



ALEXANDER ROAD HIGH SCHOOL

MAY 2010

3 HOURS

PHYSICAL SCIENCE

IC, MA, CO

TOTAL = 180

GRADE 11

Instructions

- The question paper consists of 11 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 A contact force that is always perpendicular to the surface of origin.
- 1.2 The unit for the product of mass and velocity of an object.
- 1.3 The theory that explains electrical conduction in semi-conductors.
- 1.4 The phenomenon where one vibrating object causes another one to also start vibrating
- 1.5 The type of force field that exists between two charged object.

[5]

QUESTION 2: False Statements

The following statements given in questions 2.1 to 2.5 are **FALSE**. Write down ONLY the corrected part next to the question number (2.1 - 2.5) on the attached ANSWER SHEET.

- 2.1 A woman pushes a trolley with a horizontal force of 80N. There is a frictional force of 60N on the trolley. The magnitude of the force exerted by the trolley on the women is 20N.

- 2.2 Presbyopia is also known as loss of accommodation and can be corrected using concave lenses.
- 2.3 The capacitance of a capacitor is the quantity of charge per unit energy that is stored.
- 2.4 The shape of the ammonia (NH_3) molecule is trigonal planar.
- 2.5 The conditions under which a real gas deviates from an ideal gas is low pressure and high volume.

[2 x 5 = 10]

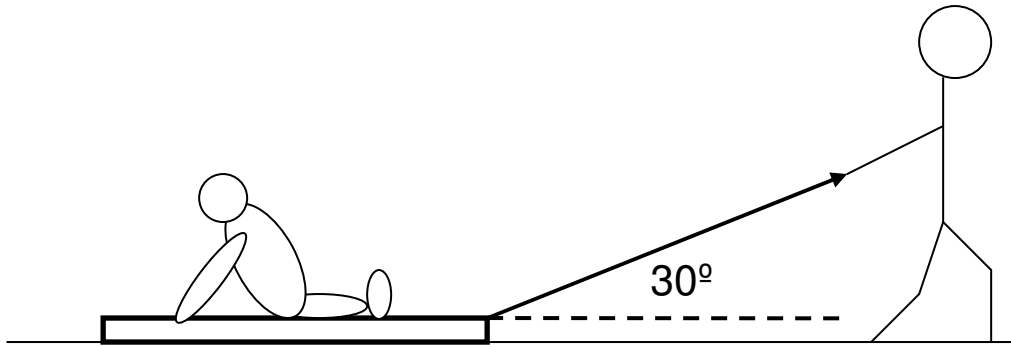
QUESTION 3: Multiple choice: Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (3.1 – 3.5) on the attached ANSWER SHEET.

- 3.1 Which of the following statements is true?
 - A. The resistance of a piece of germanium decreases as the temperature increases.
 - B. The resistance of a piece of nichrome wire decreases as the temperature increases.
 - C. The resistance of a piece of silicon increases as the temperature increases.
 - D. As the element of a kettle heats up, the resistance decreases.

3.2 The pitch and loudness of sound depends on

	Pitch	Loudness
A	Frequency	Speed of vibration
B	Frequency	Amplitude
C	Amplitude	Speed of vibration
D	Speed of vibration	Amplitude

- 3.3 One of the following is not a property of electric field lines.
 - A They circle the charged object in three dimensions.
 - B They start and end perpendicular on the surface of the charged object.
 - C They can cross but never touch each other.
 - D There is a uniform field between two oppositely charged parallel plates.



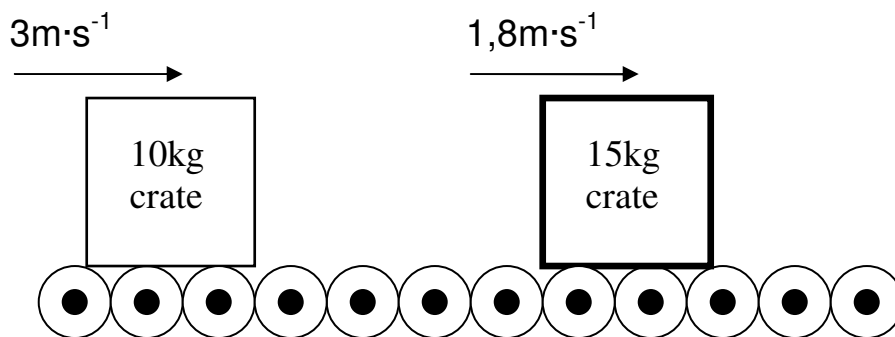
The board moves over grass with a frictional force of 7N acting between the grass and the board.

- 4.1 Draw a free body diagram of the forces acting parallel to the surface of the ground for the board. (2)
- 4.2 Calculate the magnitude of the horizontal component of the applied force. (3)
- 4.3 Calculate the magnitude of the acceleration of the board. (5)

[10]

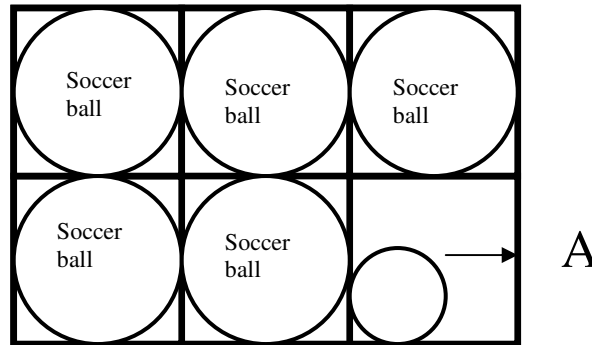
QUESTION 5

5. A 10kg crate is moving on a straight, horizontal set of rollers. The crate is moving to the right at $3\text{m}\cdot\text{s}^{-1}$. The 10kg crate collides with a 15kg crate that is moving at $1,8\text{m}\cdot\text{s}^{-1}$ to the right. The 10kg crate comes to rest immediately after the collision. The momentum and friction of the rollers can be ignored.



- 5.1 Calculate the velocity of the 15kg crate immediately after the collision. (5)
- 5.2 Which conservation law did you make use of to calculate the velocity of the 15kg crate after the collision?
State this law. (3)

Inside the 10kg crate are boxes with soccer balls in separate compartments in each box. In all of the boxes a smaller 2010 World Cup promotional soccer ball is put into one of the compartments in the box. The mass of the smaller ball is 265g. So when the 10 kg crate collided with the 15kg crate, the smaller ball, initially at rest in the box, moves forward striking the side of the box at A and rebounding at a velocity $2\text{m}\cdot\text{s}^{-1}$. Ignore the effects of friction.



- 5.3 Using a law of physics explain why the ball continued moving forward. (3)
- 5.4 Calculate the impulse of the small ball as a result of its collision with the side of the box at A. (4)
- 5.5 If the ball is contact with the side of the box for 0,03 s, calculate the resultant force that the side of the box exerts on the ball. (4)
- 5.6 Using principles of physics, briefly explain why soccer balls must be inflated with air to the correct pressure (i.e. the ball must not be too soft). (3)

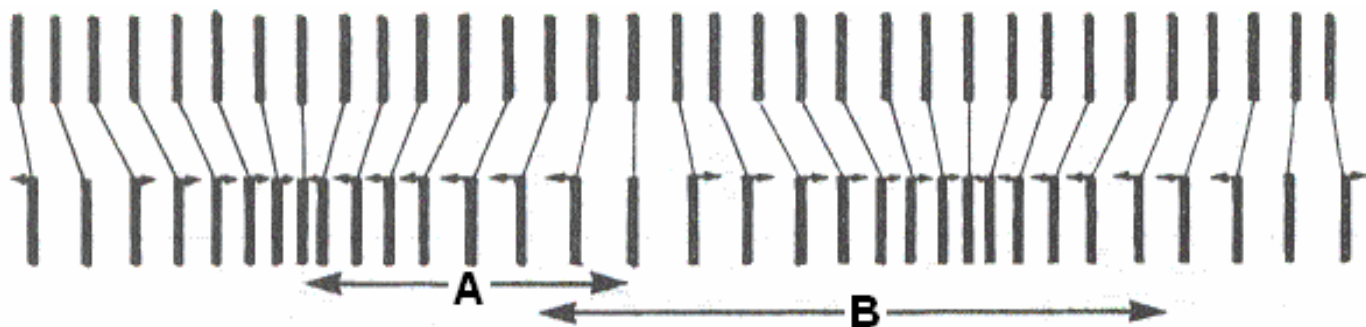
[22]

QUESTION 6: Waves, sound and light

- 6.1 An object, 50mm in height, is placed 40mm from a concave lens. The focal length of the lens is 35mm.
- 6.1.1 Draw an accurate ray diagram to show how the image is formed. (3)
- 6.1.2 Describe the image. (3)
- 6.1.3 Calculate the magnification of the lens. (3)
- 6.2 Mr Clifford suffers from an eye defect. Without his glasses on he struggles to see Castignani misbehaving at the back of the class, but he can clearly see Tania talking at the front of the class.
- 6.2.1 Give the scientific name for the eye defect that Mr Clifford suffers from. (2)

6.2.2 With the use of diagrams and a short explanation, indicate what type of lens Mr Clifford has in his glasses that help him keep an eye on Castagnani's behaviour (include 3 diagrams: Close object (without lens), distant object (without lens), distant object (with lens). (7)

6.3 Consider the diagram below and answer the questions that follow.



6.3.1 Which distance above, A or B depicts a wavelength? (2)

6.3.2 The distance between 21 consecutive compressions of a longitudinal wave is 500cm. The wave propagates through a container of nitrogen gas.

- Determine the wavelength of the waves. (2)
- Calculate the frequency of the waves, if they move at 200 m.s^{-1} . (4)

6.3.3 How would the speed of sound change if

- The temperature of the gas was increased. (2)
- The nitrogen gas was replaced with a more dense gas. (2)

(Write only **INCREASES**, **DECREASES** or **STAYS THE SAME**)

6.4 The captain of a ship uses sonar to determine the position and depth of a submarine. From the ships sonar instruments, a pulse is emitted and returns after 10s. Determine the speed of sound in water if the ship is 7760m directly above the submarine.

(4)

[34]

QUESTION 7: Electrostatics

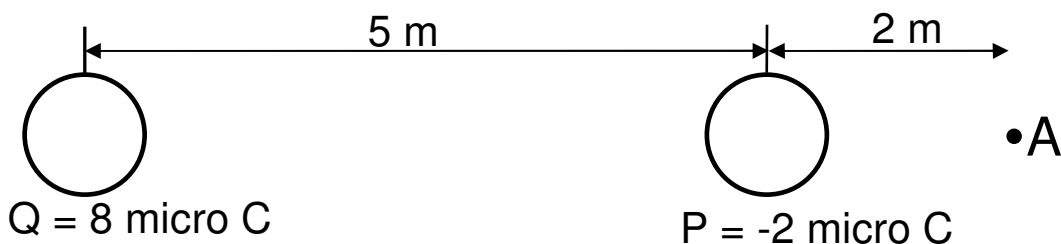
7.1

7.1.1 Define the electric field strength at a point in an E-field. (3)

7.1.2 Give the mathematical term for the relationship between the E-field strength and the distance from a charge. (1)

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

7.2 Two charges (P and Q) are positioned as shown in the diagram below.



- 7.2.1 Find the net electric field at A. (6)
- 7.2.2 A charge is placed at A and it experiences a force of 3×10^{-3} N towards the left. What are the magnitude and polarity of this charge? (4)
- 7.2.3 Calculate the electrical potential energy of the system of charges. (only for P and Q) (5)
- 7.2.4 Draw the electric field pattern between P and A. (3)

[24]

QUESTION 8

- 8.1 Capacitors are circuit devices used to store electrical energy. Capacitance depends, amongst other factors, on the plate area. The larger the plate area the more the energy that can be stored.
- 8.1.1 Apart from plate area, state ONE other *physical* factor and ONE non-physical (electrical) factor that can influence the capacitance of a capacitor. (2)
- 8.1.2 A certain type of material can be placed between the plates to change the capacitance.
- (a) Give the general name for this material. (2)
- (b) Explain shortly how this material changes the capacitance. (5)
- 8.2 A certain parallel plate capacitor consists of two plates, each having dimensions of 2 cm by 10 cm. The plates are 0,2 mm apart and are held at a potential difference of 20 V. The space between the plates is filled with a vacuum (nothing).
- 8.2.1 Sketch the electric field pattern between the two oppositely charged parallel plates of the capacitor. (3)
- 8.2.2 Calculate the capacitance of this capacitor. (5)

- 8.3 Capacitor discharging takes place at a certain rate. Draw a sketch graph of the change in current strength versus time. (3)
[20]
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QUESTION 9: Chemistry

- 9.1 Draw a labeled graph of Potential energy versus Distance between nuclei. Show on the axes an L (for Bond length) and an E (for Bond energy) where these quantities will be read off. (4)
- 9.2 The Bond energy is influenced by 3 factors. Name **one** factor and state how it influences bond energy. (2)
- 9.3 Show, by using Lewis structures, how two Oxygen atoms bond to form the diatomic molecule. (3)
- 9.4 Show the dative covalent bonding to form H_3NBF_3 . Use Lewis and Couper structures. (2)
- 9.5 Explain in one short sentence why resonance structures occur in certain molecules. Refer to the SO_3 molecule. (2)
- 9.6 What is the significance of electron lone pairs in the shape of molecules? (1)
[14]
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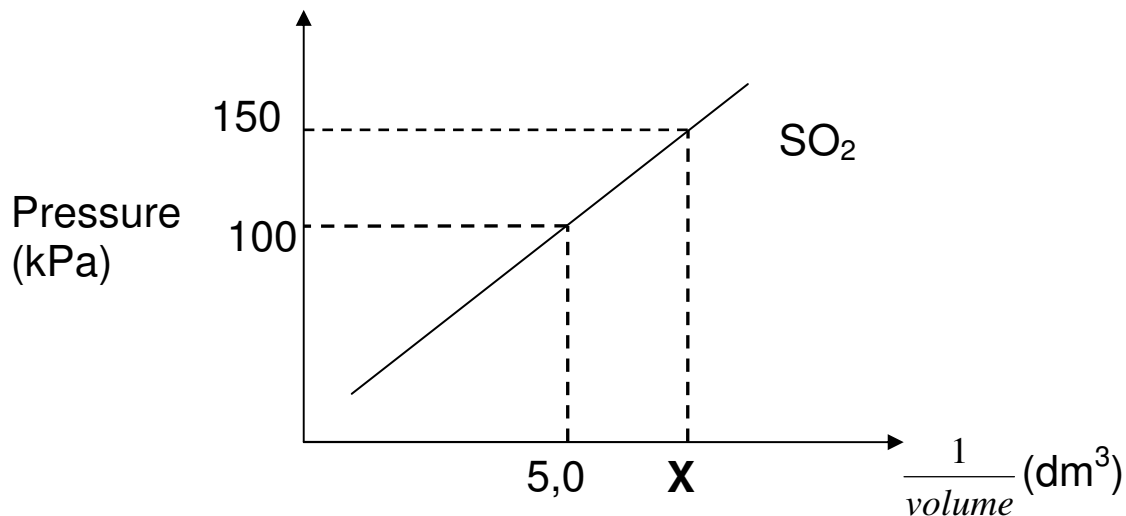
QUESTION 10: Electronic properties of matter

Silicon operates as a semi-conductor in electronic devices. Semi conductors have a band structure similar to insulators at low temperatures, but as soon as energy is added to the semi-conductor, it is able to conductor a current.

- 10.1 Use labelled diagrams, along with an explanation, to indicate why a semi-conductor can conduct at high temperatures but not at low temperatures. (7)
- 10.2 Indicate which of the following semi-conductors is p-type and which are n-type...
- 10.2.1 Germanium doped with Gallium
- 10.2.2 Silicon doped with aluminium
- 10.2.3 Silicon doped with gallium (3)
- 10.3 Briefly explain how one would forward bias a pn-junction (2)
[12]
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QUESTION 11: Gases

11.1. The relationship between the volume and pressure of an enclosed SO_2 gas was investigated in the school laboratory. The results were used to obtain a graph of pressure (p) versus the reciprocal of volume ($1/v$) shown below.



11.1.1 Formulate a hypothesis for the experiment. (2)

11.1.2 What precaution did the students have to take to ensure a consistent result? (2)

11.1.3 Name the Law that is being investigated. (2)

11.1.4 Calculate the value of X in the graph. (5)

11.2 A **diatomic** gas, of mass 5,60g, occupies a volume of $3,00 \times 10^{-3} \text{ m}^3$ at a temperature of 25°C and a pressure of 165 kPa.

11.2.1 Calculate the molar formula mass of the gas. (6)

11.2.2 Give the name or formula of the gas. (2)

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TOTAL: 180 MARKS