Recall that point value is the time allotted to complete the question. See also Home, 7 habits, periodic table.

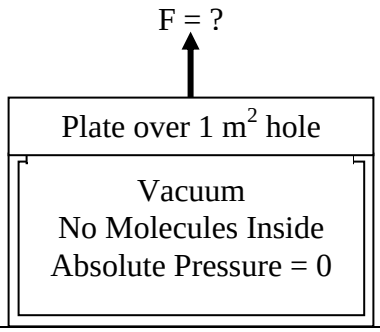
Questions	Answers
1. 5 Points: The speed of light is about 186,282 mi/sec. Convert this to km/sec where 1 mi = 1.609344 km and round answer to 3 significant figures.	300,000 km/sec
2. 5 Points: Give an example of an un-testable hypothesis. Is such a hypothesis "scientific" or "unscientific?" Explain. Is such a hypothesis a scientifically credible alternative to a scientific theory? Explain.	A secret magical word exists closed to muggles (non-magical folks) entered by passing through Platform 9 ¾. This is unscientific and cannot be tested. It is not a credible alternative to a scientific theory.
3. 5 Points: In the popular press, writers will often state something is "proven scientifically." What's wrong with this statement? Explain. Why do they make such a statement if it's not really true? Explain.	Science is never dogmatic. Everything is subject to revision if a better theory or better experiments overturn a previous theory. In this sense then, nothing is ever "proven." However some theories are so strongly substantiated that non-scientists refer to them as "proven." This communicates the idea of a theory so strong it is nearly unassailable.
4. 5 Points: What is the difference between atomic number and nucleon number (mass number)?	Atomic number is the number of protons in the nucleus and the number of positive charges. This is the most important number to chemistry and in a neutral atom is the same as the number of electrons. The nucleon number counts both protons and neutrons and is close to, but not exactly, the mass of an isotope in AMU. For this reason it is often called the mass number, but because of this confusion the preferred modern parlance is nucleon number.
5. 5 Points: What is the main difference between the atoms of two isotopes of the same element (for example, ${}_1H^1$ and ${}_1H^3$), and two different elements (for example, ${}_1H^3$ and ${}_2He^3$)? Hint: The superscript tells you the nucleon number (how may nucleons, protons and neutrons, it contains) and the subscript is the atomic number.	Two isotopes of the same element have different mass, but he same nuclear charge and are nearly identical chemically. Even if the same nucleon number, if the atomic number is different then they atoms behave much different chemically.
6. 5 points: What element is chemically most like Calcium (Ca)? Consult periodic table. BTW, this property is very useful in medicine. (a) Aluminum (Al) (b) Barium (Ba) (c) Potassium (K) (d) All of the above (e) None of the above	Ba as it is also a column 2 element.

Questions	Answers
7. <u>10 Points:</u> Originally Superman could only leap. When Supergirl came on the scene she could fly, but let's pretend she can only leap too. She leaps with a take-of speed of 64.88 m/sec, the constant acceleration of gravity causes her to come to rest at the top of a building, and it requires 40 sec. Hint: Recall peak speed (take-off speed) is twice the average speed. (a) How tall is the building? (b) What is the acceleration due to gravity? (c) Where do you think this building is located? Hint: Earth's acceleration due to gravity is 9.8 m/sec^2.	(a) 1297.6 m. (b) 1.622 m/sec^2. (c) It's not on Earth. Actually it's the Moon.
8. <u>5 Points:</u> If an 80 kg halfback is tackled by a 105 kg lineman, which one exerts the larger force on the other? Which physics principle applies? Explain.	They exert the same force on each other according to Newton's third law and conservation of momentum.
9. <u>10 Points:</u> A student drives 87 km home for Christmas. She travels part way home at 92 km/hr for 49 min. (a) What distance was traveled during the first portion of her trip? (b) It takes an additional 48 min. to complete the trip due to heavy traffic. What is the average speed (in km/hr) during this leg of the trip? (c) What is the average speed (in km/hr) for the total trip?	(a) 75.1 km. (b) 14.8 km/hr. (c) 56.9 km/hr
10. <u>10 Points:</u> An ice cube has a mass of 41 gm (1000 gm = 1 kg) and is floating in a glass of water. (a) How much does it weigh in Newtons? Recall acceleration of gravity, g, is 9.8 m/sec2 on Earth. (b) What is the buoyant force in Newtons? Hint: The force keeping the ice cube floating. (c) What is the net force in Newtons acting on the ice cube? (d) Moon's gravity is about 1/6 of Earth. What is the ice cube's mass in gm on the Moon? (e) How much does it weigh in Newtons on the Moon? (f) What is the buoyant force in Newtons on the Moon? (g) What is the net force in Newtons acting on the ice cube on the Moon? (h) Will it still float in water on the Moon?	(a) -0.402 N (upward forces are positive). (b) 0.402 N. (c) zero. (d) 41 gm. (e) -0.670 N. (f) 0.670 N. (g) zero. (h) yes.

Questions	Answers
11. <u>10 Points:</u> Two ice skaters (zero friction) initially at rest push away from each other. The mass of one is 60 kg and the mass of the other is 50 kg. The larger mass skater has a velocity of 1.2 m/sec after the push. (a) What is the momentum in kg m/sec of the larger skater? (b) What is the momentum in kg m/sec of the smaller skater? (c) What is the speed in m/sec of the smaller skater?	(a) Total momentum is zero. Momentum of the larger after the push is mv = 72 kg m/sec. (b) Momentum of the smaller skater is equal and opposite (-72 kg m/sec) of the larger to maintain a total momentum of zero. (c) 1.44 m/sec.
12. <u>5 Points:</u> Isometric exercises are exercises where there is force, but no movement. (a) Is work being done? Explain. (b) Is energy being consumed? Explain. (c) What is the difference between work and energy? (d) According to conservation of energy, energy (or work) cannot be created or destroyed – it can only change form. So what happens to the energy consumed in Part b?	(a) No. No distance moved. (b) Yes. Chemical energy is burned to cause your muscles to push, but it all goes into waste heat. (c) Work is force times distance, energy is the potential to do work. For example, a ball at the top on the hill can operate an elevator to convert gravitational potential energy into work. (d) It becomes heat.
13. <u>10 Points:</u> A car of mass 523 kg rolls downhill (without friction on Earth, g = 9.8 m/sec^2) a vertical distance of 46 m. (a) How much potential energy in Joules is lost? (b) How much kinetic energy in Joules is gained without friction? (c) If 20% of the gravitational potential energy is "lost" due to friction, what is the kinetic energy in Joules? (d) What happens to the 20% of the energy "lost"? Can energy truly be lost? If converted, what is the "lost" energy converted to? (e) If an engine speeds the car up to the same speed (on the flat and level) it had at the bottom of the hill in 9.3 sec, what is the engine's power?	(a) 236,000 J. (b) 236,000 J. (c) 189,000 J. (d) "Lost" energy is converted to heat. (e) Energy per time is power = 25,400 W.
14. <u>5 Points:</u> Iodine 131 ($_{53}I^{131}$) is important for a couple reasons. It is a common gaseous byproduct of nuclear power production which, if released to the atmosphere, would be deleterious. However encapsulated it is useful to treat cancer. In this isotope: (d) What is the atomic number? (e) What is the nucleon number? (f) What is the number of protons? (g) What is the number of neutrons?	(a) Z = 53. (b) Nucleons = 131. (c) Protons = Z = 53. (d) Neutrons = 131 – 53 = 78. Note: The modern preferred wording is nucleon number. In the past it was referred to as mass number since it's close, but not exactly equal to, the mass in AMU units. Because it's not exactly equal to mass there was confusion so in modern parlance we call it the nucleon number, that is, the sum of proton and neutron (particles in the nucleus).
15. <u>5 Points:</u> Name an element that is chemically similar to Sodium (Na).	Anything in the first column. Li, K, Rb, Cs, or Fr. Anything in the same column is chemically similar.

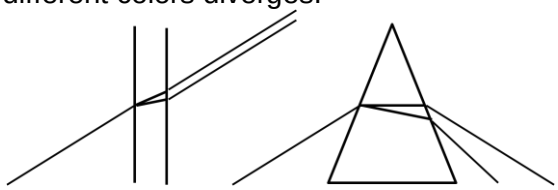
Questions	Answers
16. <u>10 Points:</u> Superman's mass is 101 kg and has a velocity of 54 m/sec in the x direction. And Supergirl's mass is 54 kg and has a velocity of 101 m/sec in the negative x direction. They collide head on. (a) What is Superman's original momentum? (b) What is Supergirl's original momentum? (c) What is the total original momentum? (d) What is the total momentum after collision? (e) Who exerts more force on the other? Does Superman exert more force on Supergirl? Does she exert more force on him? Do they exert the same force on each other?	(a) P_m = 5454 kg m / sec. (b) Pg = -5454 kg m / sec. Negative because Supergirl is moving in the negative x direction. (c) zero. (d) Also zero since the total momentum before equals the total momentum after. This is the law of conservation of momentum. (e) They exert the same force on each other according to Newton's third law.
17. <u>5 Points:</u> Explain how conservation of momentum applies to a rocket ship lifting off. Does Newton's third law (for every action there is an equal and opposite reaction) apply?	The momentum of the fuel going out the rocket nozzle is equal and opposite to the momentum of the ship. The ship exerts the same force on the burning fuel as the fuel exerts on the ship. Newton's third law applies.
18. <u>10 Points:</u> The speed of a satellite in a perfectly circular orbit around Earth is about 8 km/sec and the escape velocity is about 11.2 km/sec. What shape is the orbit if the speed of the satellite is between these two values? (a) Draw this shape and sketch where Earth would be located. (b) Show the location of the greatest gravitational energy on this sketch? (c) Show the location of the greatest kinetic energy on this sketch? (d) Why doesn't a satellite in this orbit fall to the ground? (e) Even if between these two speeds, satellites might not orbit. Why not? BTW, this is how the Apollo astronauts came home from the Moon.	(a) Elliptical shape – Earth at one focus. (b) Greatest gravitational potential energy further from the Earth. (c) Kinetic energy is greatest closest to the Earth. (d) A satellite "falls" around the Earth. (e) A satellite may have sufficient energy, however if its orbit intersects the Earth it will crash. Apollo astronauts did this intentionally hitting the atmosphere at exactly the angle to controllable land.
19. <u>5 Points:</u> What is the orbital period of a planet 9 times as far away from the sun as Earth?	27 yr. $R^3 \alpha T^2$

Questions	Answers
20. <u>1 Point each (each planet is only used once, but other solar system objects are listed):</u> (a) What planet has prominent rings? (b) What planet is the coldest planet in the solar system (and now considered a dwarf planet)? (c) What gas giant has a prominent red spot? (d) What is the hottest planet? (e) What planet is closest to the Sun? (f) What is the only known planet to support life? (g) What planet is red, rocky, colder than Earth, and nearly airless, but next to Earth is considered the next most hospitable place in the solar system? (h) What is the furthest planet from the Sun not including dwarf planets? (i) One gas giant planet, not yet mentioned, resembles a very ordinary appearing blue ball. Which planet is it? (j) What small objects of iron/nickel composition lie between Mars and Jupiter and are probably remnants of a destroyed planet?	(a) Saturn. (b) Pluto. (c) Jupiter. (d) Venus. (e) Mercury. (f) Earth. (g) Mars. (h) Neptune. (i) Uranus. (j) Asteroids.
21. <u>5 Points:</u> A car gains 50,000 J of energy going down a hill, but only has 40,000 J of kinetic energy when it reaches the bottom. (a) How much energy is wasted? (b) What happens to this energy? Where does it go? What form of energy is it converted to? (c) If an engine speeds the car up to the same speed (on the flat and level) it has at the bottom of the hill in 9.3 sec, what is the engine's power?	(a) 10,000 J. (b) The lost energy eventually turns into heat. (c) 50,000 J/9.3 sec = 5376 Watts
22. <u>10 Points:</u> An astronaut lands on a planet that has the same mass as Earth, but twice the diameter. (a) Will she weight more, less, or equal to her weight on the surface of the Earth? (b) By what factor? If less the factor is a fraction, if more then the factor is greater than 1, and if equal the factor equals 1. (c) Will her mass be more, less, or equal to her mass on the surface of the Earth? (d) By what factor?	(a) Less. (b) ¼. (c) Same mass. (d) 1.0.

Questions	Answers
23. <u>10 Points:</u> A shady jeweler sells you a 1 kg gold crown. Before you give him any money though, you take out your handy-dandy beaker and measure the volume to be 60 cm^3. (a) Your friend, Archimedes, tells you not to buy it. Why? Explain. The density of gold is 19.3 g/cm^3. (b) What is the buoyant force acting on this crown if lowered into fresh water? Recall the density of water is 1 g/cm^3 and, therefore, the weight of 1 cm^3 of water is 0.0098 N.	(a) Density is only 16.7 gm/cm^3 – it is not gold. (b) buoyant force = 0.588 N.
24. <u>10 Points:</u> The barometer reads 76 cm of mercury. (a) If the atmosphere were the same density as mercury, how thick would it be? Explain. (b) In SI units this works out to be 101,300 Pa or 101,300 N/m^2. If I had a 1 m^2 plate over a vacuum chamber, how much force would be on this plate? See diagram at right. In the famous Magdeburg hemispheres experiment of 1654, those hemispheres had a smaller area than this problem and a team of horses couldn't pull them apart.  	(a) 76 cm. (b) 101,300 N.
25. <u>10 Points:</u> (a) What effect causes a raw egg to spin slower than a hard boiled egg? Note: Bernoulli's Principle is an approximation that ignores this effect. (b) Name a circumstance where you would observe the Bernoulli effect. Explain what is happening.	(a) Drag. Bernoulli's Principle ignores drag. (b) Blowing between two pieces of paper and the paper attracts. Pressure is reduced in the flowing stream of fluid.
26. <u>5 Points:</u> What does temperature measure? What does heat measure? What is the difference between the two quantities?	Temperature measures the AVERAGE energy per molecule. Heat is a total energy.
27. <u>5 Points:</u> If the temperature of a constant volume and number of molecules of gas goes up, what happens to the pressure? Based on our discussion in class or your readings in the book, explain your answer.	PV = nRT. Temp up, pressure up. You're not changing the number of molecules or the volume, but the molecules are moving faster and hit the sides of the wall harder thus raising pressure.

Questions	Answers
28. <u>5 Points:</u> If you add more molecules at constant pressure and volume, what happens to temperature? Based on our discussion in class or you readings in the book, explain your answer.	Temperature would have to drop. To keep pressure and volume constant while adding more stuff, you have to slow down the stuff.
29. <u>5 Points:</u> A refrigerator works by inputing work (W_{in}) to a motor to move heat (H_{in}) from the inside to the outside. (h) Write an expression for heat out (H_{out}). (i) Explain how this tells us we can't use a refrigerator to cool our home. It's not because the refrigerator isn't big enough. It's the same problem as putting our air conditioner in the middle of the living room and turning it on. Why won't that work? Explain.	(a) $H_{out} = W_{in} + H_{in}$. (b) You remove H_{in} amount of heat, but a greater amount, H_{out} is put back into the room. Running a refrigerator will heat, not cool, a room.
30. <u>5 Points:</u> If I had the best engine in the world, an engine without friction, and I put 1000 J of heat into this engine, why would only a fraction of that heat be converted to work? Typically the theoretically best engines would only give 600 J of work output and, in practice, it would only give 400 J. Explain.	Heat is random, thus, by the second law of thermodynamics some is wasted. No engine can turn all the input heat into work. Some heat is wasted.
31. <u>10 Points:</u> (a) Name and give examples of the 3 means that heat is moved. (b) Heat is not moved when we rub our hands together to get warm. Where does heat come from in this case?	(a) Conduction, like heat flowing through a pane of glass. Convection, like heat carried with the water moving from an engine to radiator. Radiation, for example, the sun. (b) Rubbing our hands together does not move heat – it is converting mechanical energy to heat.
32. <u>5 Points:</u> Fill in the blanks. Like charges ___ and unlike charges ___	Repel, attract
33. <u>5 Points:</u> What particle carries electrical charge? If a particular particle carries one type of charge, how do we cause the opposite polarity on objects if we're not moving the particles with the other type of charge?	Electrons carry charge, but when they move out of a material they leave the slow and heavy positive charges behind.
34. <u>5 Points:</u> What causes magnetism? Explain why this creates electromagnets. Why does this same effect cause some materials, like iron, to have a permanent magnetism? Microscopically, how is a permanent magnet like an electromagnet?	Magnetism is caused by moving charges. Running current through a coil makes an electromagnet. However electrons orbiting around nuclei magnetize atoms. If more electron orbit one direction than other the material can have a permanent magnetism. Only a few substances are like this – Fe, Co, Ni, and Gd.
35. <u>5 Points:</u> True or False. You can have a negative charge or a positive charge by itself, but you cannot have a north pole or south pole by itself? Explain. You can have a negative charge or a positive charge by itself, but you cannot have a north pole or south pole by itself. Why is this true? Hint: it has to do with how magnetic fields are created in the first place.	True. If you cut a charged object in half you get two objects of the same charge. But if you cut a magnet in half, each half has both a north and south pole. When a charge, even tiny ones like electrons, move in a circle they create both a north and south pole.

Questions	Answers
36. <u>5 Points:</u> What happens to a moving electron in a magnetic field?	Its path will curve.
37. <u>5 Points:</u> What causes refraction? Sir Isaac Newton in 1704 hypothesized that light was a particle. He employed the metaphor of light particles rolling down a hill and gaining speed in a medium like glass. Discuss this hypothesis, why it may be correct or incorrect, and how one would discover if it were correct or incorrect.	If light speeds up in a medium then Newton's corpuscular theory would be correct. Light, however, slows down in a medium. Also light was shown to be a wave. When a CD (groove spacing 1.6 μm) interference causes light to have not only a reflected spot, but two first order diffraction spots. Only waves do this.
38. <u>10 Points:</u> A physics and music student wants to create a pipe for an organ that resonates at middle C, f = 262 Hz. The pipe will resonate at it's fundamental frequency (that is lowest frequency – the pipe is half a wavelength long). The speed of sound is 340 m/sec. (a) Knowing the speed of sound and the frequency, how do you find the wavelength? (b) Evaluate the wavelength. (c) What is the period of this wave?	(a) $\lambda = v/f$. (b) 1.30 m. (c) 0.00382 m
39. <u>5 Points:</u> Describe constructive and destruction interference. Explain why the CD disc produces a central spot plus side spots.	Constructive interference is when waves combine to make their crests larger. Destructive interference is when waves combine to counteract each other. The central spot is from ordinary reflection. The side spots are a result of fine lines on the CD (1.6 μm on a CD, 0.75 μm on a DVD) causing constructive interference.
40. <u>5 Points:</u> Explain the difference between a transverse and longitudinal wave and give examples.	For a longitudinal wave the displacement is along the direction of the wave, for example, a sound wave. For a transverse wave the displacement is perpendicular to the direction the wave travels.
41. <u>5 Points:</u> Explain the Doppler effect. We know the sound pitch is higher when the sound source (police car for example) is coming toward you and the pitch is lower when the sound source is moving away. This is also true for light. The color of the light from distant objects shifts because they are moving away from us. Explain how the light frequency and wavelengths of these distant galaxies change when they move away. Which way does the color shift for these distant galaxies?	As the police car moves toward you, you hear the crests of the waves more frequently, thus raising the pitch. As it moves away you hear the crests of waves less frequently, thus the pitch drops. As galaxies move away the frequency shifts to lower frequencies, which corresponds to higher wavelengths. Elongating wavelengths shifts light to be more red. The effect is called a red shift.
42. <u>5 Points:</u> Fill in the blanks. Like charges ___ and unlike charges ___. Like magnetic poles ___ and unlike magnetic poles ___.	Repel, attract, repel, attract.

Questions	Answers
43. <u>10 Points:</u> A physics and music student wants to create a pipe for an organ that resonates at a fifth above middle C, f = 392 Hz. The pipe will resonate at its fundamental frequency (that is lowest frequency – the pipe is half a wavelength long). The speed of sound is 340 m/sec. (a) Knowing the speed of sound and the frequency, how do you find the wavelength? (b) Evaluate the wavelength. (c) What is the period of this wave?	(a) $\lambda = v/f$. (b) 0.867 m. (c) 0.00254 m
44. <u>5 Points:</u> Light has a different index of refraction going through some materials depending on its color. This can make a rainbow, however you didn't see a rainbow in lab. This is due to the fact that the surfaces of the glass were parallel to each other. To make a rainbow, you need a prism. Why? Using principles of refraction (and that different colors refract at different angles) sketch and/or explain why glass must be in the shape of a prism, for example a triangular prism, to create a rainbow.	This is best shown with diagrams. For parallel surfaces, like a pane of glass, the light of different colors emerges parallel. For a prism the light of different colors diverges. 
45. <u>5 Points:</u> What is the law of reflection? When young kittens see a mirror they think there is another cat behind the mirror and it looks so real the kitten will begin fighting with the other cat. If the kitten is 10 cm from the mirror, how far away will the kitten's image be?	The angle of incidence equals the angle of reflection. The kitten will see its own image 10 cm behind the mirror.
46. <u>10 Points:</u> Complete the following nuclear reaction. What element goes in the blank? $_{38}Sr^{90} \rightarrow$ _____ + $_{-1}e^{0}$	$_{39}Y^{90}$
47. <u>10 Points:</u> The half life of $_{38}Sr^{90}$ 28.8 yr. If you start with 1 kg how much will you have left after the following: (a) 28.8 yr (one half life)? (b) 57.6 yr (2 half lives)? (c) 86.4 yr (3 half lives)?	(a) 0.5 kg. (b) 0.25 kg. (c) 0.125 kg.
48. <u>10 Points:</u> A diode laser emits 670 nm light. Answer the following. Recall 1 nm = 10^{-9} m; h = Plank's constant = $6.63*10^{-34}$ J sec; and c = speed of light = $3*10^{8}$ m/sec. (a) What is frequency? (b) What is the photon energy?	(a) $4.48*10^{14}$ Hz. (b) $2.97*10^{-19}$ J.

Questions	Answers
49. <u>5 Points:</u> Electrons may be accelerated very near the speed of light using easily obtainable voltages (100 kV for example). Electron microscopes can use such electrons to take pictures of atoms (spacing about $3*10^{-10}$ m). Ignoring relativistic effects, find the wavelength of an electron ($m_e = 9.11*10^{-31}$ kg) whose speed is $1.9*10^{8}$ m/sec. Recall $h = 6.63*10^{-34}$ J sec.	$\lambda = h/mv = 3.83*10^{-12}$ m.
50. <u>5 Points:</u> Explain what makes up the atom. The symbol for nuclear energy looks like electrons orbiting the nucleus. How is this model (planetary model) accurate? How is it inaccurate? Based on the modern understanding of the atom, why do atoms like mercury in fluorescent lights give off light at only certain wavelengths?	An atom is made up of a very small, but massive, charged nucleus surrounded to light large electrons. The electrons form a cloud, but thinking of them like planets in an orbit provides some understanding. It explains much, but not all, chemistry. Electrons can only change orbits in exact energies, so the light they give off is a very precise, unalterable wavelength.
51. <u>5 Points:</u> What is the missing particle in the nuclear decay of: ${}_{6}C^{14} \rightarrow {}_{-1}e^{0}$ + _____	${}_{7}N^{14}$
52. <u>5 Points:</u> What is the missing particle in the nuclear decay of: ${}_{84}Po^{210} \rightarrow {}_{2}He^{4}$ + _____	${}_{82}Pb^{206}$

Questions	Answers
53. <u>10 Points:</u> (a) Draw a Lewis diagram and structural diagram for butane, C_4H_{10}. (b) Can butane have another structure? If so, draw it. (c) Balance a chemical reaction to burn butane in oxygen (O_2) to make CO_2 and H_2O. In other words, balance the following chemical reaction. __C_4H_{10} + __O_2 → __ CO_2 + __H_2O	(a) Lewis diagram: H H H H H:C:C:C:C:H H H H H Structural diagram: H H H H | | | | H-C-C-C-C–H | | | | H H H H (b) Yes: H H:C:H H ·· H H:C:C:C:H H H H Structural diagram: H | H-C-H H | H | | | H-C-C-C–H | | | H H H (c) 2 C_4H_{10} + 13 O_2 → 8 CO_2 + 10 H_2O
54. <u>5 Points:</u> What is the difference between an ionic and covalent bond?	Ionic – one atom "takes" electrons from the other. Covalent – the atoms share electrons.
55. <u>5 Points:</u> Is the following a valid structural formula? H H | | H – C – C – H \ / N | H	Yes.
56. <u>5 Points:</u> Why does it feel hotter in Florida than Las Vegas even if the temperature is lower? The dangers from heat in these two locales are also different. Explain the differences and why it is different.	Even at the same temperature the air may hold different amounts of water vapor. In Florida there is lots of water vapor, in Las Vegas hardly any. In Florida it's hard for your sweat to evaporate (and so it stays on your skin) to remove heat. In Florida it's easy to get overheated. In Las Vegas your sweat removes heat, but it's easy to get dehydrated.

Questions	Answers
57. 5 Points: Explain why wind around low pressure systems circulates counter-clockwise, around high pressure systems wind circulates clockwise, and in the southern hemisphere these directions are switched.	Wind rushes to the center of a low pressure system (and away from the center of a high). Due to Earth's rotation the wind from the south already has easterly motion, but the Earth moves slower underneath it as wind moves north. Wind from the north does not have easterly motion, but the Earth moves faster underneath it as wind moves south giving the wind an apparent western motion. So around a low there is counterclockwise motion and clockwise motion around a high. In the southern hemisphere it's reversed. Wind from the south does not have easterly motion, but wind from the north does. So the motion is clockwise around a low and counterclockwise around a high.
58. 5 Points: Why do breezes come from the sea during the day and from the land at night?	During the day the sun heats the land, land air rises, moves out to sea, cools over the ocean, and is pulled at the surface back on to land. At the surface people feel a sea breeze. At night the sea is warmer so the directions are reversed.
59. 5 Points: What are clouds? Why don't all clouds produce rain? What is needed to make it rain? If you have this ingredient, is it guaranteed to rain?	Clouds are extremely fine water droplets. The must get bigger to rain and to do this need a particle to condense on. Even with a particle rain isn't guaranteed.
60. 5 Points: What causes lightning? How do you determine how far away a lightning strike is from you? How do you protect buildings from lightning?	The atmosphere is always charged, but occasionally it gets charged to a high enough degree and moisture in the air creates a low resistance path to ground. That's when you have lightning. If you count the number of second from the lightning flash to the thunder and divide by 5 that tells you how many miles away the lightning is. If you divide by 3 it tells you how many km away the lightning is. Lightning tends to strike things sticking up and follows the path of least resistance to ground. If you use a lightning rod and heavy wire along the side of the building, all the lightning's energy will follow the wire and won't burn the building.
61. 10 Points: Describe the 4 main types of fossils and give an example of each.	Trace – footprint. Original remains – amber. Replaced remains – fish fossils, dinosaur fossils, petrified wood. Casts or molds – an animal dies, but is removed before being covered with sediment. There is a good example of *Archaeopteryx* in your book.
62. 5 Points: How do fossils form?	First they get covered with sediment and they may convert under pressure. We observe them when some geologic event (earthquake, volcano, etc.) brings them back to the surface.
63. 5 Points: How do we date fossils?	Radioactive dating is very important although we can compare them with other fossils in the same layer also (geologists refer to this as correlation).

Questions	Answers
64. 5 Points: Name one boundary in geologic time and describe what happened.	The K-T event (end of Mesozoic and beginning of Cenozoic – the one we're in now) 65 Mya is very famous as this is when dinosaurs died and mammals rose. Although not as famous 248 Mya was the Great Dying or Permian event (End of Paleozoic and beginning of the Mesozoic eras). More species died of at this time than the K-T event. About 544 Mya began the Cambrian explosion when multi-celled life leading to current complex life forms began.