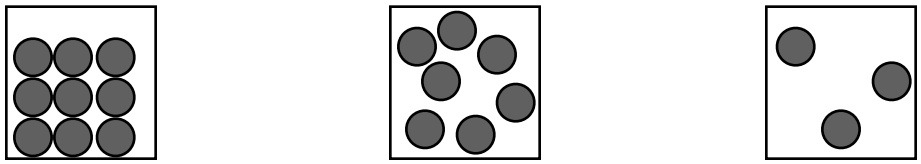
Applied Science and Technology (Sec. 3)
January 2013 Mid-Year Exam Review Package
Answer Guide

Chapter 1 stuff:

1. Matter is anything that has mass and volume.

2. The two types of mixtures are homogeneous and heterogeneous mixtures. An example of a homogeneous mixture is salt water. An example of a heterogeneous mixture is sand in water.

3.



solid liquid gas

In a solid, the particles are very close together, organized, strongly attracted and barely move.
In a liquid, the particles are still pretty close together, disorganized, fairly strongly attracted and have some ability to move.
In a gas, the particles are very far apart, disorganized, barely attracted to each other, and are free to move.

4. The four points are:
   1. Matter is made up of particles that are extremely small
   2. These particles are contantly moving
   3. When the temperature increases, the movement of these particles increases
   4. The particles may be held together by forces of attraction

5. a) solution b) element c) compound d) colloid

6. a) gases b) solids

7. Density = mass ÷ volume The acceptable units are either g/mL or g/cm^3

8. a) D = 5000 g ÷ 5000 mL = 1 g/mL
   b) D = 391 g / 220 cm^3 = 1.78 g/cm^3
   c) m = D x V , so mass = 1.8 g/mL x 30 mL = 5.4 g

9. a) mixture b) pure substance c) pure substance d) pure substance e) mixture f) mixture
   g) mixture h) pure substance

10. a) homogeneous b) homogeneous c) homogeneous d) heterogeneous e) homogeneous
    f) heterogeneous h) homogeneous i) homogeneous

11. mass = concentration x volume = 22 g/L x 0.8 L = 17.6 g of salt

12. a) 12.5 g/L, b) 23.3 g/L, c) 10 g/L so the most concentration solution is the one in b

13. volume = mass ÷ concentration = 50 g ÷ 12 g/L = 4.17 L

14. $V_1 = (C_2 \times V_2)/C_1$, so V_1 = (2 g/L x 0.654 L) / 6 g/L = 0.218 L or 218 mL

15. The new volume is 800 + 400 = 1200 mL or 1.2 L . $C_2 = (C_1 \times V_1) / V_2$, so C_2 = (0.8 g/L x 0.4 L) / 1.2 L = 0.27 g/L

16. $V_2 = (C_1 \times V_1) / C_2$, so V2 = (25 g/L x 0.035 L) / 10 g/L = 0.0875 L or 87.5 mL

17. mass = concentration x volume = 360 g/L x 0.1 L = 36 g of barium needed

18. concentration = mass ÷ volume = 80 g / 0.075 L = 1066.7 g/L, so the solution would be supersaturated because there is more solute than the solvent can hold. (1066.7 g/L > 425 g/L)

19. mass = concentration x volume = 1000 g/L x 0.4 L = 400 g, so you're missing 400 g - 225 g = 175 g

20. a) decantation and filtration b) centrifugation c) distillation d) chromatography e) evaporation

21. decantation, centrifugation, filtration, evaporation and distillation

22. evaporation or distillation

23. Chromatography. If you just evaporate the water, the medicines will still be mixed together.

24. distillation

25. melting point, boiling point, density and solubility

26. a) if it turns blue, the unknown is a base b) if it turns red, the unknown is an acid c) if the unknown has water
d) if the unknown has CO_2 e) if the object has oxygen (sustains combustion) f) if the object is flammable
g) the colour can give a hint about the presence of certain metals

27. a) oxygen b) calcium chloride c) tungsten d) glycerine (glycerol)

<u>Chapter 2 stuff</u>:

28. Energy is the ability to do work or to produce change. The unit for energy is the Joule.

29. The four main types of energy studied are radiant, chemical, thermal and mechanical

30. a) radiant b) mechanical c) chemical d) thermal e) radiant f) chemical
g) mechanical h) thermal

31. The correct answers are: b and d

32. The correct answers are: b, c and d

33. a) visible light b) radio waves c) gamma rays d) UV rays e) infrared waves
f) radio waves and microwaves g) infrared waves and microwaves h) x-rays and gamma rays
i) gamma rays

34. chemical energy

35. The correct answers are: b

36. Chemical energy examples: a, c, d, and f

37. speed, mass and position

38. a) car (greater mass) b) 5 kg rock (greater mass) c) falling from 10 m (higher position)
d) dart by air gun (greater speed)

39. Mechanical energy examples: a, b, d, and f

40. a) transfer b) transformation (chemical to radiant) c) transformation (mechanical to chemical)
d) transformation (radiant to chemical) e) transformation (chemical to radiant)
f) transformation (mechanical to electrical) g) transfer h) transfer

41. a) electrical ➞ thermal b) chemical ➞ mechanical c) electrical ➞ mechanical + thermal
d) chemical ➞ thermal + radiant + mechanical

42. fusion (melting) solid → liquid
freezing liquid → solid
vaporization liquid → gas
condensation gas → liquid
sublimation solid → gas
deposition gas → solid

43. absorb energy: fusion, vaporization and sublimation

44. release energy: freezing, condensation, deposition

45. As the water changes from a liquid to a gas, it needs energy to do so. It takes the energy as heat from your skin, which causes you to cool down, making you feel colder. The faster it evaporates, the colder you feel, which is why you feel colder when it's a windy day and you're wet.

46. a) absorb b) release

47. a) solid potassium hydroxide → dissolved potassium hydroxide + energy
b) solid ammonium chloride + energy → dissolved ammonium chloride

48. a) reversible b) irreversible c) irreversible d) irreversible e) reversible f) reversible

49. a) physical b) chemical c) physical d) physical e) physical f) physical g) chemical

50. a) $4\ Fe + 3O_2 \rightarrow 2\ Fe_2O_3$ b) $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$ c) $C_3H_8 + 5\ O_2 \rightarrow 3CO_2 + 4\ H_2O$

51. a) releases b) absorbs

52. synthesis, decomposition, oxidation and precipitation

53. synthesis (usually absorbed)
decomposition (usually released)
oxidation (usually released)
precipitation (very little energy used or needed)

54. a) synthesis b) precipitation c) decomposition d) oxidation

<u>Chapter 3 stuff</u>:

55. A fluid is a substance that can flow and assumes the form of the container into which it is poured.

56. Fluids: a, b, c, f, g, h, j

57. The particles are far enough that they can move around each other, allowing the particles to flow and fill a container.

58. A compressible fluid (gas) decreases in volume when pressure is applied to a container. That is because the gas particles are far apart and have lots of space to move closer.
An incompressible fluid (liquid) cannot decrease much in volume when pressure is applied to a container. That is because the liquid particles are already very close together and do not have much space to move any closer.

59. A force is an action that modifies the movement of an object or the shape of an object. Its unit is Newtons (N).

60. Pressure is the result of a force applied perpendicular to an object. The unit is the Pascal (Pa).

61. Area = l x w = 0.25 m x 0.35 m = 0.0875 meters squared

62. Pressure = force ÷ surface area = 15 000 N ÷ 1.1 m^2 = 13 363.4 Pa or 13.4 kPa

63. increases, decreases

64. Boots have a small surface area and the pressure of the person is concentrated on a small space. Snow shoes have a greater surface area and the pressure is spread out over a greater space, not pushing enough to make it through the snow.

65. decreases, increases

66. a) Most pressure: A (or C) Least pressure: B Same: A and C
b) Even through there's more water in C, it's only how much water is *above* the penny that's important, and there is the same height of water above the pennies in jars A and C.

67. a) manometer b) depth meter c) tonometer

68. collisions (or hits)

69. Pressure increases because increasing the number of particles increases the number of collisions.

70. Increasing temperature increases the speed and number of collisions, so pressure would increase.

71. Decreasing temperature decreases the speed and number of collisions, so pressure would decrease.

72. Decreasing volume by half would double the pressure felt in the canisters.

73. More particles = more collisions = more pressure = greater volume

74. More heat = more collisions = more pressure = greater volume

75. Less heat = less collisions = less pressure = smaller volume

76. The pressure spread itself evenly all around you, creating equal pressure all around your body that prevents you from being flattened.

77. When the plane goes up, atmospheric pressure decreases, so the pressure inside the ears is greater than on the outside of your head, which creates pain. You have to even up the pressure by moving air through the ear's Eustachian tube by yawning or swallowing.

78. the barometer

79. higher, lower

80. When you push harder on a plunger, the pressure spread through the entire fluid, causing the liquid to come out with greater pressure.

81. The third principle of fluids (hydraulics).

82. The density of helium is less than that of air, so it floats above the air even when you add the weight of the balloon. The density of a balloon filled with air is the same as that of air, but you have to add the weight of the balloon, so it sinks.

83. As you breathe in, your ribs and diaphragm make your lungs expand. As the volume of the lungs increases, the pressure decreases, so the higher pressure air outside your body pushes its way into your lungs.
As you breathe out, your ribs and diaphragm make your lungs decrease in volume, increasing the internal pressure so that air is forced out of your lungs and back into the air.

84. When you are deep under water, your body feels a lot of pressure, so any air bubbles in your blood would be tiny as pressure would make their volume decrease.
If you go back up too quickly, the pressure decreases quickly, which lets the air bubbles expand greatly, so the air bubbles in the blood would get too big and it could become medically dangerous.

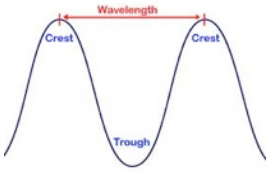
Chapter 4 stuff:

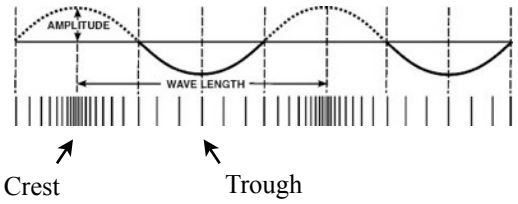
85. A wave transports energy.

86. In transverse waves, particles move at a 90° angle to the energy (perpendicular). In longitudinal waves, particles move in the same direction as the energy (parallel).

87. Frequency, amplitude and wavelength.

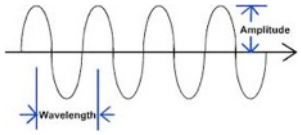
88. Transverse wave Longitudinal wave



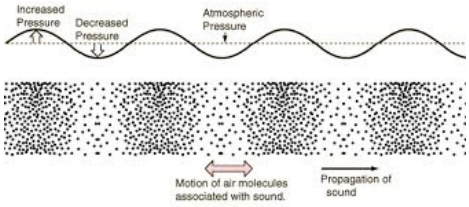


In a longitudinal wave, the middle of the compression represents the wave crest and the middle of the rarefaction represents the wave trough.

89. The amplitude of a transverse wave is represented by the height of the wave in comparison to the equilibrium line.



The amplitude of a longitudinal wave looks at how 'squished' or how 'stretched out' the particles are in a wave compared to the normal arrangement of molecules. The more compressed or stretched out, the higher the amplitude of the longitudinal wave.



90. A mechanical wave needs a medium (gas, liquid or solid) to travel. An electromagnetic wave doesn't need a medium to travel (it can go through the vacuum of space), but it can also travel through matter.

91. Frequency = # waves / time # waves = 14, time = 3 minutes or 0.05 hours
= 14 waves / 0.05 hours
= 280 waves per hour

92. highest: #4, lowest, #3

93. highest: wave B, lowest: wave A

94. No, electromagnetic waves do not need a medium to travel, but they can travel through matter if they need to.

95. A sound wave is a mechanical wave. It needs a medium (gas, liquid or solid) to travel.

96. The movement that creates sound waves is vibrations.

97. Sound travels the fastest through solids, and slowest through air.

98. Sound waves make the eardrum vibrate. Compressions push the eardrum inwards, and rarefactions push the eardrum outwards, so the eardrum alternates between going inwards and outwards every time a sound wave hits.

99. The human ear can hear frequencies between 20 Hz and 20 000 Hz.

100. The decibel scale represents the loudness of sound by measuring the energy of the sound waves, since loud sounds have more energy than quiet sounds.

101. A sound of 20 dB is 10 times louder and more powerful than a sound of 10 dB.

102. A sound of 40 dB is 1000 times louder and more powerful than a sound of 10 dB.

103. Listening constantly to sounds of 100 dB or slightly louder can lead to permanent hearing loss (deafness).

104. The higher the frequency the higher the pitch. The lower the frequency, the lower the pitch.

105. The instrument that measures earthquake waves is the seismograph.

106. Radio: television and radio signals
Microwave: heating up food and cell phones
Infrared: heating up food/people and finding/tracking people or animals in the dark
visible: seeing things, lasers, photosynthesis etc.
UV rays: disinfecting things, suntanning, etc.
x-rays: airport security, medical viewing of stuff in the body, etc.
gamma rays: radioactivity (like for killing germs on food) and treating cancers, etc.

107. Light waves are the part of the electromagnetic spectrum that can be picked up and seen by the eyes.

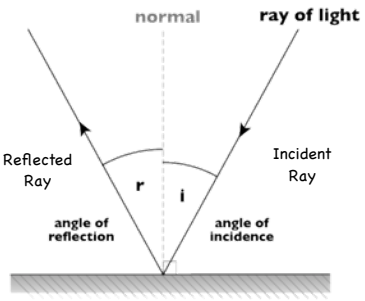
108. Light waves generally travel in a straight line, unless they change medium (like during refraction).

109. When a light wave (ray) strikes an object, it can either be reflected, refracted, or absorbed.

110. Reflection is the situation where a light wave hits another medium and bounces back.

111. If none of the light reflected back from the object, the object would be invisible to your eyes and would just be a dark shape with no texture, since none of the light rays would bounce off and reach your eye.

112.



113. The two rules are: 1. The angle of incidence and the angle of reflection are identical. 2. The incident ray and reflected ray are on the same plane (lined up as if they were drawn on a piece of paper).

114. Reflection on a rough surface is called diffuse reflection. In that case, even though the light rays come in parallel, they bounce off in all directions and angles because of the roughness of the surface that they hit. The reflected rays are produced, and any image produced is either warped or else no image is created.

115. Reflection on a perfectly smooth surface is called specular reflection. In this case, the rays of light that bounce off the surface follow the 2 rules of reflection (see answer for #113), and a perfect mirror image is produced.

116. a) The reflected image is on the other side of the mirror compared to the person/object, and at the same distance from the mirror.
b) The image produced is virtual as it is caused by 'imaginary' extended light rays.
c) The size of the image is the same as the size of the object.
d) The inversion is horizontal, meaning that left becomes right and right becomes left.

117. The two functions of plane mirrors are to: a) change the trajectory (direction) of light rays by reflection, and b) to increase the field of vision (by allowing you to see things you normally wouldn't see with your eyes).

118. Refraction is the deviation (shifting) of light rays as light travels from one transparent medium (e.g. air) to another (e.g. glass, water, or plastic).

119. Refraction happens because light travels at different speeds in different media. As it passes from one medium to another, the light 'bends' as it slows down or picks up speed. What is altered is the speed of the light, and the direction it is traveling.

120. The most common practical use for refraction is lenses.

121. A lens is an object made of transparent material that has at least one curve and that refracts light.

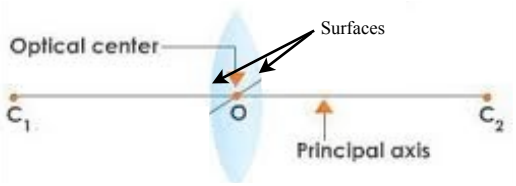
122. The two types of lenses are converging (convex) and diverging (concave).

123. Converging lenses refract light in a way that brings them closer together.

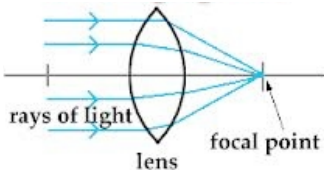
124. Diverging lenses refract light in a way that moves them further apart.

125. Converging lenses are wider in the middle and narrower in the edges. Diverging lenses are narrower in the middle and wider at the edges.

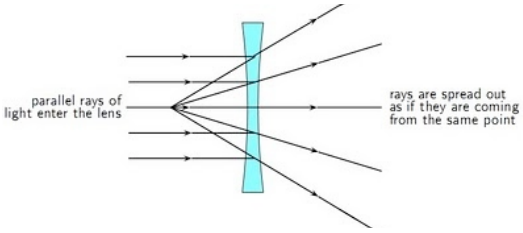
126.



127. The focal point of a converging lens is on the opposite side of the parallel rays coming in, and is the point where the light rays all bend and meet.



128. The focal point of a diverging lens is the imaginary source of the refracted rays. It happens on the same side as the parallel incoming rays of light.



129. There are two focal points on a lens because light can come from either direction, so the focal point can be on one side or the other of the lens. The first focal point is the primary focal point (F or F_1) and the second focal point is the secondary focal point (F' or F_2).

130. See the pictures in your book, figure 4.37, page 112. Or you can look at your workbook, page 59.

131. See the pictures in your book, figure 4.38, page 113. Or you can look at your workbook, page 60.

132. The principal focal point of a converging lens is on the opposite side of where the light rays come into the lens (i.e. in front of the lens). The principal focal point of a diverging lens is behind the lens, one the same side as where the rays come from. See the images in answers for #127 and #128 for the visuals.

133. See attached sheet for how the lines should be drawn, and where the images should be.
a) The image is real, smaller than the object, and inverted.
b) The image is real, the same size as the object, and inverted.
c) The image is real, larger than the object, and inverted.
d) There can be no image, as the rays are parallel and will never cross.
e) The light rays have to be 'stretched' to get the image, so the image is virtual. The object is larger, and right side up.

134. The only case where the image is not inverted when using a converging lens is when the object is between the lens and the secondary (alternate) focal point (F').

135. See attached sheet. In all cases with diverging lenses, the image is virtual, right-side-up, and smaller than the object.

136. In one word, no.

137. Myopia (near-sightedness) is treated with diverging lenses, and hyperopia (near-sightedness) is treated with converging lenses.

Chapter 5 stuff:

138. A cell is the basic unit of life.

139. The three parts are the nucleus, the cytoplasm, and the cell membrane.

140. Nucleus - the control center of the brain.
DNA - (deoxyribonucleic acid) Is the genetic material that holds the blueprint and has all the information that the cell needs to function. It is found inside the nucleus.
Nuclear membrane - a barrier that surrounds the nucleus and controls what goes in and out.
Cell membrane - the barrier that surrounds the cell to protect it and control what goes in and out.
Mitochondria - They produce energy for the cell.
Lysosomes - Digest and recycle material within the cell.
Cytoplasm - a gooey-like substance that fills the inside of the cell and surrounds the organelles.
Cytosol - a name for all the inside of the cell, including the cytoplasm, organelles, and dissolved substances.
Ribosomes - the protein manufactures of the cell. They can either be free or attached to the ER.
Endoplasmic Reticulum (ER) - The main transport system for the cell.
Golgi apparatus - Stores material, packages it, and distributes it through the cell and in or out of the cell.
Vacuoles - Bubbles within the cell that are used for storage (and sometimes transport).

141. The difference between a plant and animal cell is that a plant cell tends to be square in shape, the plant cell has an extra outer layer called the cell wall, the plant cell has a very large vacuole that usually stores food and water for the plant, and the plant cell has an extra organelle called chloroplasts that are green and are where photosynthesis happens.

142. DNA (deoxyribonucleic acid) is a long chain of chemicals that are arranged in base pairs. It has the shape of a helix (twisted rope ladder look), and the order of the base pairs dictates all the information a cell needs to function.

143. A genome is the entire set of genetic information (DNA) that a person has within their cells. A genome can also represent all the genetic information that is available within a species.

144. A gene is a distinct segment of DNA that contains information to do one particular job within a cell.

145. Genetic diversity is the unique variation within all the genes in a species. Variation means that each individual has a unique mix of genes that code for every possible function within an organism, such as height, skin colour, hair colour, shape of body parts, etc.

146. The more genes get distributed and mixed up within a population, the more each individual is unique and can perhaps overcome problems - such as resistance to illness, or adaptations to the environment.

When a population is very small and doesn't mix with other populations, the genetic diversity is very limited. That means if a problem occurs that affects one individual, chances are very strong that most of the rest of the population will be affected in the same way.

But when a population is very large, and has lots of mixing of its genes, every individual has a different genetic makeup that gives unique advantages or disadvantages. So if something bad happens, there is a greater chance that many members of the population will survive to pass on their genes.

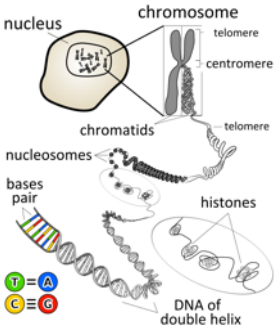
147. Cell division is the process by which a cell reproduces its genetic material and splits to make new cells.

148. Cell division is important for growth, repair and reproduction.

149. No, cells are not constantly dividing. Most of the time they are in a restful state going about their normal business. Division only happens some of the time. The period of rest between divisions is called interphase.

150. A chromosome if a distinct part of the genome (DNA) in a cell. In humans, there are 23 pairs of chromosomes, to make a total of 46 chromosomes. Half the chromosomes come from a parent, and the other half from the other parent.

151. Each half of the 'X' is called a chromatid.
The ends of the chromatics are called telomeres.
The centre of the x is called the centromere.



152. Interphase - the part where the cell rests, and makes copies of its DNA in preparation for cell division. The DNA is invisible, unwound and tangled together like a big bowl of spaghetti.
Prophase - the DNA winds itself up into the shape of chromosomes, and the nuclear membrane disappears.
Metaphase - the DNA migrates towards the center of the cell in a line. Each chromosome is attached to filaments, that connect them to spindles at each end of the cell.
Anaphase - the sister strands separate, and half of each chromosome is pulled to opposite ends of the cell.
Telophase - The cell membrane pinches into two new cells, the DNA unwinds, the nuclear membrane re-forms, and the cell returns to interphase.

153. A haploid cell has half of the genetic material a normal cell would have. A diploid cell has the complete set of genetic material of a normal cell. For humans, a haploid cell would have 23 chromosomes, and a diploid cell has 46 chromosomes (23 from each parent).
Haploid cells are only used for reproduction (sperm and eggs). Diploid cells make up the rest of the cells in an organism.

154. Mitosis happens when regular diploid cells divide to make two new regular diploid cells. Meiosis is a special type of division that only occurs in the ovaries and testes to make gametes (the reproductive cells - sperm and eggs). In Meiosis, the diploid cells divide twice, making four new haploid cells.

155. Meiosis has two divisions in a row. The first division (Meiosis I) separates one cell with 46 x-shaped chromosomes into 2 cells with 23 x-shaped chromosomes each. The second division (Meiosis II) breaks the x-shaped chromosomes into separate sister strands that go into separate cells. After Meiosis II, there are 4 haploid cells with 23 single strand chromosomes.

156. The organization goes as follows: cells ➔ tissues ➔ organs ➔ systems ➔ organism
As you move towards the right, the cells become more and more organized and the groups of cells get bigger and bigger.

157. A tissue is a group of similar cells that are grouped together to perform a common function.

158. An organ is a group of two or more tissues that group together to perform one or more specific functions.

159. A system is a group of organs that work together to accomplish a common function.

160. An organism is a group of system that form an individual (a plant, an animal, a fungus, etc.)

161. The four main types of tissues in the body are:

Epithelial tissue - they cover and protect the body and organs, secrete, absorb and filter substances.
Connective tissue - they connect and support tissues and organs within the body. They also feed and protect.
Nerve tissue - they control and guide the body, and use signals to allow different parts of the body to communicate.
Muscle tissue - They help different parts of the body move and carry material through the body. They can either be voluntary or involuntary movements.

162. The systems (as listed in the book, plus one) are:
Cardiovascular - circulates the blood.
Digestive - breaks down, absorbs and eliminates food
Endocrine - uses hormones to control organs
Excretory - eliminates waste
Immune - defends the body against invaders that could harm it
Lymphatic - works with the immune system to fight invaders
Musculoskeletal - gives the body its shape and movement
Nervous - controls the body and interacts with the environment around it
Reproductive - sexual reproduction
Respiratory - Takes in oxygen and expels carbon dioxide.

That's it! If you can answer all these, you're in *very* good shape for the January exam.