



**ALEXANDER ROAD HIGH SCHOOL**

JUNE 2011

3 HOURS

**PHYSICAL SCIENCE**

IC, MA, CO

TOTAL = 160

**GRADE 12**

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**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. Do not write on it.
- Round off to two (2) decimal place unless otherwise stated

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**SECTION A**

- Answer on the answer sheet -

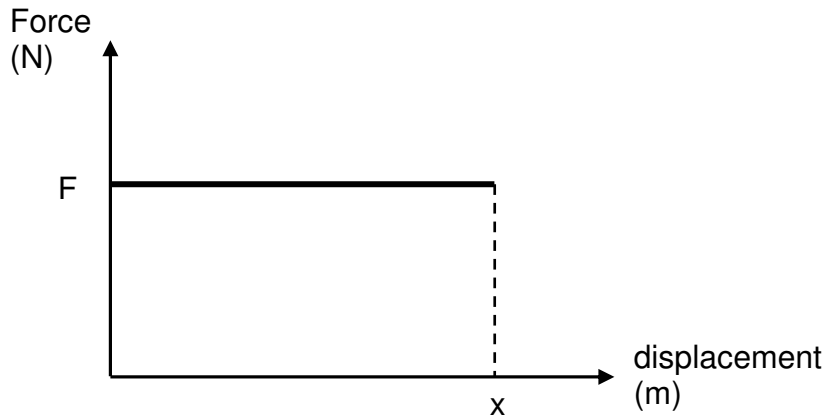
**QUESTION 1:** Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

- 1.1 The product of force and the rate of change of displacement.
- 1.2 The type of light spectrum that is produced by passing an electric current through a dilute gas mixture.
- 1.3 The induced emf in a conductor is directly proportional to the rate of change of magnetic flux.
- 1.4 The ring that ensures current direction change in the dynamo.
- 1.5 The process of making margarine.

**[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 graph below represents a constant force  $F$  acting on an object over a displacement  $x$ . The force and displacement are in the same direction.



Which one of the following statements can be deduced from the graph?

- A. The area under the graph represents the net work done by the force.
  - B. The area under the graph represents the power dissipated by the force.
  - C. The gradient of the graph represents the work done by the force.
  - D. The gradient of the graph represents the change in kinetic energy of the object.
- 2.2 The siren of a police car, travelling at a speed  $v$ , emits sound waves of frequency  $f$ . Which one of the following best describes the frequency that will be observed by a passenger in a car following right behind the police car at a speed  $2v$ ?
- A. Greater than  $f$
  - B. Equal to  $f$
  - C. Less than  $f$
  - D. Zero
- 2.3 The pattern observed in a double slit experiment is best described by...
- A. Diffraction
  - B. reflection
  - B. Interference
  - D. refraction
- 2.4 A DC source must be used to
- A. obtain a changing magnetic field
  - B. operate a transformer
  - C. produce heat
  - D. charge a battery

2.5 The type of compound formed when but-1-ene reacts with water in the presence of a suitable catalyst is a/an ...?

- A. alkane  
B. haloalkane  
C. alcohol  
D. ester

[2 X 5 = 10]

**SUB – TOTAL: 15**

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**SECTION B**

- Answer all questions on the folio pages provided -

**QUESTION 3: Mechanics**

3. The velocity-time graph shown below represents the motion of two objects **A** and **B**, released from the same height. Object **A** is released from REST and at the same instant object **B** is PROJECTED vertically upwards. (Ignore the effects of friction.)

- 3.1 *Object A undergoes a constant acceleration.* Give a reason for this statement by referring to the graph. (No calculations are required) (2)
- 3.2 At what time/times is the SPEED of object **B** equal to  $10 \text{ m}\cdot\text{s}^{-1}$ ? (2)
- 3.3 What is the velocity of object **A** relative to object **B** at  $t = 1\text{ s}$  (3)
- 3.4 Object **A** strikes the ground after 4 s. USE EQUATIONS OF MOTION to calculate the height from which the objects were released. (3)
- 3.5 What physical quantity is represented by the area between the graph and the time axis for each of the graphs **A** and **B**? (1)

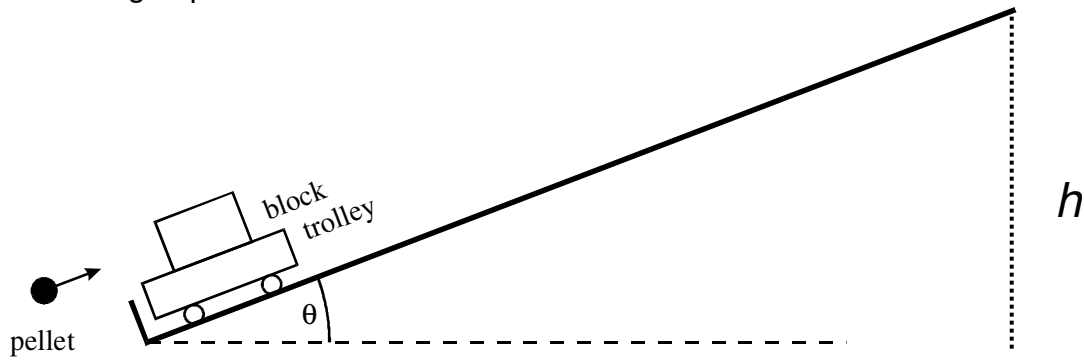
3.6 Calculate, WITHOUT USING EQUATIONS OF MOTION, the distance between objects **A** and **B** at  $t = 1\text{ s}$

(5)

[16]

#### QUESTION 4

The diagram represents part of an experiment that is being used to estimate the speed of an air gun pellet.



The pellet, which is moving parallel to the frictionless track, strikes the block, embedding itself. The trolley and the block then move along the track, rising to a vertical height,  $h$ .

The following data is collected from the experiment

<b>Mass of trolley, block and pellet</b>	<b>=</b>	<b>0.50 kg</b>
<b>Mass of pellet</b>	<b>=</b>	<b>0.002 kg</b>
<b>Speed of trolley and block immediately after impact</b>	<b>=</b>	<b>0,48 m.s<sup>-1</sup></b>

4.1 State the Law of Conservation of Momentum. (2)

4.2 Calculate the speed of the pellet just before impact. (5)

4.3 Is this collision elastic or inelastic? (2)

4.4 Write down the work-energy principle/relationship. (2)

4.5 A farmer used an electric pump to raise water from a borehole of depth 40m. If 500kg of water is to be pumped every minute and water is to be discharged at  $4\text{m.s}^{-1}$ , Calculate the minimum power of the electric pump the farmer must use. (Ignore friction). (7)

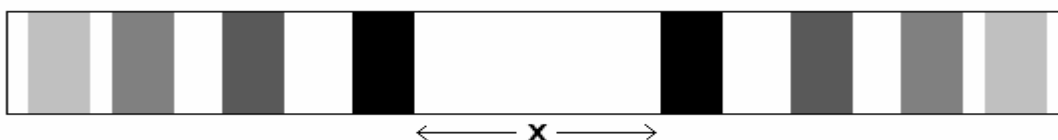
[18]

**QUESTION 5: Waves, sound and light(Start on a new page.)**

5. A police car with its siren on moves at a constant velocity past a person standing next to the road. At one point the person measures a frequency, which is 80% of the frequency of the sound emitted by the siren on the police car
- 5.1 Name the phenomenon observed (2)
- 5.2 Is the car moving towards or away from the person when the frequency is measured? (2)
- 5.3 If the speed of sound in air is  $340 \text{ m}\cdot\text{s}^{-1}$ , calculate the speed of the ambulance (5)
- 
- [9]**

**QUESTION 6: Waves, sound and light**

6. An experiment with a monochromatic light source is performed. The light is shone through a single slit placed some fixed distance away from the screen. The following pattern is formed



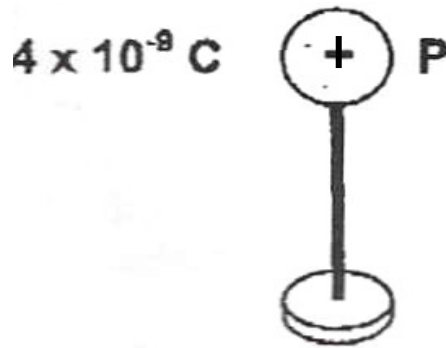
- 6.1 Name the phenomenon demonstrated above. (2)
- 6.2 What phenomenon causes the formation of the bright bands? (2)
- 6.3.1 Calculate the wavelength of the monochromatic light if the width “x” of the central maximum is 0.1m, the distance between the slit and the screen is 9m and the width of the slit is 0.0972mm. (6)
- 6.3.2 What is the likely colour of the light if the speed of light is  $3 \times 10^8 \text{ m}\cdot\text{s}^{-1}$

Colour	Frequency
Red	$4,54 \times 10^{14}$
Orange	$4,92 \times 10^{14}$
Yellow	$5,17 \times 10^{14}$
Green	$5,56 \times 10^{14}$
Blue	$6,38 \times 10^{14}$
Indigo	$6,82 \times 10^{14}$
Violet	$7,32 \times 10^{14}$

- 6.4 How will the value of “x” ,in the diagram above, change if a colour of lower frequency is used?  
Write only, **INCREASES, DECREASES or STAYS THE SAME.** (2)
- 
- [16]**

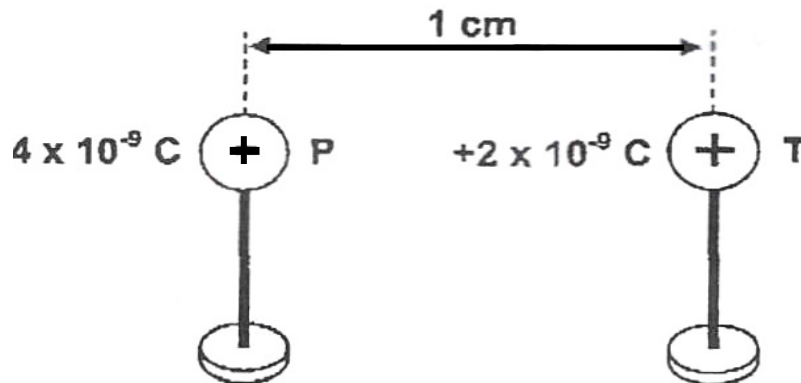
**QUESTION 7 (Start on a new page.)**

The diagram below shows a small metal sphere P on an insulated stand. The sphere carries a charge of  $4 \times 10^{-9} \text{ C}$ , as shown in the diagram.



- 7.1 Draw the electric field pattern around sphere P. Assume that no other charges affect this pattern. (2)
- 7.2 Calculate the number of electrons in excess on sphere P. (2)

A second metal sphere T carrying a charge of  $+2 \times 10^{-9} \text{ C}$  is placed 1cm from sphere P as shown in the diagram below.



- 7.3 Calculate the magnitude and direction of the electrostatic force that sphere P exerts on sphere T. (4)

The spheres are now brought into contact with each other and returned to their original positions.

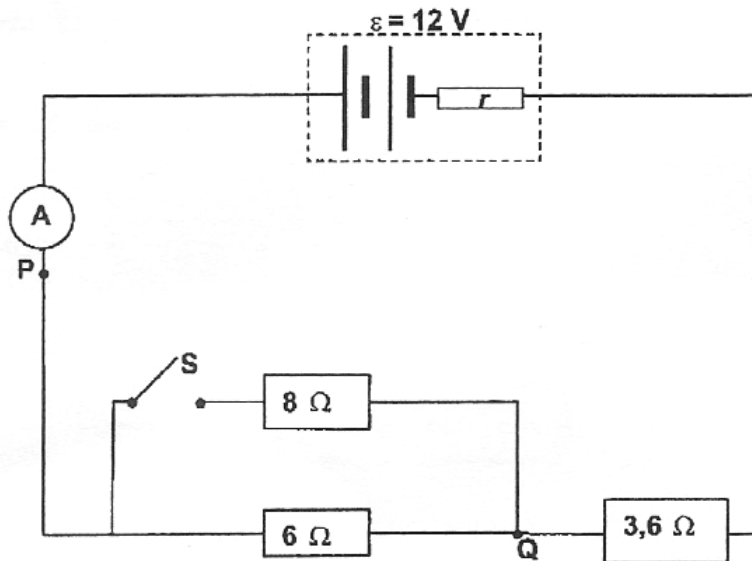
- 7.4 Calculate the electric potential energy of the system of two charges. (6)

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**[14]**

### QUESTION 8

The circuit diagram below represents a combination of resistors in series and parallel. The battery has an emf of 12 V and an unknown internal resistance  $r$ .



With switch S **open**, ammeter A gives a reading of 1,5 A.

- 8.1 Calculate the total resistance of the circuit. (3)
- 8.2 Calculate the internal resistance of the battery. (4)
- 8.3 Calculate the energy dissipated in the 3,6 Ω resistor in 3 minutes. (3)

Switch S is now **closed**.

- 8.4 How will EACH of the following be affected? Write down only INCREASES, DECREASES or REMAINS THE SAME.
  - 8.4.1 The total resistance of the circuit (1)
  - 8.4.2 The reading on ammeter A (1)
- 8.5 A conducting wire of negligible resistance is now connected between points P and Q. What effect will this have on the temperature of the battery?  
Write down only INCREASES, DECREASES or REMAINS THE SAME.  
Explain how you arrived at the answer. (4)

[16]

## QUESTION 9

AC generators at coal-fired power stations supply most of the electrical energy needed in our country.

9.1 State ONE structural difference between an AC and a DC generator. (2)

A certain AC generator (alternator) produces a peak current ( $I_{\max}$ ) of 6,43 A when connected to an electrical heater of resistance 50  $\Omega$ .

9.2 Calculate the rms current ( $I_{\text{rms}}$ ) produced by the generator. (3)

9.3 Calculate the peak voltage ( $V_{\max}$ ) output of the generator. (5)

9.4 Draw a sketch graph of potential difference versus time for this AC generator. Clearly label the axes and indicate  $V_{\max}$  on the potential difference axis. (2)

9.5 To meet energy demands in the country, the government plans building nuclear power stations. State ONE environmental advantage of the generation of electricity in nuclear power stations over coal-fired power stations. (1)

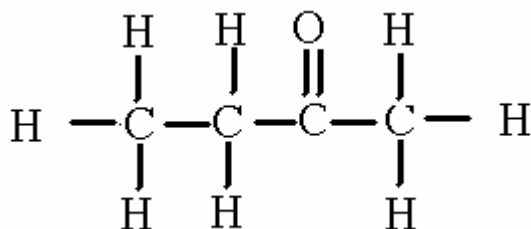
**[13]**

## QUESTION 10: Organics(Start on a new page.)

Millions of organic compounds are known to date. These compounds, represented by the letters **A** to **F** are shown below.

A. methanal

B.



C.  $\text{CH}_3\text{CH}_2\text{CH}_2 - \text{C} = \text{CH}_2$

D.  $\text{C}_5\text{H}_8\text{BrCl}$   $\begin{array}{c} | \\ \text{CH}_3 \end{array}$

E. Ethyne

F. 2-Chloropropane



Write down the following.

- 10.1 Structural formula of the functional group of **A**. (1)
- 10.2 Structural formula of an isomer of **B**. (2)
- 10.3 IUPAC name of **C**. (2)
- 10.4 Which compound is used in the welding industry? (1)
- 10.5 Is compound **E** a saturated or unsaturated compound? (1)
- 10.6 Draw the structural formula of **D**. (2)
- 10.7 Name the type of reaction that produced compound **F** if one of the reactants were an alkene. Write down structural chemical equation. (3)
- 10.8 To what homologous series does compound **F** belong. (1)

**[13]**

### QUESTION 11

The table shows the boiling points that can be used to identify chemical compounds. The following are given below.

	Compound	Boiling point ( $^{\circ}\text{C}$ )
<b>A</b>	Propane	-42
<b>B</b>	Pentane	36
<b>C</b>	2-methylbutane	27,8
<b>D</b>	Pent-1-ol	137

- 11.1 Define the term boiling point. (2)
- 11.2 Which ONE of **A** or **B** has the lower vapour pressure? (1)
- 11.3 An unknown STRAIGHT CHAIN ALKANE has a boiling point of  $-0,5^{\circ}\text{C}$ . Use the information in the table to identify this alkane and write down its IUPAC name? (2)
- 11.4 **B** and **C** are structural isomers.
- 11.4.1 Define structural isomers (2)
- 11.4.2 Explain why **B** has a higher boiling point than **C**. Refer to structure, the type of intermolecular forces and energy in your explanation. (3)
- 11.5 Explain the difference in the boiling points of **B** and **D**. Refer to intermolecular forces and energy in your explanation. (4)

11.6 Name a use for compound A.

(1)

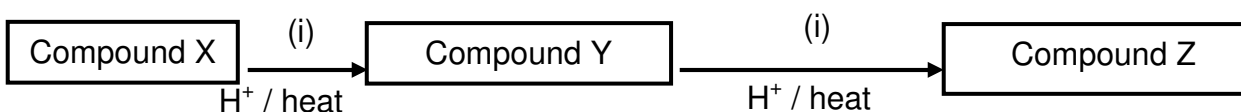
**[15]**

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### **QUESTION 12**

12. Mr Clifford wants to prepare an ester, ethylpropanoate, in the science laboratory. He has ethanol but does not have the other compound to make this ester. He also has another alcohol that he can use.

The table below shows how he uses the other alcohol to make the other compound for the ester.



12.1 What is the name given to this process above? (2)

12.2 Name compound **X** and compound **Z**. (2)

12.3 Write down the structural formula and IUPAC name for compound **Y** that is formed. (3)

12.4 What is a possible oxidizing agent used for (i). (1)

Once Mr Clifford has made compound **Z** he can now make his ester.

12.5 Write down structural formula and names of the compounds to show the chemical equation for the formation of ethylpropanoate. (6)

12.6 Give one use of esters. (1)

**[15]**

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**TOTAL: 160 MARKS**