion
- c) immaterial to conclusion

74) Consider the experiment below. Steam is seen at the end of the tube but not in the flask. Where does the steam come from?

- a) steam materializes naturally, with new atoms of water being generated, whenever hot air encounters cold air
- b) The steam was in the flask, but is only made visible when a chemical reaction with oxygen in the air causes it to become slightly colored
- c) The steam is small drops of water that condense from invisible water vapor where the water vapor encounters cooler air
- d) High pressure in the flask causes the air to rise, as it rises, eventually getting out of the flask through the tube, clouds (steam) form.



75) Suppose you calculate by looking at all the craters on the Moon how many "big" meteorites are in orbits in which they might hit the Earth or the Moon. You further calculate that "big" meteorites will hit the earth on average about once every 20,000,000 years. If you live to be 100 years old, what are your chances of seeing such an impact?

- a) about 1 in 20,000
- b) about 1 in 200,000
- c) about 1 in 2,000,000,000
- d) about 1 in 100

76) The average amount of energy arriving on Earth from the Sun is about 350 watts for each square meter of Earth's surface. The average amount *leaving* the Earth is

- a) Substantially more than 350 watts/m²
- b) Substantially less than 350 watts/m²
- c) Very nearly 350 watts/m²
- d) Not yet known with any certainty

77) **On a separate sheet of paper** draw a sketch illustrating how the "greenhouse effect" works, using the following 10 symbols and words:

absorption
CO₂ and H₂O
absorption
visible light
emission

_____ ground

air
infrared radiation



78) Suppose that somehow the Earth cooled and glaciers started to form at the poles. One effect of this might be

- a) A compensating warming trend because there will be more sunlight on Earth
- b) A compensating warming trend because more of the sunlight will be reflected into the atmosphere
- c) Further cooling because more of the sunlight will be reflected back into space
- d) Further cooling because ice is cold and will cool the Earth

79) Climate can change naturally. One major cause of climate change in the past that has resulted in periodic changes (that is, changes at predictable intervals) is

- a) volcanic eruptions
- b) changes in Earth's orbit around the Sun
- c) loss of the ozone layer
- d) production of greenhouse gases

80) **On a separate sheet of paper** make a stratigraphic column of sediment layers beneath the Red River Valley describing both the type of sediments and the environment/climate they represent, Make sure you show which one was first (on the bottom) and last (on the top).

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