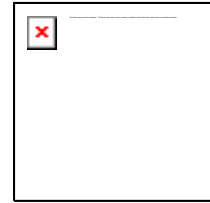


# Earth Science Today

Russ Colson

Minnesota State University Moorhead



## 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

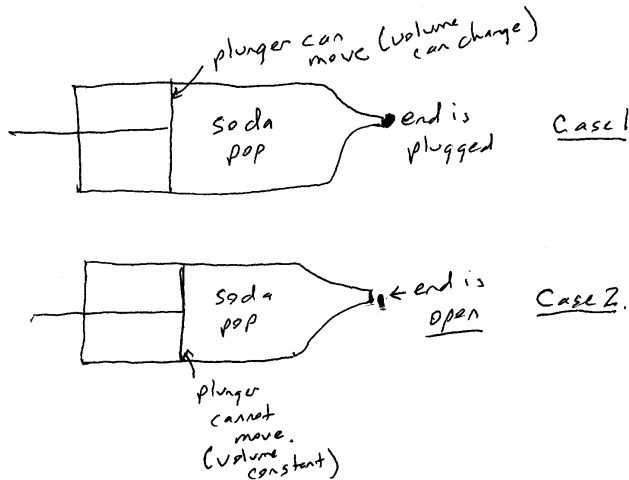
- a) gases are present as part of the magma, then bubble out as a gas
- b) gases come from deeper in the earth than the magma
- c) gases come from less deep in the earth than the magma
- d) gases come from the combination of baking soda and vinegar deep in the volcano

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?

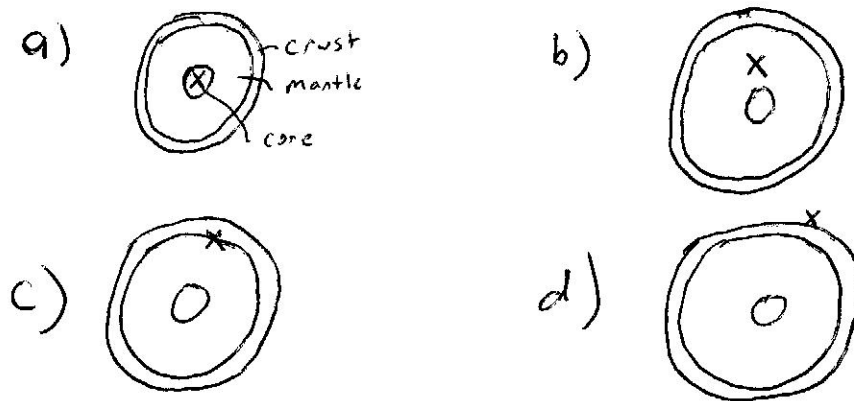
- a) layers above and below the basalt which contain fossils of sea creatures
- b) bubbles in the basalt
- c) basalt is made of many different types of minerals
- d) basalt sometimes contains fossil tree imprints

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 molten material (that will become lava at the surface) comes from (at the X)?

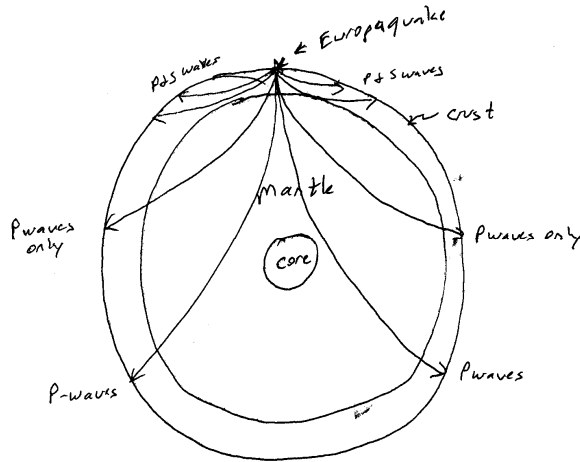


9) Which of the following conditions increase earthquake occurrence

- 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



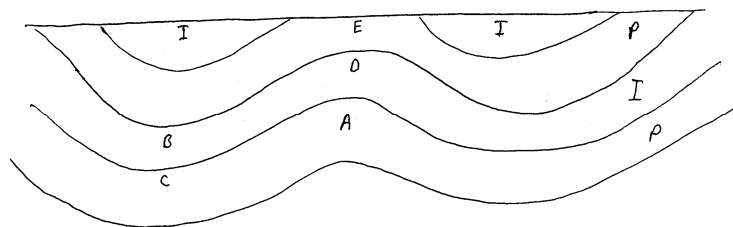
11) Consider the separation of glass and wooden marbles by adding water to them in a beaker. The *process* that allows them to be separated is

- a) when water is added, one of them floats and the other doesn't
- b) they have different densities
- c) The two materials have different chemical properties and react differently with water
- d) 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 *property* that separates them is

- a) when water is added, one of them floats and the other doesn't
- b) they have different densities
- c) The two materials have different chemical properties and react differently with water
- d) 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? I=impermeable rock layer, P=permeable rock layer, assume all layers are water saturated. The image is a cross-sectional view.



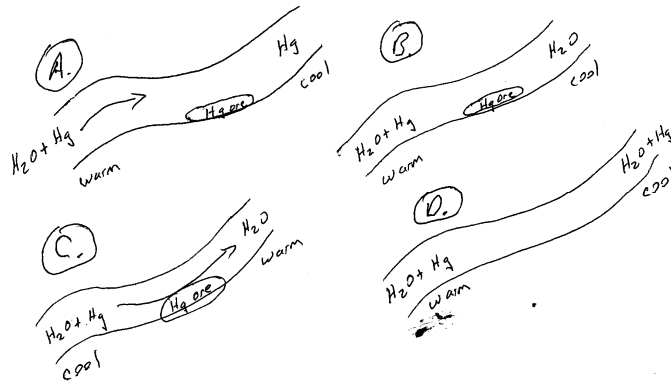
- a) A
- b) B
- c) C

- d) D
- e) E

14) Infer the necessary chemical relationship from actual observations: In the ocean, acidity of the water is often controlled by the amount of  $\text{CO}_2$  in the water. More  $\text{CO}_2$  results in higher acidity. However, more  $\text{CO}_2$  dissolves in the water when the water is colder (just like in your pop).  $\text{CaCO}_3$  is found in warmer, shallower seas much more than in colder deeper seas. Coral are made of  $\text{CaCO}_3$ .

- a) Coral are more likely in acidic, deep water
- b) Coral are more likely in non-acidic deep water
- c) Coral are more likely in acidic, shallow water
- d) Coral are more likely in non-acidic, shallow water

15) Mercury ( $\text{Hg}$ ) dissolves in hot water, but precipitates (crystallizes) at lower temperatures. Which one of the following correctly portrays how a Mercury ( $\text{Hg}$ ) ore might form in an underground hot-water system?



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 a crystal of quartz in equilibrium with magma. Suppose that only 0.001% of the quartz is Sodium ( $\text{Na}$ ), but 1% of the magma is Sodium. The partitioning for  $\text{Na}$  between quartz and magma would be 1/1000.

You do an experiment with Sodium, quartz, and magma in a high-temperature furnace. add 1 grams of sodium to 100 grams of magma. You freeze 10 grams of the magma into quartz (the quartz is the frozen magma). How much sodium (about) will be left in the magma?

- a) about 10 grams  $\text{Na}$
- b) about 5 grams  $\text{Na}$
- c) about 1 grams  $\text{Na}$
- d) about 0.1 gram  $\text{Na}$

17) Considering the same scenario as above, the concentration of  $\text{Na}$  in the original magma is 1/101, or 0.99%  $\text{Na}$ . If you froze half of the magma to quartz, the concentration of  $\text{Na}$  in the remaining magma would be most close to:

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

18) A pollutant has a high partition coefficient between clay (clay is present in soil and sediment) and water, such that concentration in clay/concentration in water is a very large 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 crust is more silica rich than Earth's mantle. The crust is believed to have separated from the mantle during ongoing chemical differentiation of the Earth. We know from laboratory experiments that the partition coefficient for potassium (K) between silica-rich crust material and the more silica-poor mantle material is very high. %K in crustal material/%K in mantle material is  $> 5$ . This means we should expect that

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

20) On a separate sheet of paper, identify the **2 processes** 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 coarse-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 coarse-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) An evaporite sedimentary rock (like rock-salt or rock-Gypsum), tells us
- a) the area was once a high energy environment (like a swift river)
  - b) The area was once a low energy environment (like a deep lake)
  - c) The area was once arid, with little precipitation or hot conditions or both
  - d) The area was once near a volcano

- 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 the question above 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

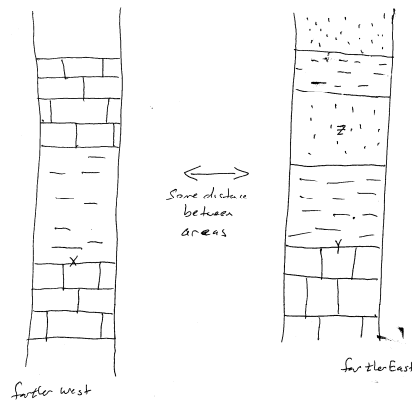
fine mud  
on bottom poorly sorted mixture of mud, sand, and gravel

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 the question above, 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

34) Still considering the columns in question above, 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

35) A key feature of earthquakes that is consistent with the theory of plate tectonics is

- a) occur in blob-shaped regions
- b) occur only in elastic rocks capable of storing energy
- c) occur in linear or curve shaped regions
- d) occur mainly in the deep interiors of continents

36) On a separate sheet of paper, list and explain one evidence supporting the theory of plate tectonics. Be clear and succinct.

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:

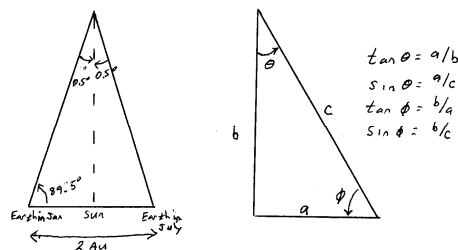


Several months later you only see one object:



- 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 89.5 AU
- c) about 115 AU
- d) about 205 AU

Note: No stars are actually this close to our solar system!

40) Cepheid variables allow us to determine distances to stars that are too far away to measure a parallax angle (the angle is too small to measure). What is the relationship that allows us to determine the star's distance?

- a) distance is proportional to true brightness only
- b) distance is proportional to apparent brightness only
- c) distance can be determined if both true brightness and apparent brightness are known
- d) distance is proportional to the rate (period) at which brightness varies with time

41) Aristarchus discovered that the Sun is larger than Earth, and far away. Which of the following lines of evidence did he use to establish that the Sun is far away from Earth?

- a) At full Moon, the angle to the Sun is close to 90 degrees
- b) When the Moon is half lit (quarter moon), the angle Moon-Earth-Sun is nearly 90 degrees
- c) When the Moon is half lit (quarter moon), the angle Moon-Earth-Sun is nearly 45 degrees
- d) During Lunar eclipses, the Earth's shadow falls on the Moon





42) Consider the diagram showing the Sun and Earth, with the Moon in two different locations. The direction of Earth's rotation and direction of the Moon's orbit around the Earth are shown with arrows. 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 the question above, how much of the total surface 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 above, the time that passes from when the Moon is at position Y and when it is at position X is about how many "Moon days"?

- a) 1/4
- b) 1/2
- c) 3/4
- d) 1

45) Continuing to consider the diagram above, the time that passes between when the moon is at position Y and when it is at position X is about how many "Earth days"?

- a) 1/2
- b) 7
- c) 10
- d) 21

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

- a) the Earth is closer to the sun
- b) The sun is less directly overhead
- c) the length of the period of daily insolation is more
- d) the sun warms up in the winter time

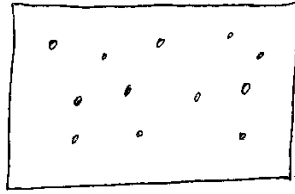


47) Consider the configuration of the Earth and Sun shown (the Earth's axis of spin is also shown, the Earth's plane of orbit about the Sun is horizontal in this picture).

- a) This illustrates the N. Hemisphere summer, daylight at the North Pole are 0 hours long
- b) This illustrates the N. Hemisphere summer, daylight at the North Pole are 24 hours

long

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



48) Meteorites fall on the region shown below at an average rate of about 1 meteorite per 100,000 years. How old is the surface shown?

- a) 100,000 years
- b) 1,200,000 years
- c) 2,000,000 years
- d) the age cannot be determined this way

49) Examine the illustration of the craters from a portion of the surface of Mars. We know from this image that

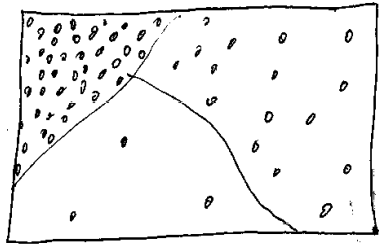
a) Mars was not all created at the same time, but some parts were created first and then the parts were put together later

b) We cannot determine the age of the surface of this area

c) 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) On a separate sheet of paper, list one process that has effected the surfaces of both Earth and the Moon.

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 10 cubic meters. The mass of the asteroid is 400 kilograms as determined from gravity measurements. A 2nd asteroid is 40 cubic meters in volume and has a mass of 1600 kilograms. Which of the following is correct. (Note about the process of asteroid formation: 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 1st 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) There are not craters on the planet
- 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 2 cm on each side. The mass of the cube is 7 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

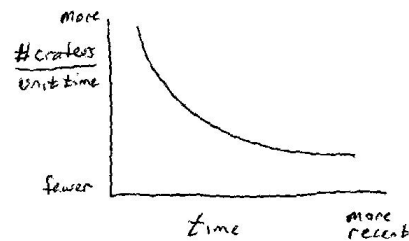
For Each of the next three questions, fill in the missing item with one of the 12 options above.

	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!).

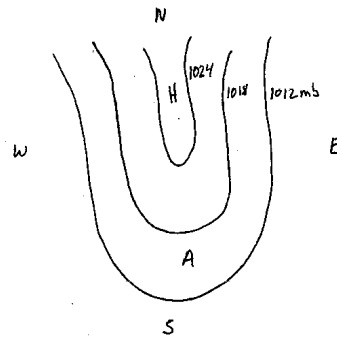
- a) The number of craters per unit time is decreasing with time, and is decreasing faster today than in the past
- b) The number of craters per unit time is decreasing with time, and is decreasing slower today than in the past
- c) The number of craters per unit time is increasing with time, and is 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 (assume the map portrays conditions in the Northern Hemisphere of Earth)

- 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 rises 10° C, to a final temperature of 40° 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) Consider the situation in which a low pressure area approaches from due West, passes over you, and departs toward the East. Which of the following describes how winds will change (ignoring the effects of friction with the ground). (assume northern hemisphere).

- a) Winds begin in the east, become northeasterly, and finally northerly.
- b) winds begin in the southeast, become southerly, and fanally westerly.
- c) winds begin in the north, increase rapidly in speed, then become southerly
- d) winds begin in the south, die down, the rise up again from the north.

61) Which of the following describes where winds will be the fastest

- 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 temperature is highest
- d) the velocity of the wind is highest where the temperature is lowest
- e) none of the above

62) On Earth, winds are influenced by the coriolis effect (the merry-go-round effect). In the southern 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

63) 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). You cool the two balloons. Which of the following will occur

- a) Condensation begins in both balloons after cooling about 10 degrees C.
- b) Condensation begins in the first balloon immediately, but begins in the second balloon after cooling about 10 degrees C
- c) Condensation does not occur in the first balloon, but begins almost immediately in the second
- d) Condensation occurs immediately in both balloons.
- e) none of the above

64) Considering the same two balloons as in the previous question, 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) Condensation begins in both balloons when decompression begins.
- b) Condensation occurs in neither balloon
- c) Condensation occurs in the first balloon when decompression begins, but not in second
- d) Condensation occurs in the second balloon when decompression begins, but not in the first

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 25% and the temperature is 15 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? (also, remember from our lab-activity that capacity to hold water vapor changes by a factor of 2 with a 10 degree C change in temperature).

- a) 500 meters
- b) 1000 meters
- c) 2000 meters
- d) 3000 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) 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/m<sup>2</sup>
- b) Substantially less than 350 watts/m<sup>2</sup>
- c) Very nearly 350 watts/m<sup>2</sup>
- d) Not yet known with any certainty

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

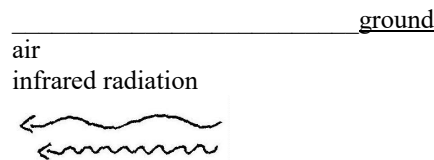
absorption

CO<sub>2</sub> and H<sub>2</sub>O

absorption

visible light

emission



71) Suppose that somehow the Earth warmed, causing the oceans to warm. One effect of this might be

- a) A compensating cooling trend because the oceans would reflect more sunlight
- b) A compensating cooling trend because CO<sub>2</sub> exsolving (bubbling out) from the oceans would block sunlight
- c) Further warming because the oceans would absorb more sunlight
- d) Further warming because CO<sub>2</sub> exsolving (bubbling out) from the oceans would absorb energy radiation toward space from Earth.

72) 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) plate tectonics and volcanoes
- b) changes in Earth's axial tilt
- c) loss of the ozone layer
- d) production of greenhouse gases

73) **On a separate sheet of paper** make a simple sketch of sediment layers at the Regional Science Center illustrating both the type of sediments and the environment/climate they represent, including Lake Agassiz, the glaciers, and arid wind-blown sand. Make sure you show which one was first (on the bottom) and last (on the top).

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.

74) 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

75) 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

76) 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

77) 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.



78) 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 700,000 years. If you live to be 100 years old, what are your chances of seeing such an impact?

- a) about 1 in 100
- b) about 1 in 7,000
- c) about 1 in 700,000
- d) about 1 in 70,000,000