Part A: Short-Answer Questions

Question 1

Example of appropriate responses

$Ca(OH)_2$	+ H_3PO_4	→ **H_2O**	+ **$Ca_3(PO_4)_2$**
calcium hydroxide	**hydrogen phosphate or phosphoric acid**	dihydrogen monoxide	calcium phosphate

Note: *Teacher should accept the naming of H_3PO_4 as an ionic bond or as an acid.*

Marking Scale

4 marks	Four (4) correct elements.
3 marks	Three (3) correct elements.
2 marks	Two (2) correct elements.
1 mark	One (1) correct element.
0 marks	No correct elements or no answer given.

Question 2

Example of appropriate responses

This is an **exothermic** reaction.

Marking Scale	
2 marks	Correct answer given.
0 mark	Incorrect answer or no answer given.

Question 3

The chemical equation for the oxidation of aluminum is:

$$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$$

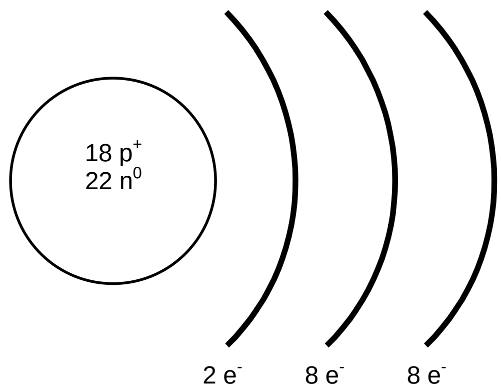
Note: *Students should not be penalized if the equation is not balanced.*

Marking Scale	
2 marks	Two (2) or three (3) correct elements (student recognized oxidation as reacting with oxygen; student remembered that oxygen is diatomic; student got the correct molecular formula for aluminum oxide).
1 mark	One (1) correct element.
0 marks	No correct elements or no answer given.

Question 4

Example of an appropriate response

Simplified atomic model of Argon:



Marking Scale	
4 marks	Four (4) correct elements (including number of p^+, e^- and n^0 and number of shells).
3 marks	Three (3) correct elements.
2 marks	Two (2) correct elements.
1 mark	One (1) correct element.
0 marks	No correct elements or no answer given.

Question 5

Example of appropriate responses

a) Terminal 1 is **negatively** charged.

Pole A is a **South** Pole.

b) **Any two (2**) of the following:
Increase current.
Increase the number of coils.
Change the core material to something more ferromagnetic.

Marking Scale	
4 marks	Four (4) correct elements.
3 marks	Three (3) correct elements.
2 marks	Two (2) correct elements.
1 mark	One (1) correct element.
0 marks	No correct elements or no answer given.

Question 6

Example of an appropriate procedure

Determine the mass of the second chlorine isotope
$17\ p^+ + 20\ n^0 = 37$ a.m.u.

Determine the abundance of the second chlorine atom
100% - 76% = 24%

Determine the average atomic mass

$$\begin{aligned}\text{Average atomic mass of Cl} &= (0.76 \times 35) + (0.24 \times 37) \\ &= 26.6 + 8.88 \\ &= 35.48 \text{ a.m.u.}\end{aligned}$$

The average atomic mass of chlorine is **35.48 a.m.u.**

Note: *Students should not be penalized for not using significant figures.*

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure, but incorrect answer because of minor mistakes such as a calculation or transcription error, an incorrect or missing unit of measure.
2 marks	Appropriate procedure but incorrect answer because of major mistakes.
1 mark	Partially appropriate procedure regardless of the answer.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the answer.

Question 7

Example of an appropriate procedure

Determines the mass of the water

$$2\ \text{L} \times \frac{1000\ \text{mL}}{1\text{L}} \times \frac{1\text{g}}{1\text{mL}} = 2000\ \text{g}$$

Determines ΔT

$$Q = mc\Delta T$$

$$670\ 400 = 2000\ (4.19)\Delta T$$

$$\frac{670\ 400}{(2000)(4.19)} = \Delta T$$

$$\frac{670\ 400}{8380} = \Delta T$$

$$80°\text{C} = \Delta T$$

Determines the initial temperature of the water

$$\Delta T = T_\text{f} - T_\text{i}$$

$$80 = 100 - T_\text{i}$$

$$T_\text{i} = 20°\text{C}$$

Answer: The initial temperature of the water is **20°C or** $\mathbf{2 \times 10^{1}}$**°C**.

Note: *Significant figures should not be applied until the final result. The "2" will limit the answer to 1 significant digit.*

Marking Scale

4 marks	Appropriate calculations and correct answer.
3 marks	Appropriate calculations with minor error (e.g. boiling temperature not 100 C and/or missing units) and/or incorrect significant figures.
2 marks	Appropriate calculation with major error (e.g. did not calculate temperature difference, did not convert L to g).
1 mark	Inappropriate calculation related to topic.
0 marks	Inappropriate calculation not related to topic or no calculations.

Question 8

Example of appropriate responses

a) **Lake Whitefish** can be eaten more often.

Marking Scale	
2 marks	Correct answer.
0 marks	Incorrect answer.

b) **Justification**

- Lake Whitefish can be eaten more often because they are at a lower **trophic** level than the Lake Trout or the Northern Pike.
- Contaminants like mercury **bioaccumulate** over time in the tissues of organisms.
- They will **bioconcentrate (bioamplify)** at higher trophic levels.

Marking Scale	
2 marks	Any two (2) correct elements.
1 mark	One (1) correct element.
0 marks	No correct elements or no answer given.

Question 9

Example of an appropriate procedure

Determines the amount of work

$W = F\Delta d$

$W = 50.0 \cos(40.0) \times 200$

$W = 7660 \text{ J}$

Answer: Mr. Logan will do **7.7×10^3 Joules of work.**

Note: *Significant figures should not be applied until the final result. The 2.0×10^2 limits the answer to 2 significant digits.*

Marking Scale	
4 marks	Appropriate procedure and calculations with no errors.
3 marks	Appropriate procedure and calculations with minor errors (e.g. significant figures and/or missing units).
2 marks	Significant error in calculations (forgets trigonometry, uses wrong trigonometric function).
1 mark	Significant error in both procedure and calculations.
0 marks	Inappropriate calculation not related to topic or no calculations.

Part B: Long-Answer Questions

Question 10

Example of an appropriate procedure

Equivalent Resistance of Circuit A

Determines the value of the unknown resistor

$$R_1 = \frac{V_1}{A} = \frac{1.0}{0.50} = 2\ \Omega$$

Determines the equivalent resistance of the circuit

$$R_{eq} = R_1 + R_2 + R_3 + R_4 + R_5$$

$$R_{eq} = 2 + 10 + 10 + 5 + 5$$

$$R_{eq} = 32\ \Omega$$

Equivalent Resistance of Circuit B

Determines the value of the resistor A
Brown – Black – Brown
$10 \times 10^1 = 100\ \Omega$

Determines the value of the resistor B
Green – Black – Black
$50 \times 10^0 = 50\ \Omega$

Determines the equivalent resistance of the circuit

$$R_{eq} = \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

$$\frac{1}{R_{eq}} = \frac{1}{100} + \frac{1}{100} + \frac{1}{25} + \frac{1}{50} + \frac{1}{50}$$

$$\frac{1}{R_{eq}} = 0.1$$

$$R_{eq} = 10\ \Omega$$

Answer: **Circuit A** has the greatest resistance.

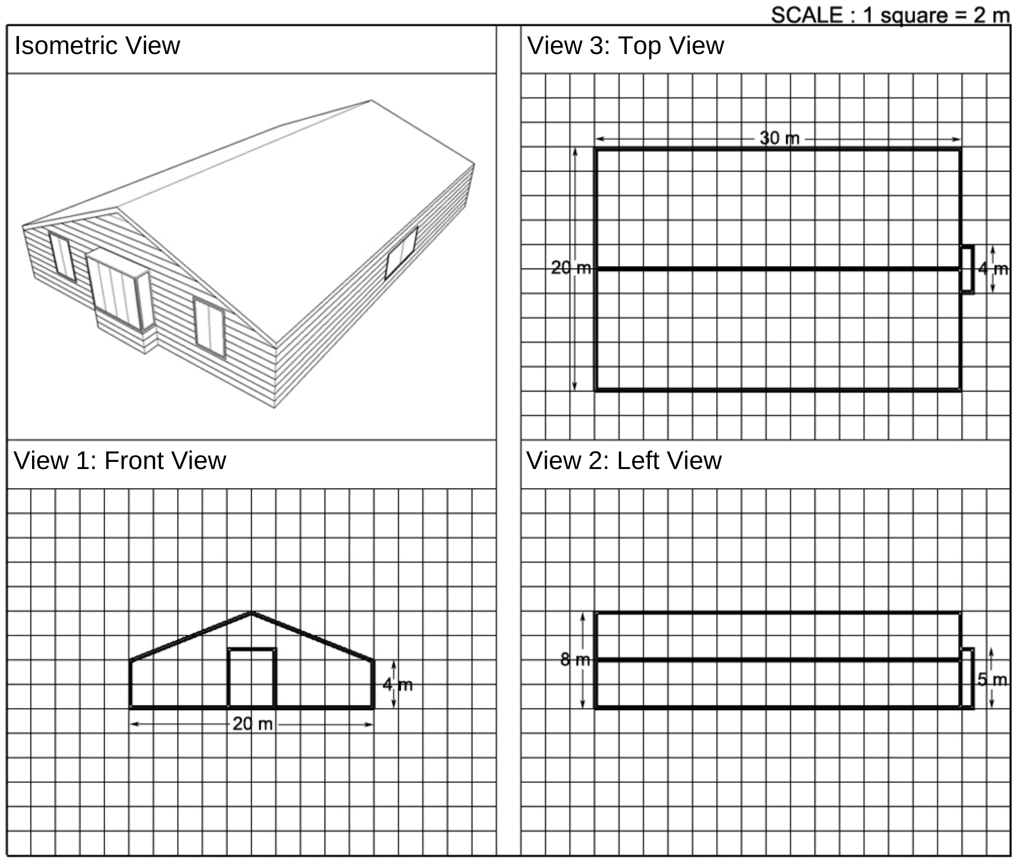
Note: *Students should not be penalized for not using significant figures.*

Marking Scale

8 marks	Appropriate calculations and correct answer.
7 marks	Appropriate calculations with minor error (e.g. addition/subtraction or multiplication/division error and/or missing units).
5 marks	Appropriate calculation with one major error (e.g. wrong coding for resistors).
4 marks	Appropriate calculation with two major errors.
2 mark	Inappropriate calculation related to topic.
0 marks	Inappropriate calculation not related to topic or no calculations.

Question 11

Example of an appropriate procedure



Note: *Accept other possible solutions.*

Marking Scale

8 marks	Three (3) correctly drawn views with proper scaling and labelling.
6 marks	Three (3) correctly drawn views with minor errors in labelling (eg. scale, measurement and /or alignment).
4 marks	Three views with significant scaling errors or does not take into account the presence of the Bay window.
2 mark	Incomplete views or major errors in scaling.
0 marks	Improper views with no scaling factor.

Question 12

Example of an appropriate procedure

Determine the number of moles of carbon

$$20.0 \text{ g of C} \times \frac{1 \text{ mol}}{12.01 \text{ g}/\text{mol}} = 1.67 \text{ mol of C}$$

Determine the number of moles of potassium sulfide by using the mole ratio

$$3\text{C} : 1\text{K}_2\text{S}$$
$$\frac{3}{1} = \frac{1.67}{x}$$
$$x = 0.557 \text{ mol K}_2\text{S}$$

Determine the molar mass of potassium sulfide

$$39.1 + 39.1 + 32.1 = 110.3 \text{ g}/\text{mol}$$

Determine the mass of potassium sulfide produced

$$0.557 \text{ mol of K}_2\text{S} \times \frac{110.3 \text{ g}}{1 \text{ mol of K}_2\text{S}} = 61.4 \text{ g K}_2\text{S}$$

Answer: A mass of **61.4 g** of K_2S will be produced.

Note: *Significant figures should not be applied until the final result. The answer is limited to 3 significant figures by step 2.*

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure, but incorrect answer because of minor mistakes such as a calculation or transcription error, an incorrect or missing unit of measure.
2 marks	Appropriate procedure but incorrect answer because of major mistakes.
1 mark	Partially appropriate procedure regardless of the answer.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the answer.

Question 13

Example of an appropriate procedure

a) Variables: 5.0 m = height
55 kg = mass
9.8 N/kg = gravitational field intensity

Solution:

1. Find the energy at the top of the waterslide (gravitational potential energy).

$$E_p = mgh$$
$$= 55 \times 9.8 \times 5.0$$
$$E_p = 2695 \text{ J}$$

E_T at top of waterslide = 2695 J

2. Find the velocity at the bottom of the waterslide.

$$E_T = E_p + E_k$$
$$E_T = mgh + ½\, mv^2$$
$$2695 = 0 + ½\, 55\, v^2$$
$$V^2 = 2695 / 27.5$$
$$V = \sqrt{98}$$
$$V = 9.9 \text{ m/s}^2$$

Answer: When Debra reaches the water she will be travelling at **9.9 m/s^2.**

Note: *Significant figures should not be applied until the final result. The answer is limited to 2 significant figures because of 55 and 5.0.*

Marking Scale	
6 marks	Appropriate calculations and correct answer.
5 marks	Appropriate calculations with a minor error (e.g. significant figures and/or missing unit).
4 marks	Appropriate calculations with a major error (e.g. does not find E_T or calculates E_K incorrectly).
2 marks	Does not apply.
1 mark	Inappropriate calculation related to topic.
0 marks	Inappropriate calculation not related to topic or no calculations.

b) Doubling the velocity of an object will increase the kinetic energy by a factor of four because kinetic energy is the energy an object has due to its motion. The energy that an object has depends upon two variables: the mass (m) of the object and the velocity (v) of the object. The kinetic energy of an object is directly proportional to the square of its velocity. That means that for a twofold increase in velocity, the kinetic energy will increase by a factor of four. The kinetic energy is dependent upon the square of the velocity.

Marking Scale	
2 marks	Approriate response related to the topic.
0 marks	Inappropriate response related to the topic.

Question 14

Example of an appropriate procedure

R	=	*round seeds*	*Y*	=	*yellow seeds*
r	=	*wrinkled seeds*	*y*	=	*green seeds*

Parental Genotypes

GgHh × gghh

Punnett Square

	RY	Ry	rY	ry
ry	RrYy	Rryy	rrYy	rryy

Expected Ratio

The expected ratio of phenotypes of the F_1 generation is

25% Round yellow seeds
25% Round green seeds
25% Wrinkled yellow seeds
25% Wrinkled green seeds

Note: *Students may answer using a ratio or fractions.*

Marking Scale

8 marks	Student had the correct genotypes for the parents, correctly completed the Punnett square and obtained the correct phenotype ratios.
6 marks	Student did not have the correct genotypes for the parents but correctly completed the Punnett square based on the genotypes he/she gave and the correct ratios given his/her genotypes.
4 marks	Had the correct genotypes for the parents but the student did not correctly fill in the Punnett square.
2 marks	Student was able to correctly identify the genotype of one parent.
0 marks	No elements of the solution showed an understanding of genetics or no answer was given.

Question 15

Note: *Calculations are not required for full marks.*

Example of appropriate calculations

Average phosphate concentrations:

Lake A:

$$\frac{4.5+4.2+4.8+4.9+4.6+4.0+3.8}{7}$$

$$=\frac{30.8}{7}$$

$$=4.4\mu\text{g per 50 mL sample}$$

$$\frac{4.4\ \mu g}{50\text{ mL}}\times\frac{1000\text{ mL}}{\text{L}}=\frac{88\ \mu g}{\text{L}}$$

The average concentration of phosphate in Lake A is 88 μg/L.

Lake B:

$$\frac{5.8+5.8+6.0+5.6+5.6+5.3+5.1}{7}$$

$$=\frac{39.2}{7}$$

$$=5.6\mu\text{g per 200 mL sample}$$

$$\frac{5.6\ \mu g}{200\text{ mL}}\times\frac{1000\text{ mL}}{\text{L}}=\frac{28\ \mu g}{\text{L}}$$

The average concentration of phosphate in Lake B is 28 μg/L.

Lake C:

$$\frac{4.3+4.1+4.2+4.2+4.3+3.9+4.4}{7}$$

$$=\frac{29.4}{7}$$

$$=4.2\ \mu\text{g per 25 mL sample}$$

$$\frac{4.2\ \mu g}{25\text{ mL}}\times\frac{1000\text{ mL}}{\text{L}}=\frac{168\ \mu g}{\text{L}}$$

The average concentration of phosphate in Lake C is 168 μg/L.

Average water temperature:

Lake A:

$$\frac{22.6 + 24.4 + 26.5 + 25.7 + 25.3}{5}$$
$$= \frac{124.5}{5}$$
$$= 24.9°C$$

The average water temperature for Lake A was 24.9°C.

Lake B:

$$\frac{22.1 + 23.8 + 26.0 + 25.2 + 24.4}{5}$$
$$= \frac{121.5}{5}$$
$$= 24.3°C$$

The average water temperature for Lake B was 24.3°C.

Lake C:

$$\frac{21.6 + 22.8 + 24.5 + 24.2 + 23.4}{5}$$
$$= \frac{116.5}{5}$$
$$= 23.3°C$$

The average water temperature for Lake C was 23.3°C.

Pros and Cons chart:

Example of appropriate responses

	Pros	Cons
Lake A	• The trees will absorb some of the nutrients flowing downhill from King Farms.	• Based on the phosphate concentration there is stimulated bacterial growth. • Average water temperature was 24.7°C, very close to the 25°C, which is optimal for bacterial growth. • Shade provided by trees will create intermittent light which promotes bacterial growth. • Lake A is stable with little to no water flow which will promote bacterial growth.
Lake B	• Based on the phosphate concentrations the lake in uncontaminated. • Average water temperature was 24.3°C, below the 25°C which is optimal for bacterial growth. • Lack of trees will encourage constant high intensity light which slows bacterial growth. • The presence of the large stream with rapids will create turbulence that will discourage bacterial growth.	
Lake C	• Average water temperature was 23.3°C, below the 25°C which is optimal for bacterial growth. • Lack of trees will encourage constant high intensity light which slows bacterial growth.	• Based on the phosphate concentrations, the lake is undergoing accelerated eutrophication. • Lake C is stable with little to no water flow which will promote bacterial growth. • There is no shelter/barrier to stop the flow of nutrients from Tremblay farms from entering the lake.

Example of appropriate responses

I would choose **Location 1** for the camp because:

Sample 1

Lake C is not at all swimmable, a key activity for summer camp. The phosphate concentrations show that it is undergoing accelerated eutrophication, which means a high presence of cyanobacteria. The cyanobacteria can cause health problems as minor as skin irritations but as major as attacking the liver. Although Location 2 has another available lake (Lake B) that shows no contamination, and is therefore not a health risk, by choosing Location 1 the camp could have 2 swimmable lakes because although Lake A shows some signs of bacterial growth, measures can be taken to preserve the lake.
(Aspect: Health)

Sample 2

Location 1 is also better because of the presence of the trees around Lake A. The dense tree population will be a good location for orienteering, another classic summer camp activity but will also shelter Location 1 from the smells produced by agricultural activity. The wall of trees will prevent the wind from blowing the smells directly towards the camp. Location 2 does not have the tree protection and although trees can be planted, it will take a long time for them to grow thick enough and tall enough to create a wall against the wind.
(Aspect: Social/environmental)

Sample 3

Location 1 shows the potential for expansion at a later date because of the undeveloped land surrounding it. Location 2 has less undeveloped land around it, which will limit expansion. Also, there is a higher chance of land contamination at location 2 because there are no “filters” to prevent run-off from Tremblay Farms from contaminating the soil. The presence of the tress above Location 1 will act as a filter, preventing run-off from King Farms from contaminating the soil.
(Aspect: Economic)

Conclusion

Location 1 is the better choice because there is a choice of two Lakes to swim in, there will be less of a “farm” odor, the trees provide more possibility for camp activities, there is a smaller risk of land contamination and the potential for expansion.

Marking Scale

Ten (10) marks are attributed to the two arguments.
Five (5) marks per argument.

- 2 marks Appropriate use of background information.
- 3 marks Application of scientific knowledge (interpretation).

Five (5) marks for overall structure.

- The student provides a summary statement.
- The student presents a cohesive argument overall. All arguments support the conclusion.
- The student used appropriate scientific language.
- The student included arguments that touched on more than one aspect.

Feedback Questionnaire

Environmental Science and Technology – Secondary Cycle 2 Year 2
Theory Examination – June 2011

Please comment on the following:

1. Time allotted for theory examination:

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2. Students' level of interest:

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3. Level of difficulty:

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4. Administration and Marking Guide (quality and clarity):

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5. Other comments:

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6. Please list any errors or omissions:

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Please return questionnaire to your school board Science consultant.
Thank You.