ALEXANDER ROAD HIGH SCHOOL

JUNE 2014 | 2.5 HOURS

PHYSICAL SCIENCE

IC, CO, KB | TOTAL = 150

GRADE 11

Instructions

- The question paper consists of 8 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided.
- Answer section B on the folio sheets provided.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system used on this question paper.
- A list of formulas and relevant constants can be found on the last page of this question paper.
- A periodic table can be found on the back of the answer sheet.
- Round off to two (2) decimal places unless otherwise stated.

SECTION A

- Answer on the answer sheet -

QUESTION 1 Multiple choice:

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (1.1 – 1.10) on the attached ANSWER SHEET.

1.1 An ideal gas is a gas …

A. with no spaces between the particles.

B. where there exists intermolecular forces.

C. in which the particles are constantly moving.

D. with perfectly elastic collisions between particles.

1.2 Boyle and Gay-Lussac investigated the following relationships:

	Boyle	**Gay-Lussac**
A	$p \alpha V$	$T \alpha P$
B	$T \alpha {}^{1}/_{P}$	$p \alpha V$
C	$T \alpha P$	$p \alpha {}^{1}/_{V}$
D	$p \alpha {}^{1}/_{V}$	$T \alpha P$

1.3 The electric field strength at a distance "*r*" from a charged sphere is E. When the charge on the sphere is doubled, what is the new electric field strength at a distance of 2*r* from the sphere?

A. 4E

B. ½ E

C. E

D. 2E

1.4 The formation of the NH_4^+ ion is an example of what type of bond?

A. Dative molecular bond

B. Dative ionic bond

C. Dative covalent bond

D. Dative metallic bond

1.5 The following pair of substances (NaCl and CCl_4) is an example of which type of intermolecular forces?

A. Ion-dipole forces

B. Dipole-dipole forces

C. Ion-induced dipole forces

D. London forces

1.6 If the speed of light in paraffin is $2{,}03 \times 10^8 m.s^{-1}$. What is its refractive?

A. 1,52

B. 1,48

C. 1,33

D. 1.50

1.7 You are given a positively charged electroscope. If a negatively charged perspex rod is brought closer to the disk on top, the gold foil leaf will…

A. Collapse

B. Stand up more

C. Drop a little

D. remain the same

1.8 Which of the following statements correctly describes Newton's third law of motion:

Forces occur in pairs that are…

A. Equal in direction and opposite in magnitude.

B. Equal in magnitude and opposite in direction.

C. Opposite in magnitude and opposite in direction.

D. Equal in magnitude and equal in direction.

1.9 A standard solution is a solution of known…

A. Temperature B. Pressure

C. Concentration D. Volume only

1.10 Which one of the following statements about a chemical reaction is TRUE…

The theoretical yield of a chemical reaction is usually…

A. equal to the percentage yield

B. equal to the percentage purity

C. less than the actual yield

D. greater than the actual yield

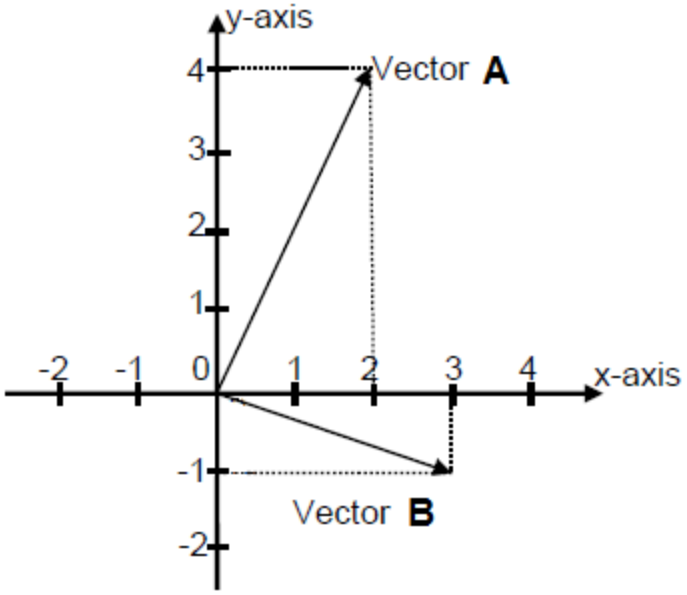
[2 X 10 = 20]

SECTION B

- Answer all questions on the folio pages provided -

QUESTION 2

Two vectors A and B were drawn to scale on the Cartesian plane below



2.1 Calculate the magnitude of Vector A. (2)

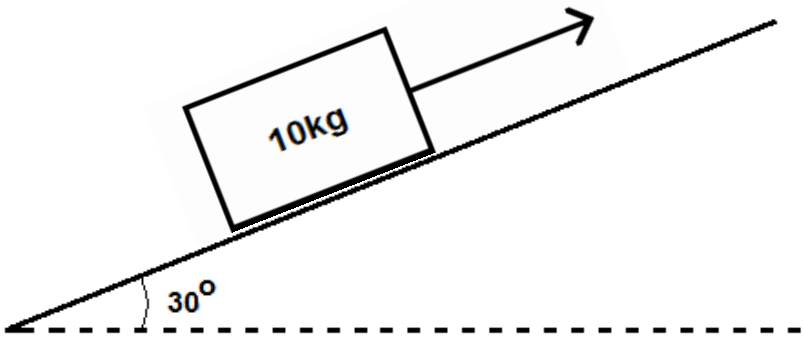
2.2 Calculate the direction of vector B (measured clockwise from the positive y-axis). (3)

2.3 Using components, calculate the magnitude of the resultant of vectors A and B. (3)

[8]

QUESTION 3:

A 10kg block is pulled up a rough inclined plane with a force of 200N. The plane makes an angle of 30^0 with the horizontal. Throughout the motion, the block experiences a constant frictional force of 30N.



3.1 Draw a free body diagram showing all the forces acting on the block. (4)

3.2 Determine the parallel and perpendicular components of the weight of the block. (4)

3.3 Calculate the magnitude of the NET FORCE parallel to the slope. (2)

3.4 Calculate the magnitude of the normal force. (1)

3.5 Determine the coefficient of kinetic friction between the block and the floor. (3)

3.6 If the angle between the slope and horizontal decreases, would the magnitude of the frictional force INCREASE, DECREASE or STAY THE SAME? (1)

[15]

QUESTION 4:

4.1.1 Give the definition of the EMPIRICAL formula of a compound. (2)

4.1.2 The molecular mass of an unknown substance is $93 g.mol^{-1}$. When analysed, it was found that the substance contained approximately 38.8% C, 16.1% H and 45.1% N. Calculate the molecular formula of the substance.

(4)

4.2 154g of sodium carbonate is treated with $500 cm^3$ of a $5 mol.dm^{-3}$ hydrochloric acid solution and $21 dm^3$ of CO_2 is collected from the reaction at STP.

$$Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$

4.2.1 Balance the above chemical equation. (2)

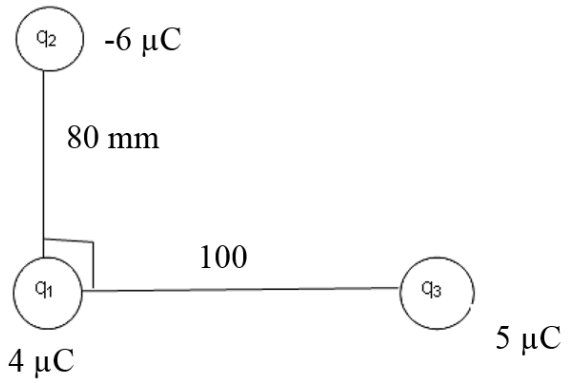
4.2.2 Calculate which reagent (Na_2CO_3 or HCl) is the limiting reagent. (8)

4.2.3 Calculate the percentage yield for the reaction. (5)

[21]

QUESTION 5

Consider the diagram below, not drawn to scale:



5.1.1 Draw a free-body diagram for all the electrostatic forces that act on $\mathbf{q_1}$. Also show the net electrostatic force (F_{net}). Label forces clearly. (2)

5.1.2 Draw a sketch of the electric field between q_2 and q_3. Only consider these two charges in the drawing. (2)

5.1.3 Calculate the magnitudes of $F_{q_1q_2}$ and $F_{q_3q_1}$. (5)

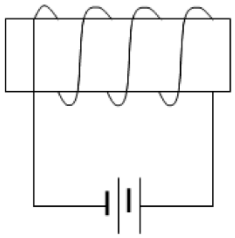
5.1.4 Calculate the net electrostatic force on q_1; magnitude and direction. (4)

5.2 Redraw the following sketches and draw the shape of the magnetic field caused by the current in each case. Also indicate the magnetic polarity in the solenoid.

5.2.1

(2)

5.2.2



(3)

5.2.3 What is the **name** of the law that was used to determine the polarity of the solenoid? (1)

5.3 A solenoid with 500 turns has a square cross-sectional area with 5cm side length. A magnetic field of 0,7 T is allowed to electromagnetically link with the solenoid with an angle of 60º between the normal and the field.

5.3.1 Calculate the flux through the solenoid. (3)

5.3.2 Calculate the induced *emf* if the solenoid is pushed **into** the magnetic field in 0,2 s and from a point where the magnetic flux is zero. (4)

5.3.3 State the name of the law that was used in 5.3.2. (1)

5.4.1 500cm^3 of oxygen is at a temperature of 27ºC under a pressure of 100kPa. The temperature of the gas is now changed to 77ºC and the pressure is increased to 150kPa. Calculate the new volume that the gas will occupy in dm^3. (5)

5.4.2 What does STP mean? (1)

5.4.3 Give the values related to STP in terms of absolute temperature and kiloPascal. (2)

5.4.4 Calculate the volume of 32g of oxygen gas at a pressure of 100kPa at a temperature of 40ºC. (5)

5.4.5 Give 2 methods by which one can increase the pressure on an enclosed gas. (2)

[42]

QUESTION 6

6.1 Draw the lewis structure of CH_4. (2)

6.2.1 What is the name given to the molecular shape of CH_4? (1)

6.2.2 What is the angle formed between the bonds for this particular shape? (1)

6.3 Does CH_4 have polar or non-polar bonds? (Support your answer with the relevant calculation) (3)

6.4 With the aid of a sketch show whether CH_4 is a polar or non-polar molecule. (3)

[10]

QUESTION 7

7.1 Chlorine (Cl_2) and Iodine (I_2) are both non-polar molecules, but chlorine is a gas at room temperature and iodine is a solid. Using your knowledge of intermolecular forces, explain why this is the case. (3)

7.2 Water has a concave meniscus and mercury has a convex meniscus.

7.2.1 Draw a diagram to show what the meniscus, for both water and mercury, would look like in a test tube (Indicate which meniscus belongs to which substance). (2)

7.2.2 Using your knowledge of the forces of adhesion and cohesion, explain the difference in shapes of the meniscus in these two liquids. (4)

7.3 Will I_2 dissolve in H_2O? Explain your answer. (4)

7.4 Which of the following will have the higher boiling point: CCl_4 or HCl?
(Explain using your knowledge of intermolecular forces) (6)

[19]

QUESTION 8

8.1 A ray of light travels from air (n =1) into Perspex. The light ray in air strikes a block of perspex at an angle of incidence of 30°. If the angle of refraction is 20°, calculate:

8.1.1 The refractive index of the block of Perspex. (4)

8.1.2 The speed of light in Perspex. (3)

8.2 Give two conditions necessary for total internal reflection to occur. (2)

8.3 Light travelling from clear crystal (n = 1,46) to air, strikes the boundary with an angle of incidence of 50°.

8.3.1 Calculate the critical angle for clear crystal, if the light ray is travelling from clear crystal to air. (4)

8.3.2 Will the light ray be totally internally reflected? Explain your answer. (2)

[15]

TOTAL: 150 MARKS

FORMULAS:

$F = \frac{kQ_1Q_2}{r^2}$ $E = \frac{F}{Q}$ $E = \frac{kQ}{r^2}$

$\Phi = BAcos\theta$ $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$

$F = ma$ $f_s = \mu_s N$ $f_k = \mu_k N$

$n = \frac{c}{v}$ $n_1 sin\theta_1 = n_2 sin\theta_2$

$n = \frac{m}{M}$ $C = \frac{n}{V}$ $n = \frac{V}{V_0}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $PV = nRT$

CONSTANTS:

$k = 9 \times 10^9$ N.m^2.C^2 $g = 9.8$ m.s^{-2} $R = 8.31$ J.K^{-1}.mol^{-1}

c = 3×10^8 m.s^{-1}