



ALEXANDER ROAD HIGH SCHOOL

JUNE 2011

3 HOURS

PHYSICAL SCIENCE

IC, MA, CO

TOTAL = 160

GRADE 11

Instructions

- The question paper consists of 12 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 data sheet will be provided for your use.
 - Round off to two (2) decimal places unless otherwise stated.
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SECTION A

- Answer on the answer sheet -

QUESTION 1:

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

- 1.1 The type of collision in which kinetic energy is conserved.
- 1.2 The eye defect where either the cornea or the lens is not exactly spherical.
- 1.3 The quantity of charge stored per unit potential difference.
- 1.4 The outer most band, within a solid that contains electrons
- 1.5 The name given for -273 degrees Celsius

[5]

QUESTION 2: 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 (2.1 – 2.5) on the attached ANSWER SHEET.

2.1 The driver of a motor car places a cup of coffee on the level dashboard of his car in front of him. He observes that the cup slides towards the windscreen when the brakes are applied.

Which of the following laws best explains this motion for the cup of coffee?

- A. Charles Law.
- B. Newton's First Law.
- C. Newton's Second Law.
- D. Newton's Third Law.

2.2 Which one of the following is not a method of strengthening the electromagnet?

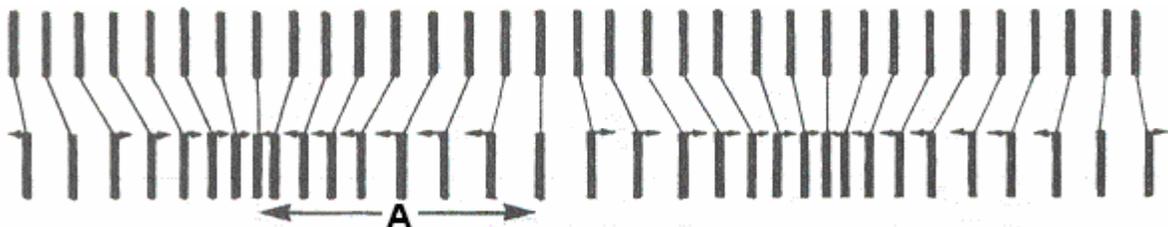
- A increase the number of windings
- B increase the current strength
- C Soft metal in the core
- D Hard metal in the core

2.3 Which of the following statements are true with respect to a **p-type** semiconductor?

- i. Intrinsic
- ii. Doped with an atom with one more electron
- iii. Positively charged
- iv. Conduction through movement of holes

- A. ii and iii
- B. i, ii and iv
- C. iii and iv
- D. iv only

2.4 Consider the movement of a wave through a slinky spring



If the distance indicated by "A" above is 100mm, and the wave moves at $5\text{m}\cdot\text{s}^{-1}$, then the frequency of the wave is...

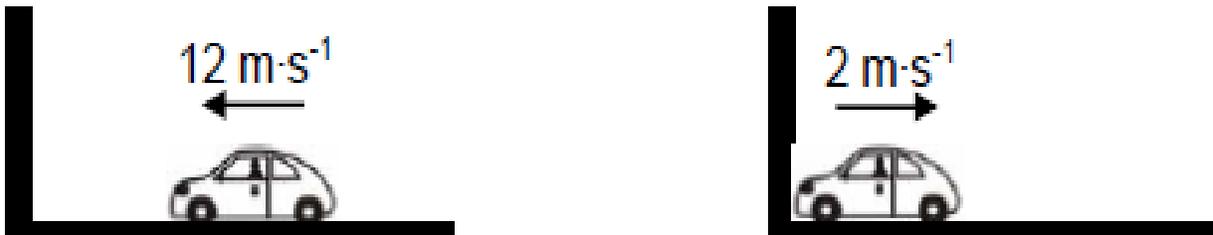
- A. 25Hz
- B. 250Hz
- C. 0.05Hz
- D. 50Hz

QUESTION 4

4. New cars have a crumple zone to help minimise injuries during accidents. In addition seat belts, air bags and padded interiors can reduce the chance of death or serious injury

4.1 Use principles in Physics to explain how air bags can reduce the chance of death or injury. (2)

In a crash test, a car of mass $1,2 \times 10^3$ kg collides with a wall and rebounds as illustrated below. The initial and final velocities of the car are $12 \text{ m}\cdot\text{s}^{-1}$ to the left and $2 \text{ m}\cdot\text{s}^{-1}$ to the right respectively. The collision lasts 0,1 s.



Calculate the:

4.2 Impulse of the car during the accident. (4)

4.3 Average force exerted on the car. (4)

4.4 How will the magnitude of the force exerted on the car be affected if the time interval of the collision remains 0,1 s, but the car does not bounce off the wall? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

4.5 An astronaut is motionless in outer space. Upon command, the propulsion unit strapped to his back ejects some gas with a velocity of $14 \text{ m}\cdot\text{s}^{-1}$, and the astronaut recoils (goes back) with a velocity of $0,7 \text{ m}\cdot\text{s}^{-1}$ in the opposite direction. After the gas is ejected the mass of the astronaut is 160kg. Calculate the mass of the ejected gas.



(5)
[16]

QUESTION 5: Waves, sound and light

- 5.1 Luke is given a convex lens to study the type of image that it can form. He sets the lens up and finds that when he places an object, of height 30mm, a distance of 60mm from the lens, he obtains an inverted image exactly 40mm from the lens.
- 5.1.1 Draw an accurate ray diagram of the above situation. (4)
- 5.1.2 Calculate the focal length. (1)
- 5.1.3 Calculate the magnification. (2)
- 5.1.4 Name 3 properties of the image if the object is placed 15mm from the lens. (3)
- 5.2 A family of three, a father, daughter and grandmother, all wear glasses. Without their glasses, the father struggles to see distant objects, the daughter struggles to see nearby objects and the grandmother struggles to focus on both distant as well as nearby objects.
- 5.2.1 Give the scientific name for the eye defect that the grandmother suffers from. (2)
- 5.2.2 What type of glasses should the grandmother get to help her focus better? (1)
- 5.2.3 With the use of diagrams and a short explanation, indicate what type of lens the daughter has in her glasses that helps her focus on nearby objects. (Your answer should include 3 diagrams: Nearby object (without lens), distant object (without lens), nearby object (with lens). (7)

[20]

QUESTION 6: Waves, sound and light

- 6.1 A boy stands between two tall cliffs. He claps his hands and hears two echoes, one slightly after the other. The first echo is heard after 4 seconds. The second echo is heard 2 seconds after the first echo. Calculate the distance between the cliffs if the speed of sound in air is $340\text{m}\cdot\text{s}^{-1}$. (7)
- 6.2.1 In what phase of matter does sound travel fastest? (1)
- 6.2.2 Give a reason for your answer in QUESTION 6.2.1 (2)
- 6.2.3 Give two factors that influence the speed of sound. (2)
- 6.3 Usually humans have difficulty hearing sound having a frequency above 20 000Hz.
- 6.3.1 What is this sound called? (1)
- 6.3.2 State ONE medical use of the sound referred to in question 6.3.1. (2)

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QUESTION 7: Electrostatics

7. Figure 1 is an image of a Van Der Graaff generator which is switched on, and a positive test charge, A, 2m from the center of the sphere of the generator. Answer the following questions.

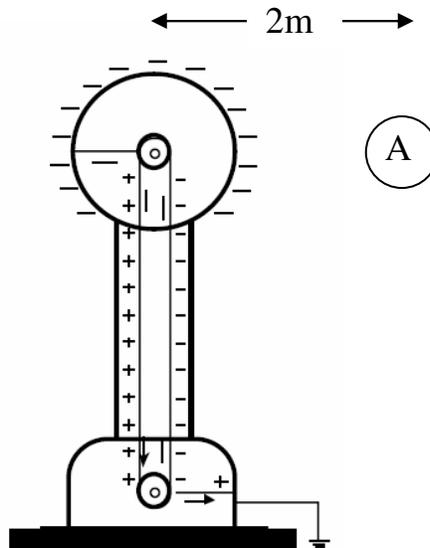


Figure 1
Van de Graaff generator

- 7.1 Explain how the Van der Graaff generator becomes charged. (3)
- 7.2 What would the electric field strength of the generator be if it had a charge of -6 mC ? (3)
- 7.3 Now assume test charge A was replaced with a charged sphere of 3 mC . Calculate the magnitude of electrostatic force between the two charged spheres? (4)
- 7.4 Draw the electric field lines between the new spheres, and indicate relative strength of the fields clearly. (3)
- 7.5 Calculate the electrical potential energy of this closed system, if the 3 mC charge has now moved 80 cm closer to the generator. (4)

[17]

QUESTION 8: Capacitance

- 8.1 Calculate the capacitance of a capacitor with parallel plates having area $1,4 \text{ m}^2$. The distance between the plates is $0,6 \text{ cm}$. (4)
- 8.2 Calculate the size of the electric field between the plates if the potential difference across the plates is 5000 V . (3)

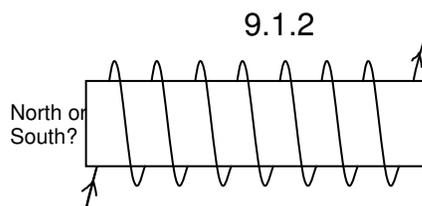
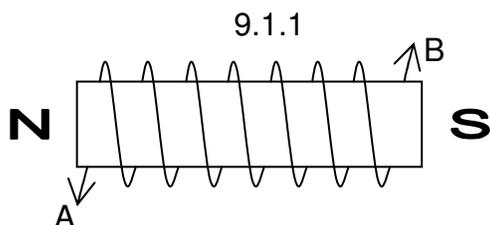
[7]

QUESTION 9: Electromagnetism

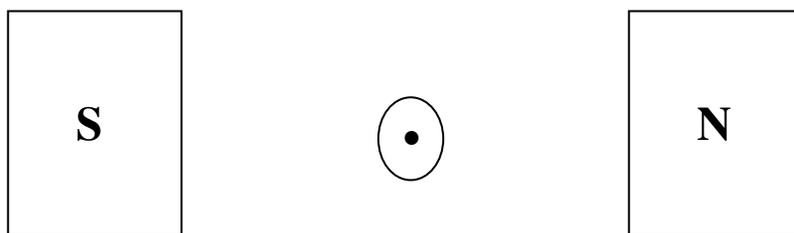
9.1 On the following sketches of solenoids, choose the correct missing label.

9.1.1 Choose the correct current direction (only write A or B) (2)

9.1.2 Choose the correct Polarity for the left hand side (only write North or South) (2)



9.2 Determine the direction in which the current carrying conductor will move:



Only write down **Upwards, Downwards, Left** or **Right**

(2)

[6]

QUESTION 10: Chemistry

10.1 Two Hydrogen atoms approach each other in order to form a covalent bond to form the H_2 molecule. Draw the labeled graph of potential energy vs distance to show the changes in energy between the atoms. Indicate bond energy and bond distance clearly. (4)

10.2 Can Helium undergo the same bonding to form He_2 ? Explain in not more than 2 lines. (3)

10.3 Define the term *electronegativity*. (3)

10.4 Expand the acronym VSEPR. (1)

10.5 The shape of a methane (CH_4) molecule is tetrahedral and it is non-polar. The shape of the chloromethane (CH_3Cl) molecule is also tetrahedral but it is a polar molecule. Explain why this is the case by using dipole moments. (3)

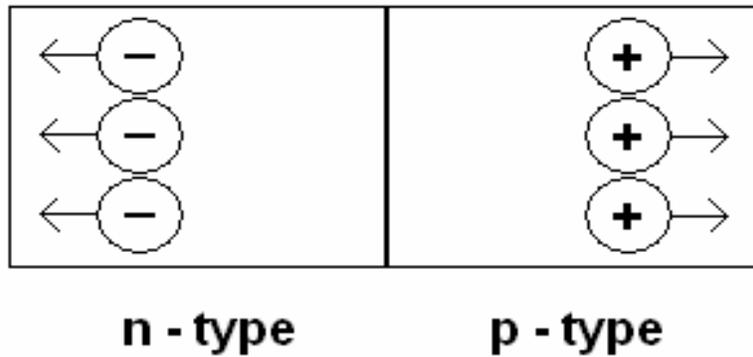
10.6 Why can the water (H_2O) molecule not be linear? Explain your answer by using Lewis structures and not more than 3 lines writing. (3)

[17]

QUESTION 11: Electronic properties of matter

11.1 Explain, along with labelled diagrams of the relevant band structures, why an Insulator cannot conduct electricity, while a semi-conductor can. (8)

11.2 The pn-junction depicted below has been biased...



11.2.1 How has the junction been biased? Write only **FORWARD** or **REVERSE**? (2)

11.2.2 Explain how to create the bias depicted above. (2)

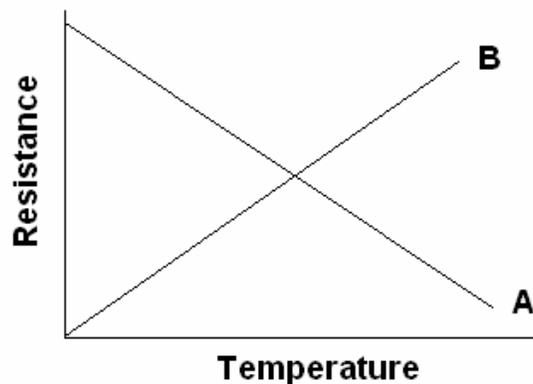
11.3 Indicate which of the following semi-conductors is p-type and which are n-type...

11.3.1 Germanium doped with boron

11.3.2 Silicon doped with nitrogen

11.3.3 Silicon doped with aluminium (3)

11.4 Consider the graph of two substances A and B



11.4.1 Identify which of the substances is a conductor and which is a semi-conductor. (2)

11.4.2 Give a reason for your answer in QUESTION 11.4.1 (2)

[19]

QUESTION 12: Gases

12. A rubber (elastic) balloon is filled with 50 g of chlorine gas at atmospheric pressure and a temperature of 10°C.
(The chlorine does not react with the rubber.)

12.1 Calculate the volume of the balloon in dm³. (7)

The balloon is now attached to a submarine and taken to a depth of approximately 150 m below the surface of the sea, where the pressure is $1,5 \times 10^3$ kPa and the temperature is also 10°C.

12.2 Calculate the new volume of the balloon. (5)

12.3 Name the law that describes the balloon's change in volume as it moves down. (2)

12.4 Draw a graph of volume versus pressure to illustrate the law mentioned in 12.3. (2)

12.5 Accurate measurements show that the **real** volume of the balloon is larger than that calculated in 12.2.
Give an explanation for this. (2)

[18]

TOTAL: 160 MARKS