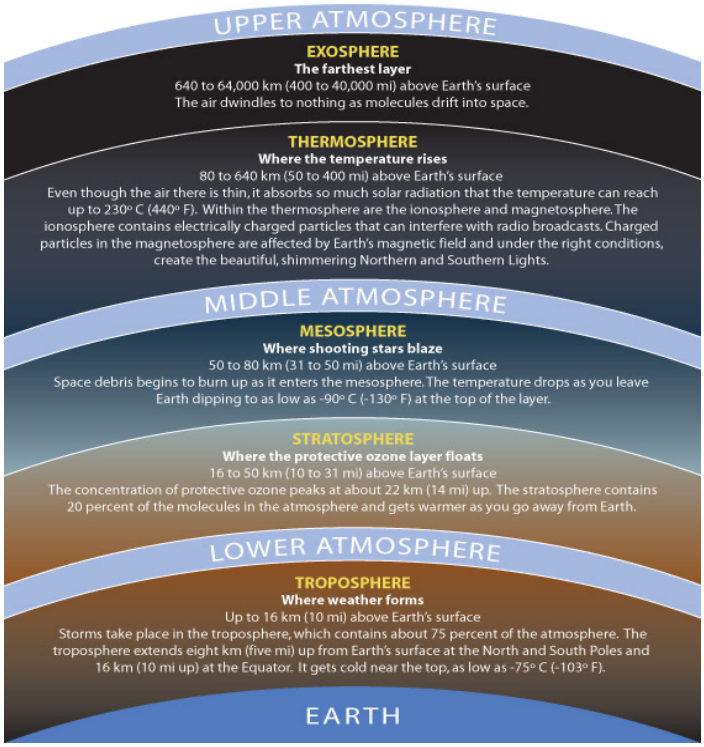
MOCK UPCAT 5: ANSWER KEY WITH EXPLANATIONS

1. **A**



Source: http://forces.si.edu/atmosphere/04_00_01.html

Troposphere is the layer of atmosphere which contains most of the clouds and 99% of the water vapor. Since lightning is the discharge of built-up static electricity in clouds, lightning must be formed in an area which contains clouds.

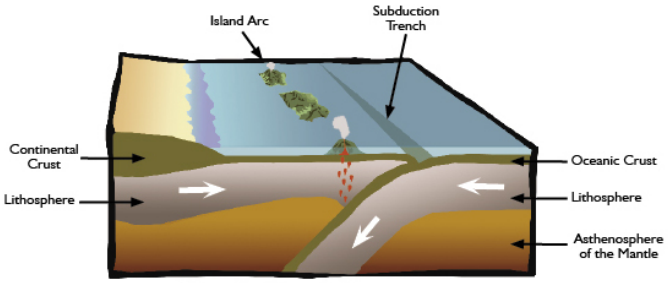
2. **C**

Heat is first transferred from the flames to the metal steamer by conduction. Water particles near the bottom of the steamer are also heated through conduction. After some time, the density of the heated water decreases and will thus rise. Cool water will then sink. This heat transfer occurs through convection.

3. **C**

A sound wave is formed by a disturbance or vibration and is transmitted through collisions of matter. Since particles in a solid are compact, sound waves immediately propagate to the neighboring particle. Thus, sound waves can be transmitted faster throughout a solid object.

4. **A**

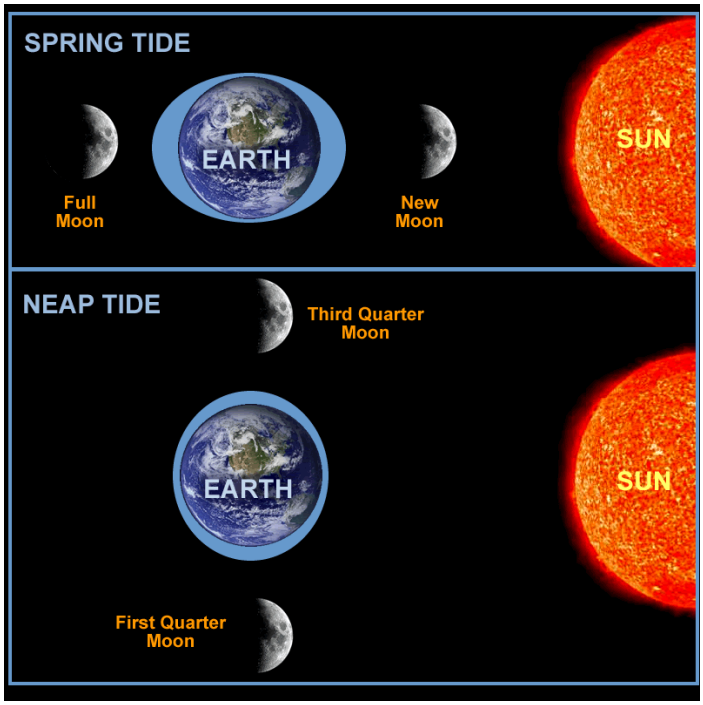


Oceanic-Oceanic Convergence

http://www.ncgeology.com/Eno_interactive_webs/Geologic_Principles_Geologic_story.html

When two oceanic plates converge, the older and thus, cooler and denser, will sink to the asthenosphere. An oceanic trench will form where the denser plate is subducted beneath the less dense plate.

5. **A**



Source:http://www.windows2universe.org/earth/Water/images/tides_lg_gif_image.html&edu=elem

When the moon is at its 1st or 3rd Quarter, the Sun, Earth and the moon forms a right angle. This circumstance causes the Sun to cancel some of the Moon's tidal pull to Earth's waters. This leads to lower-than-normal tides which are called neap tides.

(Note: Since the distance between the Moon and Earth is much smaller than that of the Sun and Earth, the Moon has a much greater attraction to Earth and has more effect on tides than the Sun.)

6. **B**

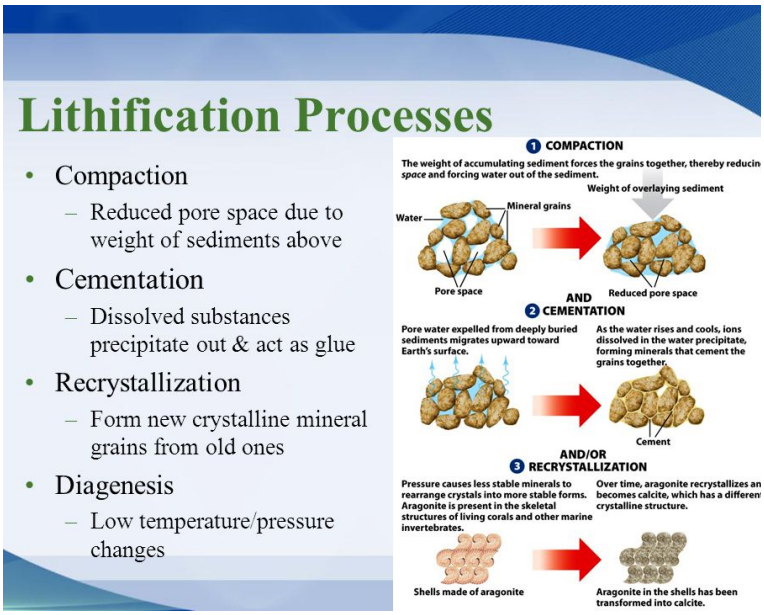
Source: http://www.astronomy.org/programs/seasons/

The star which all other stars revolve around is known as the North Star or the Polaris.

7. **B**

The correct measurement of the **speed of light** in a vacuum is "exactly 299, 792, 458 metres per second" which is equal to 2.99792458×10^8 m/s.

8. **B**



Source:http://slideplayer.com/4182361/14/images/7/Lithification%20Processes.jpg

9. **A**

During a total solar eclipse, the Moon appears to completely block the light from the Sun from reaching the Earth. Because of this, an observer can only see the outer layer of the Sun's atmosphere which is the corona. However, during normal days, the corona is not visible because it is really dark compared to the photosphere.

10. **C**

A material will be able to scratch a fingernail only if it is harder than the latter. Talc and gypsum are both softer than a fingernail. On the other hand, calcite, which has a hardness of 3, is harder than a fingernail.

11. **B**

Apatite has a hardness of 5, while feldspar has a hardness of 6. For a material to be able to scratch apatite but not feldspar, it must have a hardness which is intermediate that of apatite and that of feldspar.

12. **C**

Fluorite cannot scratch any material is harder than it. Thus, that material must have hardness which is higher than that of fluorite. Among the choices, only apatite is harder than fluorite.

13. **D**

Spectral Class	Color	Temperature
O	blue	28,000 - 50,000
B	blue-white	9900- 28,000
A	white	7400-9900
F	yellow-white	6000-7400
G	yellow	4900-6000
K	orange	3500-4900
M	orange-red	2000-3500

Source:http://www.windows2universe.org/cool_stuff/HR_spectralclass.html&edu=high

14. **C**

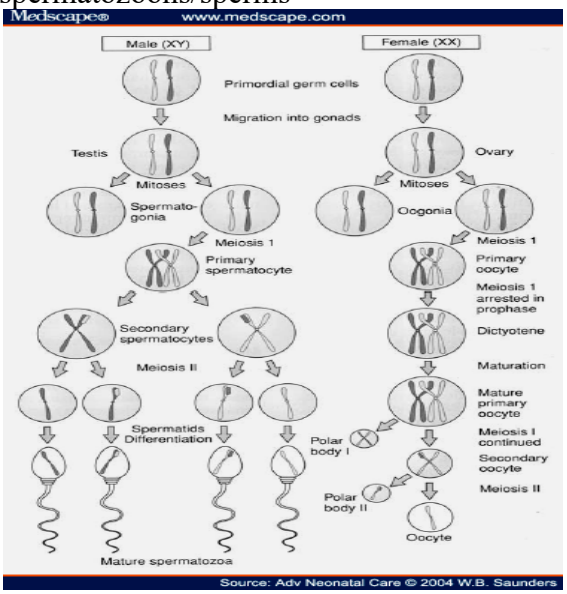
Earthquakes can be measured by its effects or seismic intensity. The Mercalli scale rates the ground movement by a description of reactions of humans, other organisms and artificial structures to the tremor. This scale ranges from 1 to 12 wherein 1 denotes a weak earthquake and 12 denotes a very destructive one.

15. **B**

Mitosis is the process wherein a cell divides into two daughter cells, each of which has the same number of chromosomes as the parent cell. This process is used in somatic cells. However, sex cells or gametes are formed by meiosis. In meiosis, the daughter cells have half the number of chromosomes of the parent cell.

16. **A**

Spermatogenesis: spermatogonium (diploid) → primary spermatocyte → 2 secondary spermatocytes (haploid) → 4 spermatids → 4 spermatozoons/sperms



17. **A**

Monera is a kingdom which consists of all prokaryotic (or simple, single-celled) organisms.

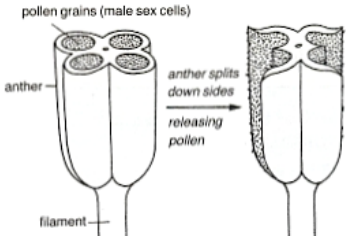
18. **D**

Echinodermata is a phylum which consists of animals which usually have a five-part radial symmetry and are equipped with tube feet, such as starfish, brittle stars, sand dollars, sea cucumbers and sea urchins.

19. **B**

Peas are round green seeds that grow in a pod. A seed is a plant part that contains embryo. Thus, it is produced by the fertilization of ovule. Usually, the ovule is enclosed within the ovary. The ovary turns into an outer covering after fertilization of the ovule.

20. **D**



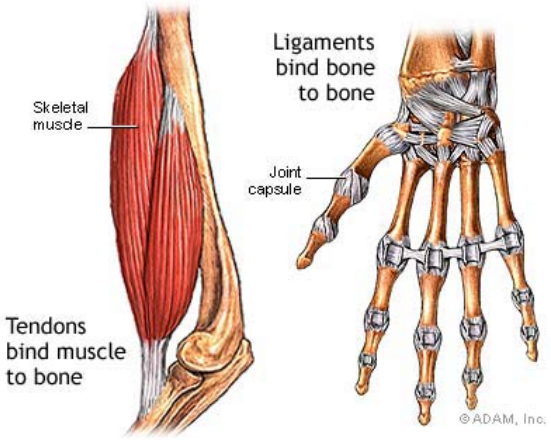
Source:http://www.ssc.education.ed.ac.uk/bsl/biology/stamen.html

Stamen is the male reproductive part of a flower. It consists of the filament, anther and pollen.

21. **B**

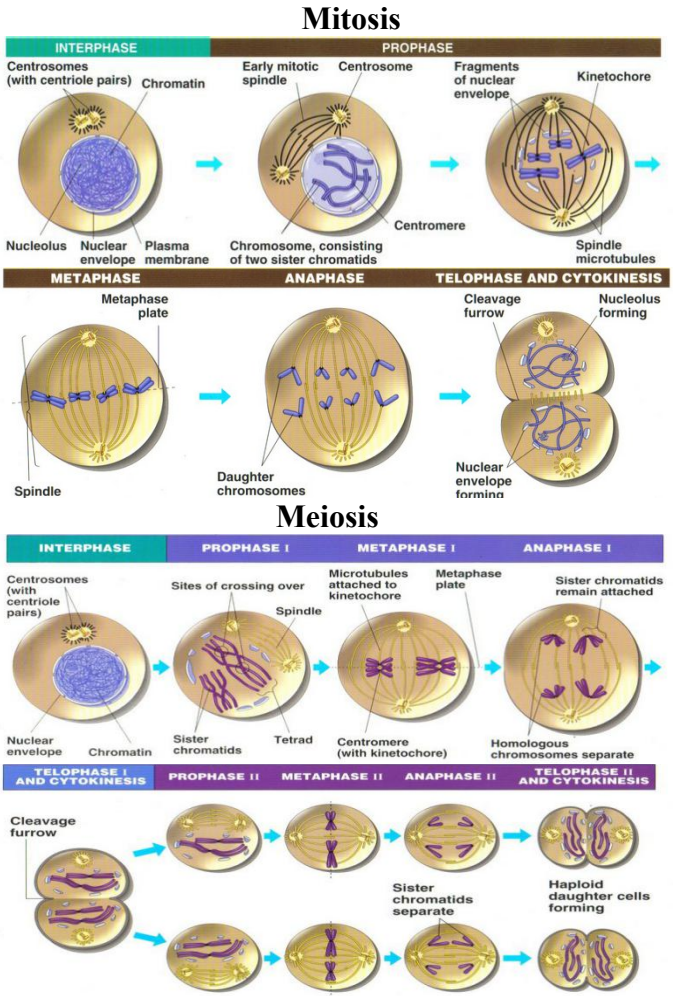
Cardiac and smooth muscles are involuntary. These muscles are usually found in organs. Conversely, skeletal muscles are voluntary. This means that it is usually under conscious control. Contractions of these muscles cause bones and cartilages to move. Biceps are among the skeletal muscles.

22. **B**



Source:http://www.nytimes.com/imagepages/2007/08/01/health/adam/19089Tendonvsligament.html

23. **A**



In the diagram, we can see that chromosomes, centrioles and the mitotic spindle participate in cell reproduction. During prophase, centrioles move to the opposite poles of the cell and form the mitotic spindle, which in turn, pull the chromosomes apart during anaphase.

24. **C**

Almost all of marine life is found between the shoreline and the edge of the continental shelf. Sunlight cannot penetrate deeper areas of the ocean. Without sunlight, photosynthetic aquatic plants would not be able to undergo photosynthesis and thus, die. As a result, all consumers will not be able to thrive.

25. **D**

Natural erosion from Mt. Makiling, discharge of sewage and wastes from factories, and run-off fertilizers and animal wastes from farms will cause the infiltration of excess minerals to Laguna de Bay, which in turn, can cause eutrophication.

26. **B**

$pH = -\log[H^+] = -\log[1.0\ x\ 10^{-8}] = 8$

$pOH = 14 - pH = 14 - 8 = 6$

27. **B**

According to The Law of Conservation of Mass, in any chemical reaction, the mass of reactants must be equal to the mass of products. Thus, the mass of KNO_3 must be equal to the sum of the masses of KNO_2 and O_2 which is 65.

28. **C**

$N_t = N_0\left(\frac{1}{2^t}\right)$

where *N(t)* is the amount remaining after N_0 radioactive particles underwent decomposition *t* times

$\frac{1}{16}N_0 = N_0\left(\frac{1}{2^t}\right)$

$\frac{1}{2^t} = \frac{1}{16}$

$2^t = 16$

t = 4

Thus, in four days, the sample underwent four decompositions. Thus, its half-life is one day.

29. **B**

Distillation is the process of separation of water to other particles through boiling and condensation. Pure water or H_2O does not have any other particles. Thus, it cannot be distilled.

30. **A**

An atom is the smallest portion of any material which still retains its properties. Despite this, it can still be dissociated into protons, neutrons and electrons through nuclear fission.

31. **B**

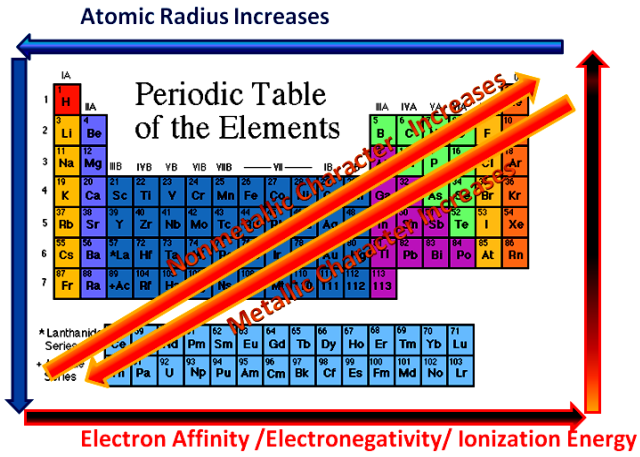
Carbon-12 and Carbon-14 are isotopes. Isotopes are forms of a chemical element that differ in the number of neutrons. All carbon isotopes still have an atomic number of 6. However, the mass number of Carbon-12 is 12 while that of Carbon-14 is 14. Thus, the number of neutrons in Carbon-12 is 12 – 6 or 6 while the number of neutrons in Carbon-14 is 14 – 6 or 8.

32. **C**

A noble gas is a chemically inert gas. This is due to its full outer shell of electrons. Thus, they possess an ns^2np^6 configuration.

33. **B**

Usually, metals tend to lose electrons to form cations while non-metals tend to gain electrons to form anions. This is due to the fact that elements follow the Octet Rule, which states that elements lose or gain electrons so that they will have the same number as that of the nearest noble gas. Thus, the ability of an element to form anions increases with decreasing metallic property (or increasing nonmetallic property). Among these elements, fluorine is the least metallic and thus has the highest tendency to form anions.



Source:http://i150.photobucket.com/albums/s118/hi78953/chemwiki.png

34. **B**

The polarity of bonds can be measured by the difference between the electronegativities of the two elements. If the elements have a high electronegativity difference, then one of the two elements has a much stronger pull to electrons than the other one does. This makes the molecule is more polar. Since electronegativity follows a trend (Refer to picture in # 33), we can say that the farther elements are in a periodic table, the higher is the electronegativity difference between them. Among these bonds, the one which has the highest electronegativity difference is O-H.

35. **D**

According to periodic trends, as electron affinity increases, atomic radius decreases, electronegativity increases, ionization energy increases and nonmetallic property increases. Also, a more nonmetallic element has a higher tendency to form anions and thus, a lower tendency to form cations (Refer to # 33).

36. **B**

$$12\ g\ glucose\left(\frac{1\ mol}{180.16\ g}\right)(6.022\ x\ 10^{23}\ molecules)$$
$$\approx 12\ g\ glucose\left(\frac{1\ mol}{180\ g}\right)(6\ x\ 10^{23}\ molecules)$$
$$\approx 4\ x\ 10^{22}\ molecules$$

37. **B**

After 250mL of water dissolve 20g of NaCl, 40g of NaCl remain undissolved.

20g : 250mL :: 40g : x

(20g)x = (40)(250)

$$x = \frac{(40g)(250\ mL)}{(20g)} = 500\ mL\ of\ water$$

38. **A**

$$Rate\ of\ Effusion = \frac{1}{\sqrt{MM}}$$
$$\frac{Rate_A}{Rate_B} = \frac{\sqrt{MM_B}}{\sqrt{MM_A}} = \sqrt{\frac{MM_B}{MM_A}}$$
$$\frac{Rate_x}{Rate_{CO_2}} = \sqrt{\frac{MM_{CO_2}}{MM_x}} = 2$$
$$\frac{MM_{CO_2}}{MM_x} = 4$$
$$MM_{CO_2} = 4MM_x$$
$$44\ \frac{g}{mol} = 4MM_x$$
$$MM_x = 11\ \frac{g}{mol}$$

39. **B**

Matter moves from an area of higher concentration to an area of lower concentration. In the given setup, water concentration in solution A is $1 - \frac{10\ g}{50\ g/mol} = 1 - 0.2 = 0.8$ while that in solution B is $1 - \frac{10\ g}{100\ g/mol} = 1 - 0.1 = 0.9$. Thus, water will move from solutions B to A.

40. **B**

$$(10\ g)(24°C - 20°C)\left(0.2\ \frac{cal}{g-°C}\right)$$
$$= (10\ g)(4°C)\left(0.2\ \frac{cal}{g-°C}\right) = 8 \text{ calories}$$

41. **C**

Opposite charges attract while like charges repel. Thus, if both balls have a positive charge, they will repel each other. Since they exert the same repulsive force to each other, each ball will have the same displacement from its original position.

42. **D**

$$V_f = V_i + at = 50\ m/s + (2\ m/s^2)(10\ s)$$
$$= 50\ m/s + 20\ m/s = 70\ m/s$$

43. **C**

$$S = V_i t + \frac{1}{2}at^2 = 0 + \frac{1}{2}(10\ m/s^2)(4\ s)^2$$
$$= 80\ meters$$

44. **C**

As an object that is thrown up reaches the maximum point, its velocity drops to zero. The time the object needs to reach its maximum point is

$$t = \frac{V_f - V_i}{a} = \frac{0-4\ m/s}{-10\ m/s^2} = \frac{-4\ m/s}{-10\ m/s^2} = 0.4\text{s}$$

In 0.4 seconds, it will reach a height of

$$S = V_i t + \frac{1}{2}at^2$$
$$= (4\ m/s)(0.4s) + \frac{1}{2}(10\ m/s^2)(0.4s)^2 =$$
$$1.6\ m + 0.8\ m = 2.4\ m \sim 2.5\ m$$

Note: The actual value of acceleration due to gravity is 9.8 m/s^2 (which is rounded to 10 m/s^2). Thus, the actual answer should be greater than 2.4 m.

45. **A**

$$\frac{F}{m} = a = \frac{50\,000\ N}{500\ kg} = 100\ m/s^2$$

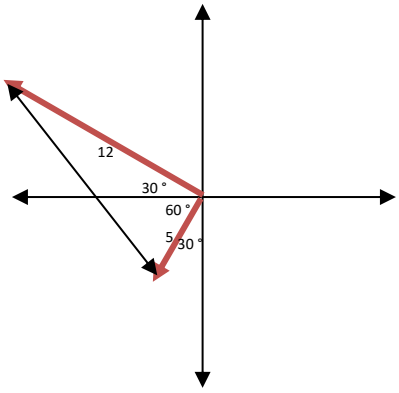
46. **A**

$F = ma$

$m = \frac{F}{a} = \frac{60\ N}{3.0\ m/s^2} = 20\ kg$

47. **C**

Suppose that the forces acting on a hockey puck are 5.0 N at 30° **W of S** and 12.0 N of W. What is the acceleration of the puck, given that its mass is 0.1 kg.



$a^2 + b^2 = c^2$

$(5)^2 + (12)^2 = c^2$

$c^2 = 169$

$c = 13\ N$

$F = ma$

$$a = \frac{Force}{mass} = \frac{13\ N}{0.1\ kg} = 130\ m/s^2$$

48. **D**

To be able to lift an object, you must apply a force that can overcome the force of gravity.

$F = ma = (5\ kg)(10\,m/s^2) = 50\ N$

49. **C**

$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.5\ kg)(2\,m/s)^2 = 1\,J$

50. **A**

$PE = mgh$

$10\,J = (2\ kg)(10\,m/s^2)(h)$

$h = \frac{10\ J}{(2\ kg)(10 m/s^2)} = 0.5\ m$

51. **A**

$KE = \frac{1}{2}mv^2 = \frac{1}{2}(50\ kg + 30\ kg)(10\,m/s)^2$

$= 4000\,J$

52. **C**

$Power = \frac{Work}{time} = \frac{(Force)(distance)}{time}$

$= \frac{(mass)(acceleration)(distance)}{time}$

$a = \frac{V_f - V_i}{t} = \frac{6\ m/s - 3\ m/s}{2.0\ s} = 1.5\ m/s^2$

$S = distance = V_i t + \frac{1}{2}at^2$

$= (3\ m/s)(2.0\ s) + \frac{1}{2}(1.5\ m/s^2)(2.0\ s)^2$

$= 6\,m + 3\,m = 9\,m$

$Power = \frac{(mass)(acceleration)(distance)}{time}$

$= \frac{(40.0\ kg)(1.5\ m/s^2)(9\ m)}{2\ s} = 270\ Watts$

53. **C**

500 mg = 0.5 kg

$\frac{F}{m} = a = \frac{300.0\ N}{0.5\ kg} = 600\ m/s^2$

$V_f = V_i + at = 0 + (600\ m/s^2)(0.1\ s)$

$= 60\,m/s$

54. **C**

Since $momentum = (mass)(velocity)$, we can say that it is a vector quantity. For a system to have a net momentum of +12 kgm/s, the movement should be to the right. This eliminates choices a, b and d. System A doesn't have a net momentum since the similar balls move in the same speed at different directions. Both systems A and B have negative momenta since its movement is to the left.

55. **B**

$V_f = V_i + at$

$t = \frac{V_f - V_i}{a} = \frac{14.75\ m/s - 2\ m/s}{1.5\ m/s^2} = 8.5\ s$

56. **A**

$KE = \frac{1}{2}mv^2$

Let K be the new value of KE after the variables m and v are changed

$K = \frac{1}{2}\left(\frac{1}{2}m\right)(2v)^2 = \frac{1}{2}\left(\frac{1}{2}\right)(m)(4)(v^2)$

$= 2\left(\frac{1}{2}mv^2\right) = 2\,KE$

Thus, if the mass of a body is halved and the velocity is doubled, its kinetic energy will double.

57. **B**

The pitch of guitar strings represents the frequency of the sound wave produced by the strings. A higher pitch is produced by high-frequency sound waves. The frequency of a

stretched wire depends on three factors which, combined in a single formula, is found to be

$f = \frac{1}{2L}\sqrt{\frac{T}{m}}$

where f is the frequency, L is the length, T is the tension and M is the mass per unit length (linear density)

From the formula, we can see that the frequency is proportional to tension and is inversely proportional to length and to mass per unit length. Thus, an object with a high pitch must be tight, short and has a low linear density. Assuming that the strings are made of the same material, a thin wire has a lower linear density than that of a thick wire.

58. **D**

$Voltage = (Current)(Resistance)$

$V = IR$

$I = \frac{V}{R}$

Current is inversely proportional to resistance. Thus, least current will be used in the object with the greatest resistance, which is the television.

59. **D**

$Power = (Voltage)(Current)$

$Voltage = (Current)(Resistance)$

$Power = (Current)^2(Resistance)$

$P = I^2R = (3.0\ A)^2(400.0\ \Omega) = 3600\ Watts$

60. **B**

In a parallel circuit, $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$.

$\frac{1}{R_T} = \frac{1}{20\ \Omega} + \frac{1}{50\ \Omega} = \frac{7}{100\ \Omega}$

$R_T = \frac{100}{7}\Omega \approx 14\ \Omega$