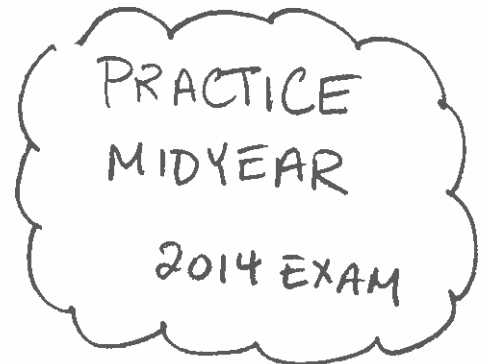




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Mid-year exam  
January 30, 1:20 – 3:30, 2 hours

# Sec 3 Applied Science and Technology

## STA 306

### Question and Answer Booklet

For classes of: Mr. D. Pyke (03/04/05/06) and Mr. L. Taylor (01/02)

Student Name: \_\_\_\_\_

Teacher: \_\_\_\_\_

Group #: \_\_\_\_\_

## Science and Technology Midyear Exam, STA-306: January 2014

There are two sections to your exam, for a total of 100 marks as follows:

- |   |                    |                          |
|---|--------------------|--------------------------|
| 1 | 25 Multiple choice | (50 marks, 2 marks each) |
| 2 | Short answers      | (50 marks)               |

### Section 1: Multiple Choice

Identify one letter that best answers the question by filling in the appropriate square on the answer sheet.

\*\*\*All answers are to be written on the answer sheet provided at the back of the booklet.\*\*\*

1. Which of the following is FALSE?

- a) Atoms are the basic units of matter.  $\uparrow$
- b) Elements may be atomic or molecular.
- c) Molecules have two or more atoms chemically bonded.  $\uparrow$
- d) Molecules are always compounds.  $\cdot \uparrow$

*All compounds are molecules but not all molecules are compounds (ie H<sub>2</sub>)*

2. The main cause for the difference between a solid phase of matter like ice and a liquid phase of matter like water is that:

- a) the solid particles are closer together.
- b) the liquid particles have lower forces of attraction between them.
- c) the solid particles have less thermal energy.
- d) the liquid particles are incompressible.

3. If Jennie prepares 200 ml of a sugar solution with a concentration of 120 g/L, how much sugar will she have to mass on a balance?

- a) 16.7 g
- b) 24 g
- c) 240 g
- d) 600 g

$$c = \frac{m}{v} \quad 120 \frac{\text{g}}{\text{L}} = \frac{m}{0.200 \text{ L}}$$

4. A 350 ml can of concentrated orange juice has a sugar concentration of 440 g/L. If Nathan adds 3 cans of water to dilute it into orange juice, what will the juice's sugar concentration be?  $C_2 = ?$

Note:  $C_1V_1 = C_2V_2$ , 1: before dilution, 2: after dilution

- a) 88 g/L
- b) 100 g/L
- c) 110 g/L
- d) 147 g/L

$$\left( \frac{440 \text{ g}}{\text{L}} \right) (0.350 \text{ L}) = C_2 (1.4 \text{ L})$$

$$C_2 = 110 \text{ g/L}$$

5. How is the solubility of carbon dioxide (CO<sub>2(g)</sub>) in sparkling mineral water and the solubility of salt (NaCl(s)) in a sports drink affected by an increase in temperature?

- ~~a) The solubility of CO<sub>2(g)</sub> increases while the solubility of NaCl(s) decreases.~~
- b) The solubility of both increases.
- ~~c) The solubility of both decreases.~~
- d) The solubility of CO<sub>2(g)</sub> decreases while the solubility of NaCl(s) increases. —

*gases:  $\uparrow T$ ,  $\downarrow$  solubility  
salts:  $\uparrow T$ ,  $\uparrow$  solubility*

6. The following table shows the data obtained when Alexia determined the density of a pure liquid.

Mass of graduated cylinder (m <sub>i</sub> )	Volume of liquid	Mass of cylinder with liquid (m <sub>f</sub> )
28.6 g	28.6 ml	51.2 g

Since the formula for density is mass divided by volume, Amy concluded that:

- a) The liquid is methanol with a density of 0.79 g/ml.
- b) The liquid is water with a density of 1.00 g/ml
- c) The liquid is vinegar with a density of 1.27 g/ml
- d) The liquid is glycerol with a density of 1.79 g/ml

$$51.2 \text{ g} - 28.6 \text{ g} = 22.6 \text{ g}$$

$$\frac{22.6 \text{ g}}{28.6 \text{ mL}} = 0.79 \frac{\text{g}}{\text{mL}}$$

7. An effective method for separating a mixture of methanol dissolved in water is:

- a) centrifugation
- b) decantation
- c) distillation
- d) filtering

8. Brandon identified various properties.

Which of the following could Brandon say was a characteristic chemical property?

- a) Blue litmus turned red in hydrochloric acid.
- b. Ethanol boiled at 75 degrees Celsius.
- c. The solubility of carbon dioxide was 1.6 g/L.
- d. A metal rod's <sup>density</sup> was found to be 2.7 g/cm<sup>3</sup>.

physical: - freezing pt.  
- boiling pt.  
- melting pt.  
- density

chemical: litmus  
flame tests  
color of salts in flame.

9. During an experiment, a glass rod, a piece of tin, some copper powder and some rubbing alcohol were each heated separately by Emily. The following changes were observed:

- 1. The glass rod became flexible.
- 2. The piece of tin became liquid.
- 3. The copper powder turned black.
- 4. The rubbing alcohol caught on fire

Which of these changes could Emily state were chemical changes?

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

10. Alex used a graduated cylinder and a hotplate to measure and heat three beakers of water.

- 1. 250 ml of water heated to 40°C
- 2. 500 ml of water heated to 20°C
- 3. 500 ml of water heated to 40°C

more molecules present, greater amount of kinetic energy in a system, greater thermal energy

Which beaker could Alex state contained the greatest amount of thermal energy?

- a) They all contain the same thermal energy.
- b) Beaker 1
- c) Beaker 2
- d) Beaker 3

exothermic = release  
endothermic = absorbed

11. Christian performed the following physical changes of state in the lab.

- 1. Alcohol evaporated from a filter paper. x liquid → gas
- 2. Mercury vapour condensed into shiny droplets on the side of a test tube. ✓ gas → liquid
- 3. Tin was melted in a crucible. x solid → liquid
- 4. Purple iodine crystals deposited on the sides of a flask of from its gas. ✓ gas → solid

Which changes could Christian state that a release of energy was observed?

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

12. Nicholas dissolved two solid solutes in 40 ml of water in a beaker and noted the following changes in temperature.

1. Sodium hydroxide caused the temperature of the water to increase by 10°C *exothermic released*
2. Ammonium chloride caused the temperature of the water to decrease by 5°C. *endothermic absorbed*

Nicholas concluded that the role energy played in the dissolution of the solutes was that:

- a) Energy was absorbed during each dissolution.
- b) Energy was released during each dissolution.
- c) Energy was released by the dissolution of ammonium chloride.
- d) Energy was released by the dissolution of sodium hydroxide.

13. When hydrogen gas, H<sub>2</sub>, burns in air, it reacts with oxygen gas, O<sub>2</sub>, to form water, H<sub>2</sub>O.

Which of the following statements is TRUE?

- a) This water is the reagent (reactant) of a synthesis reaction. *x*
- b) This water is the product of a synthesis reaction. ✓
- c) This water is the reagent of a decomposition reaction. *x*
- d) This water is the product of a decomposition reaction. *x*



14. Pressure on a surface may be reduced by:

- a) decreasing the force and decreasing the surface area to which the force is applied.
- b) increasing the force and decreasing the surface area to which the force is applied.
- c) increasing the force and increasing the surface area to which the force is applied.
- d) decreasing the force and increasing the surface area to which the force is applied.

$$P = \frac{F}{A}$$

*↓ F ↑ A*

15. Pressure on an object in an incompressible fluid can be increased by:

- a) increasing the depth of the object in the fluid and increasing the density of the fluid.
- b) decreasing the depth of the object in the fluid and decreasing the density of the fluid.
- c) increasing the depth of the object in the fluid and decreasing the density of the fluid.
- d) decreasing the depth of the object in the fluid and increasing the density of the fluid.

*↑ depth ↑ density*  
Think "deep under water."

16. Pressure on the walls of a container holding a compressible fluid may be reduced by:

- a) increasing the number of particles in the container. *x*
- b) increasing the volume of the container. ✓
- c) increasing the temperature of the fluid. *x*
- d) increasing all of the above.

Think "fire extinguisher"

17. Caroline obtained the following data for the forces applied to four surfaces.

She knows the formula for pressure is  $P = F/A$  where F is the force and A is the surface area.

1. 1000 N of force on a surface with an area of 0.10 m<sup>2</sup> *10000 N*
2. 500 N of force on a surface with an area of 0.04 m<sup>2</sup> *12500 N*
3. 200 N of force on a surface with an area of 0.01 m<sup>2</sup> *20000 N*
4. 300 N of force on a surface with an area of 0.02 m<sup>2</sup> *15000 N*

$$P = \frac{F}{A}$$

What order would Caroline have arranged them from **lowest to highest pressure**?

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

*1, 2, 4, 3*

18. The greater the amount of energy transported by electromagnetic radiation:

- a) the greater the frequency and the longer the wavelength.
- b) the lower the frequency and shorter the wavelength.
- c) the greater the frequency and the shorter the wavelength.
- d) the lower the frequency and the longer the wavelength.

19. Diverging (concave) lenses for myopia (nearsightedness) produce images that are:

- a) real, inverted and larger than the object.
- b) virtual, upright and smaller than the object.
- c) real, upright and smaller than the object
- d) virtual, inverted and larger than the object.



upright  
smaller  
virtual

20. Ultrasound is characterized by:

- a) a sound wave that has a higher frequency than what we can hear.
- b) a sound wave that has a lower frequency than what we can hear.
- c) a sound wave that has a lower intensity than what we can hear.
- d) a sound wave that has a higher intensity than what we can hear.

21. When listening to music the intensity increased from 30 dB to 60 dB the intensity of the sound increases by:

- a) twice that of 30 dB.
- b) 30 times that of 30 dB.
- c) 100 times that of 30 dB.
- d) 1000 times that of 30 dB.

30 > 10  
40 > 10  
50 > 10  
60 > 10

$$10 \times 10 \times 10 = 1000$$

22. The phases of cell division for mitosis and meiosis I and II occur in the following order:

- a) Anaphase, Metaphase, Prophase, Telophase
- b) Metaphase, Anaphase, Telophase, Anaphase
- c) Prophase, Metaphase, Anaphase, Telophase
- d) Telophase, Anaphase, Metaphase, Prophase

I P M A T

23. Characteristics of mitosis and meiosis, two methods of cell division, are listed below.

1. It produces four different haploid gametes. *meiosis*
2. It produces two identical diploid daughter cells. *mitosis*
3. It is used for tissue repair and growth *mitosis*
4. It is used for sexual reproduction *meiosis*

Which two statements describe mitosis?

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

24. Anna is at the beginning of her ovarian cycle. Which hormone triggers the maturation of her ovarian follicle?

- a) FSH
- b) LH
- c) estrogen
- d) progesterone

25. This nutrient is made of chains of amino acids and functions to build and repair body tissue.

- a) Carbohydrate
- b) Fat
- c) Protein
- d) Vitamin

Section 2 Short Answers

Answer Sheet Name: \_\_\_\_\_ Grp. \_\_\_\_\_

Section 1, Multiple Choice: Darken one appropriate square for each question.

	A	B	C	D		A	B	C	D		A	B	C	D
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	19	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	20	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	21	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	13	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	22	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	23	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	24	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	16	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	25	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	17	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	18	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>					

Section 2, Short answers:

1. Define what Atoms, Molecules, Elements and Compounds are by giving a brief description of each. Responses should include appropriate scientific vocabulary. Include an example for each by naming or giving its chemical formula. (8 marks)

- a) Atoms are basic unit of a chemical element, made up of protons, electrons, neutrons and an example is C, O, N (any element on periodic table = OK)
- b) Molecules are groups of atoms bonded together and an example is N<sub>2</sub>, H<sub>2</sub>O, O<sub>3</sub>
- c) Elements are substances that cannot be broken down by chemical means and an example is any element on the periodic table C, O, N
- d) Compounds are molecules made up of two or more elements and an example is NO<sub>2</sub>, H<sub>2</sub>O, but NOT O<sub>2</sub>, H<sub>2</sub> etc.

2. Daniel is asked to produce 250 ml of a salt solution with a concentration of 40 g/L.

Calculate the mass of salt that Daniel must mass in order to make the solution.

The formula for the concentration of a solution is  $C = m/V$ , where m is the mass of solute and V is the volume of solution.

Show all work and units (4 marks)

Data: $V = 250 \text{ mL}$ $C = \frac{40 \text{ g}}{\text{L}}$	Formula: $C = \frac{m}{V}$ Work: $\frac{40 \text{ g}}{\text{L}} = \frac{m}{0.250 \text{ L}}$
Answer: The mass of salt required to make the solution is <u>10 g</u>	

3. Katia is asked to comment on the energy transfers and transformations that occur on her farm. (8 marks)  
 She grows tomato plants in her field where they grow all summer and then harvests them for sauce that she and her family eat throughout the year. She also burns wood that she cuts on her land to warm the farmhouse.  
 For each change indicate the type of energy that is transferred or transformed.

(Use Chemical, Mechanical, Radiant and Thermal Energy)

A) The plants grow by photosynthesis on a bright summer day:

What type of energy is transferred to the tomato plants for photosynthesis? radiant

What type of energy is it transformed to by photosynthesis? chemical (plants = food)

B) The family eats a hearty spaghetti dinner with tomato sauce that allows them to dance.

What type of energy is transferred to the family by eating? chemical

What type of energy is it transformed to when they dance? Kinetic = mechanical

C) Logs in the wood stove burn.

What type of energy is transferred to the wood stove? chemical

What types of energy is it transformed to by burning? thermal and radiant

D) Heat from the fire warms their tired feet after dancing.

What type of energy is transferred to warm their feet? thermal

4. The following chemical equation represents the burning of acetylene in a welding torch:



Indicate the number of atoms of each type in the reagents and the products. (3 marks)

Before: 4 C atoms, 4 H atoms, 10 O atoms; After: 4 C atoms, 4 H atoms, 10 O atoms

Does this follow the conservation of mass (y/n): yes (1 mark)

What type of chemical reaction is represented? combustion (1 mark) (also accept oxidation)

Is energy released or absorbed? released (1 mark)

5. Mike's garage has a hydraulic lift that can generate enough force to lift heavy vehicles.

a) If the force needed to lift a 2000 kg truck is 20 000 N and the surface area is 0.1 m<sup>2</sup>, what is the pressure of the hydraulic fluid?

The formula for pressure is  $P = F/A$  where F is the force and A is the surface area.

Include work and units. (4 marks)

Data: $m = 2000 \text{ kg}$ $F = 20000 \text{ N}$ $A = 0.1 \text{ m}^2$	Formula: $P = \frac{F}{A}$ Work: $P = \frac{20000 \text{ N}}{0.1 \text{ m}^2}$
Answer: The pressure of the fluid is <u>200 000 Pa or 200 kPa</u>	

irrelevant

b) Mikes hydraulic lift is operated by a foot pedal's piston with a surface area of only  $0.001 \text{ m}^2$ .

Given the pressure generated by the hydraulic fluid that was previously calculated, how much force is required by the foot pedal to raise the truck? (4 marks) Show formula, work and units.

Data: $A = 0.001 \text{ m}^2$ $P = 200000 \text{ Pa}$	Formula: $P = \frac{F}{A}$ Work: $200000 \text{ Pa} = \frac{F}{0.001 \text{ m}^2}$
Answer: The force applied to the pedal's piston is $200 \text{ N}$	

6. Give the function of the following organelles found in our cells. (3 marks)

a) nucleus:

Contains genetic material (DNA) & proteins

b) mitochondrion:

"powerhouse of the cell" that produces energy in form of ATP

c) lysosome:

contains enzymes to break down waste products + other cellular molecules

7. The two hormones that trigger puberty are LH and FSH produced by the pituitary gland of the brain. (these are first stimulated by GnRH)

They act on the male sex glands called testes that produce the male sex hormone called testosterone and on the female sex glands called ovaries to produce the female sex hormones called estrogen and progesterone. (8 marks)

8. Use full sentences to state the three components of our diet that can supply us with energy and which foods are good sources for each. Include a discussion of energy balance in your answer. (5 marks)

Protein - comprised of amino acids, found in meat, poultry, nuts, lentils.

Carbohydrates - comprised of monosaccharides arranged in complex molecules like starch, cellulose, sucrose, etc. - fruits, vegetables, bread, grains, pasta

Fats - lipids, sterols, waxes; comprised of triglycerides (fatty acids & glycerol) Found in meats (especially dark meats), dairy, avocados, oils, olives, nuts