



ALEXANDER ROAD HIGH SCHOOL

JUNE 2016

2,5 HOUR

PHYSICAL SCIENCES MID-YEAR EXAM

CO, KB, MH

TOTAL = 200

GRADE 11

Instructions

- The question paper consists of 11 questions.
 - Answer all the questions.
 - Answer section A on the answer sheet provided AND section B on folio sheets.
 - Rule off after each question in Section B.
 - A non-programmable calculator may be used.
 - Number the answers correctly according to the numbering system
 - Round off to two (2) decimal places where necessary.
 - A periodic table has been included on the back of the answer sheet
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SECTION A

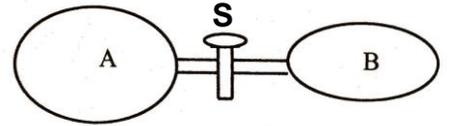
- Answer on the answer sheet -

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 write down the letter (A–D) next to the question number on the attached ANSWER SHEET.

- 1.1 One of the following is not a property of electric field lines.
- A They can cross but never touch each other.
 - B They start and end perpendicular to the surface of the charged object.
 - C They circle the charged object in three dimensions.
 - D There is a uniform field between two oppositely charged parallel plates.
- 1.2 There is a force, F , between 2 charges. The distance between them is tripled and the one charge is also tripled. What will the new force be between the charges?
- A $3F$
 - B $\frac{1}{3} F$
 - C $9 F$
 - D $\frac{1}{9} F$

1.3 A container A (with volume V , containing a gas under pressure P) is connected to an evacuated (empty, with a vacuum) container B with a closed stopcock S (a 'tap'). If S is opened, and the pressure of the gas decreases to $\frac{3}{4} P$ while the temperature remains constant, what is the volume of container B?



- A V
- B $\frac{2}{3} V$
- C $\frac{1}{3} V$
- D $\frac{4}{3} V$

1.4 What is the speed of light in diamond if the refractive index for diamond is 2,42?

- A $1,35 \times 10^8 \text{ m.s}^{-1}$
- B $1,24 \times 10^8 \text{ m.s}^{-1}$
- C $1.66 \times 10^8 \text{ m.s}^{-1}$
- D $2,02 \times 10^8 \text{ m.s}^{-1}$

1.5 Magnesium metal reacts with bromine to form the compound zinc bromide. The balanced chemical equation is as follows...



In this reaction, the oxidation number of...

- A magnesium increases and magnesium is oxidized
- B Br_2 increases and Br_2 is oxidized
- C magnesium increases and magnesium is reduced
- D magnesium increases and magnesium is the oxidizing agent

1.6 Consider the following acid-base reaction...



According to the Lowery-Bronsted theory, in this reaction the CO_3^{2-} ...

- A. donates a proton and acts as an acid.
- B. accepts a proton and acts like a base.
- C. accepts a proton and acts like an acid.
- D. donates a proton and acts like a base.

1.7 The gas with the largest volume at STP is...

- A 48g of oxygen
- B 4g of hydrogen
- C 12g of helium
- D 28g of nitrogen

1.8 A parcel of mass 80kg is stands on the floor of a lift. If the parcel exerts a force of 480N on the floor of the lift, then the acceleration of the parcel is

- A $3,8 \text{ m}\cdot\text{s}^{-2}$ downwards
- B $3,8 \text{ m}\cdot\text{s}^{-2}$ upwards
- C $6 \text{ m}\cdot\text{s}^{-2}$ downwards
- D $6 \text{ m}\cdot\text{s}^{-2}$ upwards

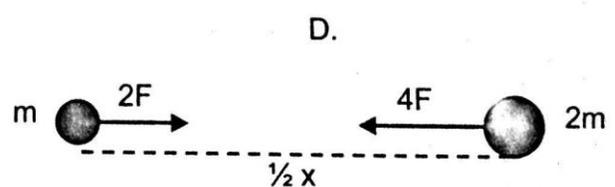
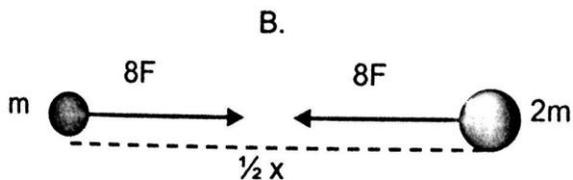
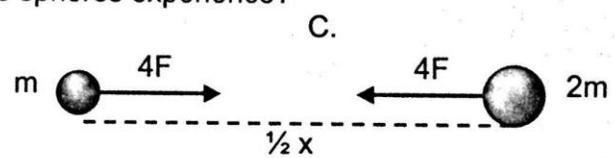
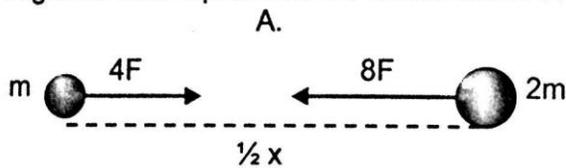
1.9 How can Newton's Third Law be represented?

- A $p = mv$
- B If $F = 0$ then $v = \text{constant}$
- C $F_{AB} = - F_{BA}$
- D $W = mg$

1.10 Two identical spheres, each of mass m are separated by a distance x . The gravitational force, F , exerted on each sphere can be represented as in this diagram:



Two other spheres of masses m and $2m$ are separated by a distance $\frac{1}{2}x$. Which of the following diagrams best represents the forces which these two spheres experience?



SUB – TOTAL: 20

SECTION B

QUESTION 2

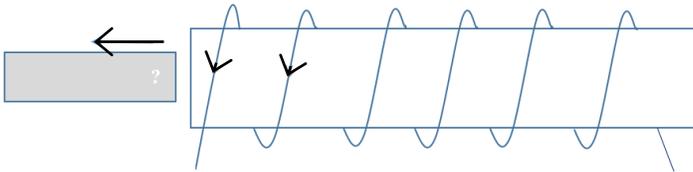
2.1 State the following in words:

2.1.1 Faraday's law

2.1.2 Right hand solenoid rule (4)

2.2.1 Calculate the induced emf in a square solenoid (side length 5 cm) with 200 windings if a 4 Tesla magnetic field is removed from it parallel to the normal of the solenoid, in 1,2 seconds. (4)

2.2.2 Which pole of the magnet was pulled out of the solenoid if the current direction is as indicated below?



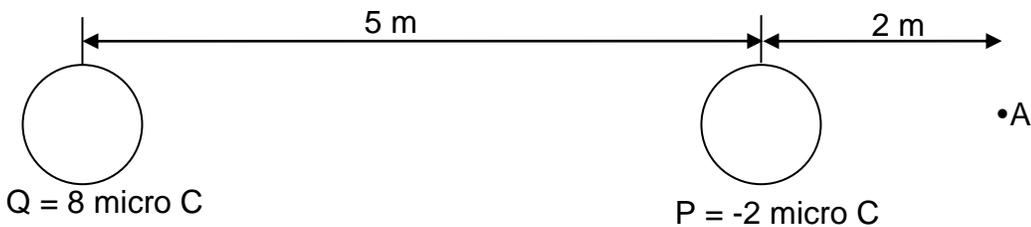
(2)

2.3.1 Define the electric field strength at a point in an E-field. (2)

2.3.2 Give the mathematical term for the relationship between the E-field strength and the distance from a charge. (2)

2.3.3 Now show the relationship on a labeled graph. (2)

2.4 Two charged polystyrene balls (P and Q) are positioned as shown in the diagram below.

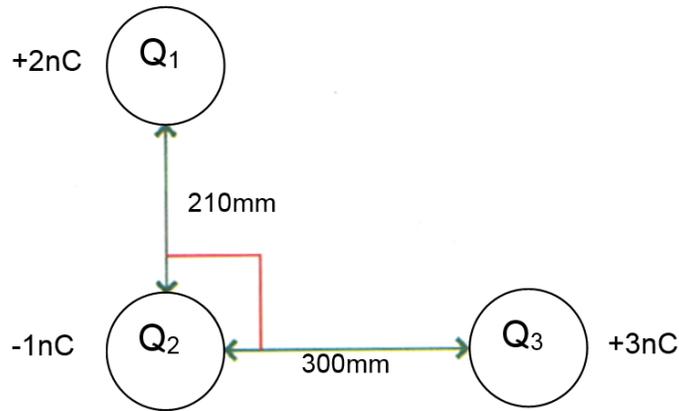


2.4.1 Calculate the net electric field at point A (with no charge) as a result of P and Q. (6)

2.4.2 A charge is now placed at A and it experiences a force of $3 \times 10^{-3} \text{ N}$ towards the left. What are the magnitude and polarity of this charge? (4)

2.4.3 Draw the resultant electric field that will be present between charges P and Q **after they were brought together to touch**, and then separated to their original positions (now there is no charge at A). (4)

2.5 For the following arrangement of charges:



2.5.1 Draw the labeled free body diagram for the forces acting on Q_1 . (2)

2.5.2 Draw the labeled free body diagram for the forces acting on Q_2 . Also show the net force on Q_2 on this diagram. (2)

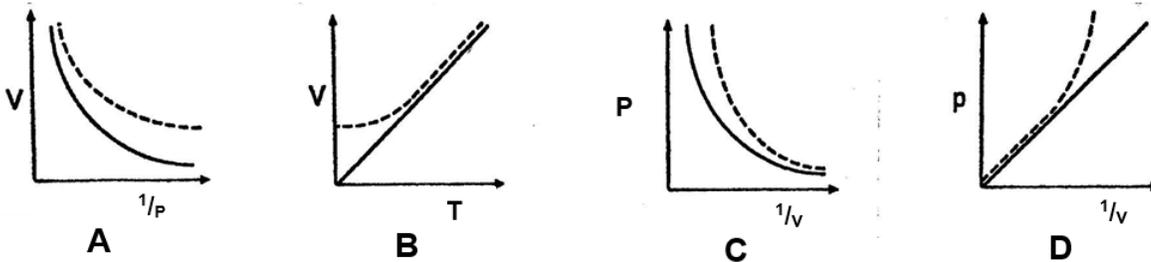
[34]

QUESTION 3

3.1 State any 2 differences between real and ideal gases (in a table). (4)

3.2 Calculate the molar mass of an unknown **diatomic** gas if 1,68 g of this gas is kept under a pressure of 150kPa, temperature of 27°C and its volume is 100 cm³. (6)

3.3 Select the correct graph for this gas (dotted line) compared to an ideal gas (solid line). Only write down the letter of your choice, **and explain** your choice by referring to the kinetic model of matter.



(3)

[13]

QUESTION 4

4.1 State Newton's law of gravitation. (3)

4.2 Draw a rough labeled sketch graph to represent the relationship described in 4.1. (2)

4.3 What is the magnitude and unit of the gradient of this graph (if any gradient)? (1)

4.4 Calculate the magnitude and direction of the force between 2 objects with masses 1 kg and 750 g if they are 5 cm apart. (4)

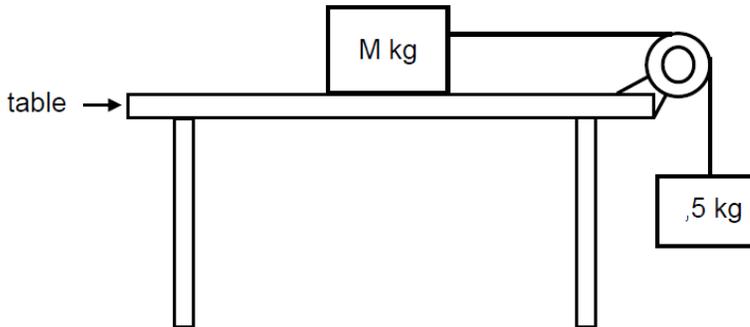
4.5 Without doing a new calculation by using an **existing formula**, what will the force between these masses be if the distance between them changes to 15 cm? (2)

[12]

QUESTION 5

Two blocks of mass M kg and 5 kg respectively are connected by a light, inextensible string. The string runs over a light, frictionless pulley as shown in the diagram below.

The blocks are stationary.



5.1 State Newton's First Law of Motion in words. (2)

5.2 Calculate the magnitude of the tension in the string. (3)

The coefficient of static friction (μ_s) between the block with unknown mass, M , and the surface of the table is $0,4$.

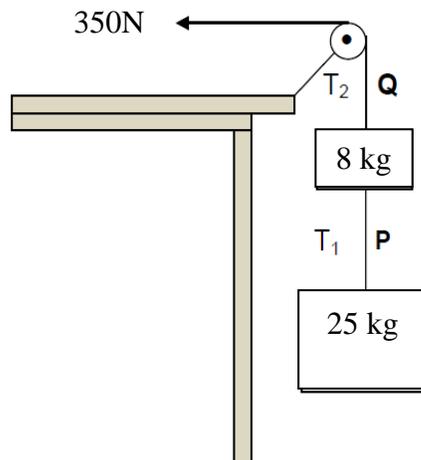
5.3 Draw a free body diagram of all the forces acting on the block with mass M . (4)

5.4 Calculate the minimum value of M that will prevent the blocks from moving. (5)

[14]

QUESTION 6

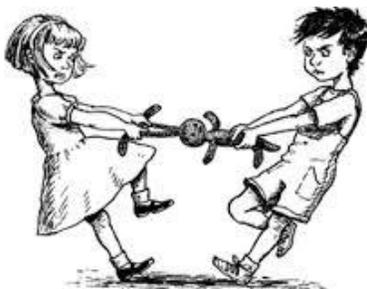
Two blocks of masses 25 kg and 8 kg respectively are connected by a light inextensible string, P . A second light inextensible string, Q , attached to the 8 kg block, runs over a light frictionless pulley. A constant horizontal force of 350 N pulls the second string as shown in the diagram below. The magnitude of the tensions in P and Q are T_1 and T_2 respectively. Ignore the effects of air friction.



- 6.1 State Newton's Second Law of Motion in words. (2)
- 6.2 Draw a labelled free-body diagram indication ALL the forces acting on the 8 kg block. (3)
- 6.3 Calculate the magnitude of the tension T_1 in string P. (7)
- 6.4 When the 350 N force is replaced by a sharp pull on the string, one of the two strings break. Which one of the two strings, P or Q, will break (the two strings are identical)? (1)

[13]

QUESTION 7

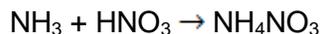


Identify three (3) force pairs according to Newton's Third Law of Motion in the picture.

[6]

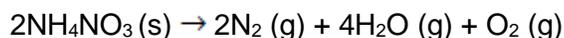
QUESTION 8

Ammonium nitrate is a very good fertiliser because it is very soluble and provides nitrogen to plants. It can be made according to the following equation:



8.1.1 If 1 161g of ammonium nitrate were obtained when 360,6 g of ammonia were reacted, calculate the percentage yield. (7)

8.1.2 Ammonium nitrate can also be used because it decomposes on heating according to the following equation:



If the ammonium nitrate prepared in 8.1.1 were heated, what total volume of gas will be produced at STP? (8)

8.2. Limestone is calcium carbonate and when it is heated, it decomposes to release carbon dioxide and calcium oxide is left.



A 50g sample of impure limestone was heated and 23,52g of CaO was left when the reaction was complete.

8.2.1 Calculate the percentage purity of the limestone. (9)

8.2.2 Calculate the volume of CO_2 produced at STP. (3)

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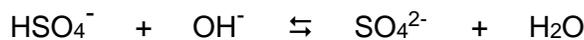
QUESTION 9

- 9.1 Complete the following table comparing acids and bases according to the Lowry-Bronsted and Arrhenius theory

	Arrhenius Theory	Lowry Bronsted
How they defined ACIDS	9.1.1	9.1.2
How they defined BASES	9.1.3	9.1.4

(4)

- 9.2 Consider the following acid-base reaction:



Write down the formula of the...

9.2.1 Acid

9.2.2 Base

9.2.3 Conjugate acid

9.2.4 Conjugate base

(4)

9.3 What is an ampholyte?

(2)

9.4 Ammonia (NH_3) is an amphoteric substance. Give an equation for the reaction between ammonia and water when ammonia acts as:

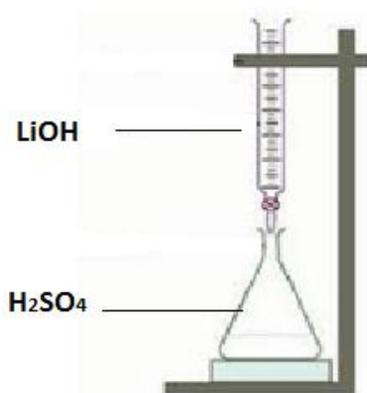
9.4.1 an acid

(2)

9.4.2 a base

(2)

- 9.5 A learner wants to perform a neutralisation reaction between sulphuric acid (H_2SO_4) and lithium hydroxide (LiOH). H_2SO_4 was placed in the conical flask and LiOH was placed in the burette. A few drops of bromothymol blue was added to the H_2SO_4 solution and this was then titrated with the LiOH . Using this information answer the following questions.



- 9.5.1 What colour change occurs when just enough LiOH is added to neutralise the acid? (be specific)(2)
- 9.5.2 What colour does the solution become when excess LiOH is added? (1)
- 9.5.3 Give a balanced equation for the neutralisation reaction taking place. (3)

[20]

QUESTION 10

10.1 Redox reactions are reactions that involve the transfer of electrons. The **unbalanced** equation below represents a redox reaction.



10.1.1 Define Oxidation (2)

10.1.2 Give the oxidation number of the underlined atom (1)

10.1.3 Write down the formula of the reducing agent in the reaction. Give a reason for your answer. (3)

10.1.4 Write down the formula of the substance which is OXIDISED in the reaction. (1)

10.1.5 Write down the formula of the spectator ion in the reaction. (1)

10.1.6 For the above reaction show the:

(a) oxidation half-reaction (2)

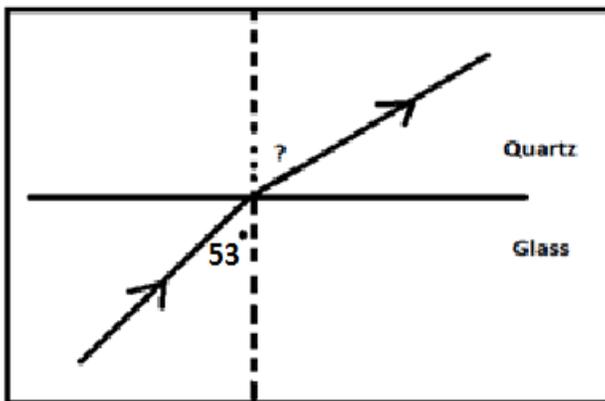
(b) reduction half-reaction (2)

(c) Balance the equation to give the nett ionic equation using the ION-ELECTRON method. (4)

[16]

QUESTION 11

11.1 A ray of light travels from glass ($n = 1,52$) into quartz ($n = 1,46$). If the angle of incidence is 53° .



11.1.1 Calculate the angle of refraction. (4)

11.1.2 Define critical angle. (2)

11.1.3 Calculate the critical angle for the glass – quartz boundary (4)

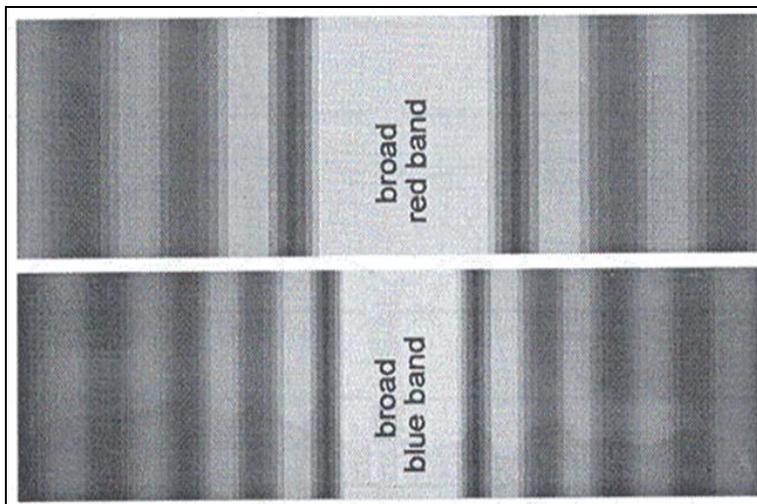
The angle of incidence of the ray of light moving from glass into quartz is now changed to 75° .

11.1.4 State the two conditions needed for total internal reflection. (2)

11.1.5 Will the ray be totally internally reflected or refracted? Briefly explain why. (3)

11.2 State two factors that affect the amount of diffraction. (2)

11.3 Consider the following diagram showing the pattern that is formed when red light and blue light are shone through a narrow slit:



11.3.1 The diffraction pattern consists of alternating dark and light bands when light is shone through a single narrow slit. What causes the

a) dark bands? (1)

b) bright bands? (1)

11.3.2 Why is the central band of the blue light narrower than that of the red light? (2)

11.3.3 Will the width of the central band in the diffraction pattern of red light become **BROADER or NARROWER** if the width of the slit is increased? (1)

11.3.4 The blue light is replaced with violet light. Will the width of the central band in the diffraction pattern become **BROADER or NARROWER** when violet light is shone through? (1)

11.3.5 How will the diffraction pattern change if the single slit is replaced with a double slit. (2)

[25]