SECONDARY SCHOOL ANNUAL EXAMINATIONS 2010
Directorate for Quality and Standards in Education
Educational Assessment Unit

FORM 4 **PHYSICS** **TIME: 1h 30min**

Name: _____ **Class:** _____

Answer ALL questions in the spaces provided on the Exam Paper.
All working must be shown. The use of a calculator is allowed.
Where necessary take the acceleration due to gravity, g = 10 m/s^2.

<table>
<tr><td colspan="3" align="center"><u>Equations for Annual Exam Physics</u></td></tr>
<tr><td>Density</td><td>$m = \rho V$</td><td></td></tr>
<tr><td>Pressure</td><td>$P = h \rho g$</td><td>$P = F/A$</td></tr>
<tr><td>Energy and Work</td><td>$PE = m g h$</td><td>$KE = \frac{1}{2} m v^2$</td></tr>
<tr><td></td><td>$E \text{ (or } W) = P t$</td><td>$W \text{ (or } WD) = F s$</td></tr>
<tr><td>Force</td><td>$F = m a$</td><td>$W = m g$</td></tr>
<tr><td>Motion</td><td>$\text{average speed} = \dfrac{\text{total distance}}{\text{total time}}$</td><td>$v = u + a t$</td></tr>
<tr><td></td><td>$s = \dfrac{(u + v) t}{2}$</td><td>$s = \frac{1}{2} a t^2$</td></tr>
<tr><td></td><td>$\text{momentum} = m v$</td><td>$h = \frac{1}{2} g t^2$</td></tr>
<tr><td>Electricity</td><td>$Q = I t$</td><td>$W = Q V$</td></tr>
<tr><td></td><td>$V = I R$</td><td>$R = R_1 + R_2 + R_3$</td></tr>
<tr><td></td><td>$P = I V = I^2 R = \dfrac{V^2}{R}$</td><td>$R \; \alpha \; \dfrac{\text{length}}{\text{area}}$</td></tr>
<tr><td>Electromagnetism</td><td>$\dfrac{N_1}{N_2} = \dfrac{V_1}{V_2}$</td><td></td></tr>
<tr><td>Heat</td><td>$H = m c \Delta\theta$</td><td></td></tr>
<tr><td>Waves and Optics</td><td>$c = f \lambda$</td><td>$m = \dfrac{h_i}{h_o} = \dfrac{\text{image distance}}{\text{object distance}}$</td></tr>
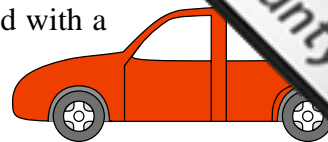</table>

Marks Grid: For the Examiners' use ONLY

Question	1	2	3	4	5	6	7	8	Theory	Practical	Total
Max. Mark	8	8	8	8	8	15	15	15	85	15	100
Score											

Section A.   **This section carries 40 marks**

1. Maria drives her car at 4 m/s in a straight line and increases the speed with a
    constant acceleration of 2 m/s² for 5 s. She then applies the brakes
    and the car comes steadily to rest in a further 10 s.

a. It can be concluded that the:

    i.   initial velocity of the car   = _____ m/s   **1**

    ii.   acceleration of the car   = _____ m/s²   **1**

    iii. final velocity of the car 10 s after Maria applies the brakes = _____ m/s   **1**

b. Calculate the:
    i.   velocity of the car after accelerating for 5 s.

_____

_____

                                                                                          2

    ii.   deceleration of the car during the final 10 s of its journey.

_____

_____

                                                                                          3

2. During a football game, Nigel is chosen to kick in a penalty for his team.
    He kicks the ball weighing 4N so that it moves off with a velocity of
    2 m/s at the end of the impact, which lasts for 0.05 s.

a. Calculate the:
    i.   mass of the football in kg. _____

                                                                                          1

    ii.   momentum of the ball in kgm/s **just after** Nigel kicks it in.

_____

                                                                                          1

    iii. acceleration in m/s² of the ball **during** impact.

_____

                                                                                          2

    iv. force in N acting on the ball **during** impact.

_____

                                                                                          2

b. State what happens to the size of the force during impact with Nigel's shoes if Nigel's kick on
    the ball lasts longer than 0.05 s.

_____

                                                                                          1

c.   Alex, the goalkeeper of Nigel's opposing team catches the ball with his hands. T̶
resistance acting against the motion of the ball as it travels towards the goalkeeper is
Calculate the impact force in N acting on the goaler's hands.

_____

1

3.   **a.**   Underline the **correct bold word** in each of the following statements:

i.   A charged polythene strip has **more / less** electrons than protons.   **1**

ii.   When rubbed with a duster, a cellulose acetate strip becomes   **1**
positively / negatively charged.

iii.   Neutral [or uncharged] objects are **repelled / attracted** by both positively and
negatively charged objects.   **1**

iv.   Charge is measured in **coulombs / amperes**.   **1**
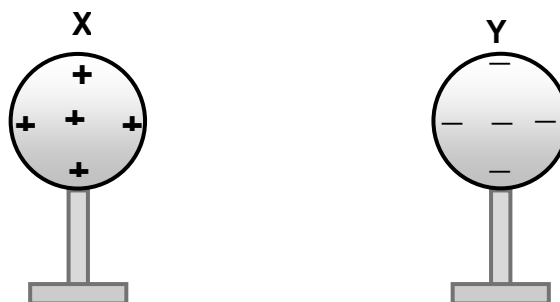
b.   Complete the following:
The size of the force of attraction or repulsion between two charged objects depends on:

•   their total amount of charge

•   _____

1

c.   Two metal spheres X and Y on insulating stands are equally and oppositely charged as shown.

State what happens **in terms of electron flow** when:
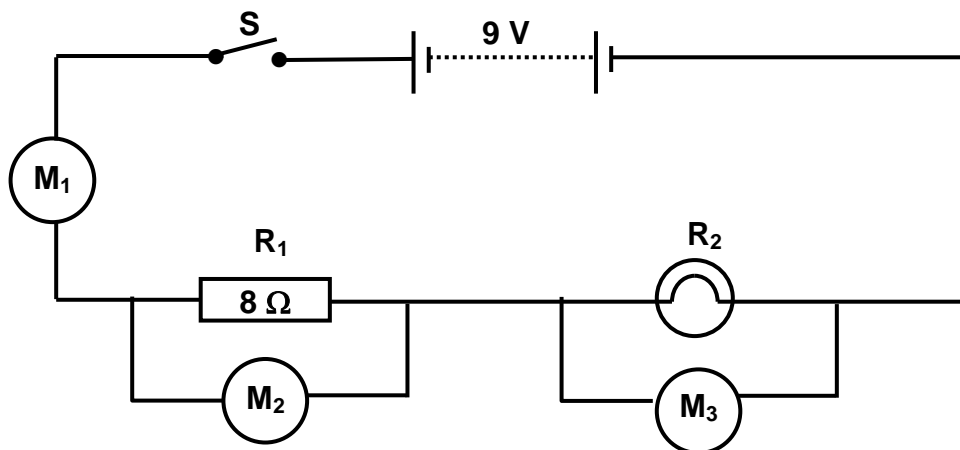
i.   sphere X is connected to earth?

_____

1

ii.   sphere Y is connected to earth?

_____

1

iii.   sphere X is connected to sphere Y?

_____

1

4. The figure represents a number of electrical components set up in a circuit.

a. **i.** Meter M_1 is the _____ measuring total current flowing through the circuit. **1**

ii. Meter M_2 is the _____measuring the potential difference across resistor R_1. **1**

iii. Electrical components R_1 and R_2 are connected in _____. **1**

b. The electric current flowing through the circuit is 0.75 A. Calculate the:

i. **potential difference** across resistor R_1 in volts,

_____
1

ii. **potential difference** across the electrical component R_2 in volts,

_____
1

iii. **resistance** of electrical component R_2 in Ω,

_____
1

iv. **power** generated by the battery **through the circuit** in Watts.
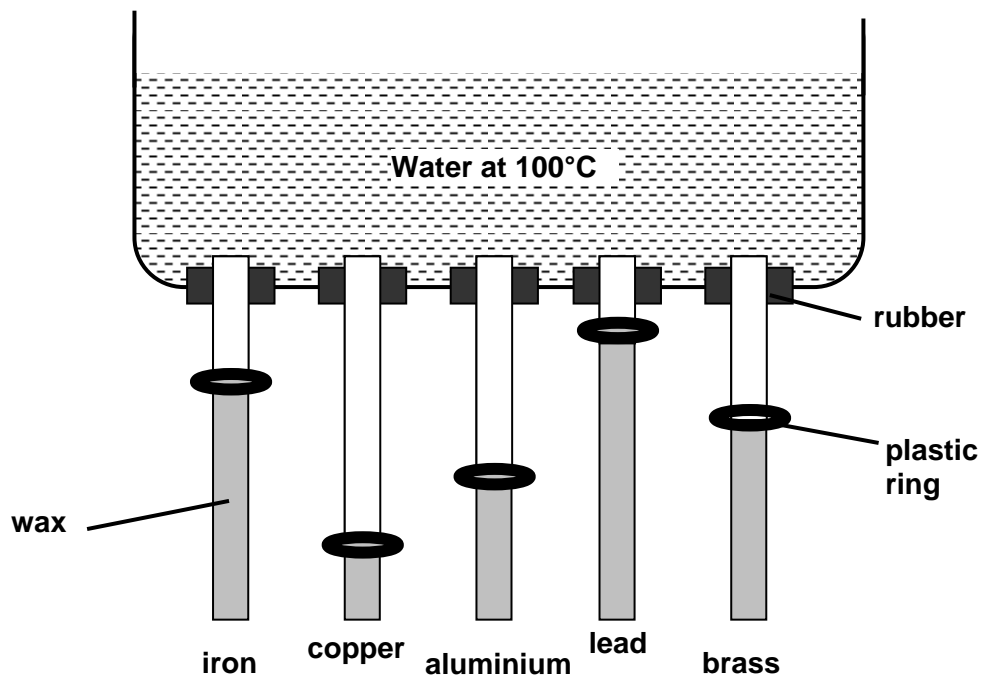
_____

_____
2

5. a. **Complete**:

_____ is the flow of heat energy through a material from places of
temperature to places of lower temperature without any movement [or flow] of the mater
itself.   **1**

b. The diagram below shows the experimental set up to compare the conductivity of different
    metals.
    As the wax melts, the plastic ring slides down the metal rod.

Complete the table below by placing the five conductors in the above diagram in order of
conductivity putting the best conductor first.

Order of conductivity	Conductor	
1		**1**
2		**1**
3		**1**
4		**1**
5		**1**

c. i. Your neighbour wants to order a barbeque metal fork. He has a choice of three metals,
        copper, brass or iron. Which metal would you advice him to choose for the fork?

    _____
                                                                                                                         1
    ii. Give a reason for your answer.

    _____
                                                                                                                         1

Section B.   **This section carrie**

6.   This question is about motion under the influence of the pull of gravity.

a.   When required, helicopters are used to drop medicines, food, and equipment in areas hit by earthquakes, floods and landslides.

Gregg a helicopter pilot and his crew drop a heavy strong specially packed crate containing tinned food and bottled water from a height of 45 m. The crate touches the ground after 3 s. It can be concluded that:

i.	initial velocity **u** of the crate	= _____ m/s	**1**
ii.	acceleration due to the pull of gravity **g**	= _____ m/s^2	**1**
iii.	height **h** covered by the crate	= _____ m	**1**
iv.	time taken **t** by the crate to reach the ground	= _____ s	**1**

v.   using the formula, $v = u + at$, the final velocity of the crate before it reaches the ground is:

_____
                                                                                                     2

b.   The table below shows how Gregg's velocity changes during the first 16 s after dropping from his helicopter as part of an exercise.

velocity v / m/s	0	20	40	50	55	57	58	58	58
time t / s	0	2	4	6	8	10	12	14	16

i.   Plot a graph of velocity v (y-axis) against the time t (x-axis).   **4**

ii.   Use your graph to find Gregg's velocity 3 s after dropping from the helicopter.

_____
                                                                                                     1

iii.   Use your graph to find the time taken for Gregg to reach constant velocity.

_____
                                                                                                     1

iv.   What did Gregg do so as to fall with constant velocity after a few seconds?

_____
                                                                                                     1

v.   Gregg's constant velocity between the 12th and the 16th second of his fall is

referred to as _____ velocity during which the resultant force acting

on Gregg is _____ N.   **2**

GRAPH PAPER

7. **This question is about specific heat capacity and heat energy transfer.**

The diagram below shows a large water heater (geyser) providing a large amount [of] water.
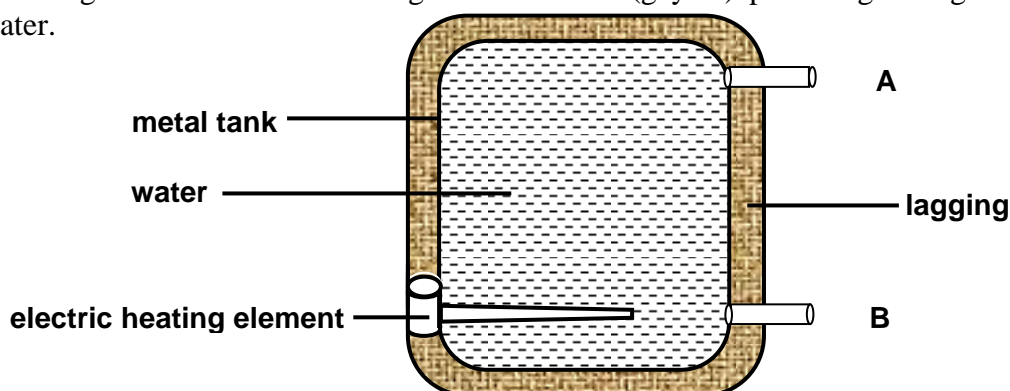
a. On the above diagram draw an arrow to indicate from where:
   i. cold water enters the geyser,
   ii. hot water comes out of the geyser. **3**

b. The geyser contains 250 kg of water at 20°C. Calculate:
   i. the change in temperature if this mass of water is heated from 20°C to 45°C,

   _____
   1
   ii. the heat energy in J required to heat this mass of water from 20°C to 45 °C given that the specific heat capacity of water is 4200J/kg °C and that heat energy Q = mass x specific heat capacity x change in temperature

   _____

   _____
   2

c. **i.** Would you use the above geyser to provide hot water only to wash a few dishes

   in the kitchen?   _____. **1**

   ii. Give a reason for your answer.

   _____ **1**

d. **i.** Name the process through which heat energy is transferred from the heating

   element to the water. _____ **1**

   ii. Name the process through which heat energy from the heating element is transferred so

   that all the water throughout the geyser becomes heated. _____ **1**

   iii. What is the purpose of the lagging material around the heating tank?

   _____
   1

   iv. Should the lagging material be made up of: a conductor or insulator?

   _____
   1

   v. Give a reason for your choice.

   _____
   1

e. **i.** What colour would you expect the inside of the water tank to be?

_____

ii. Give a reason for your answer.

_____

1

8. **This question is about the design of an experiment on Ohm's Law.**

Georg Simon Ohm (1789 –1854) was a German Physicist and a high school teacher. Using equipment of his own creation, Ohm discovered the direct proportionality between the potential difference applied across a conductor and the resulting electric current flow. This is now referred to as Ohm's law.

a. Underline the **correct bold word** in the following:

Ohm's law states that an electric **current** / **power** flowing through a metallic conductor maintained at constant temperature is directly proportional to the **potential difference / resistance** across its ends. **2**

b. Rachel and Robert are required to investigate whether a filament lamp obeys Ohm's law. They try to set up the circuit, leaving out the componets X, Y and Z as shown below:
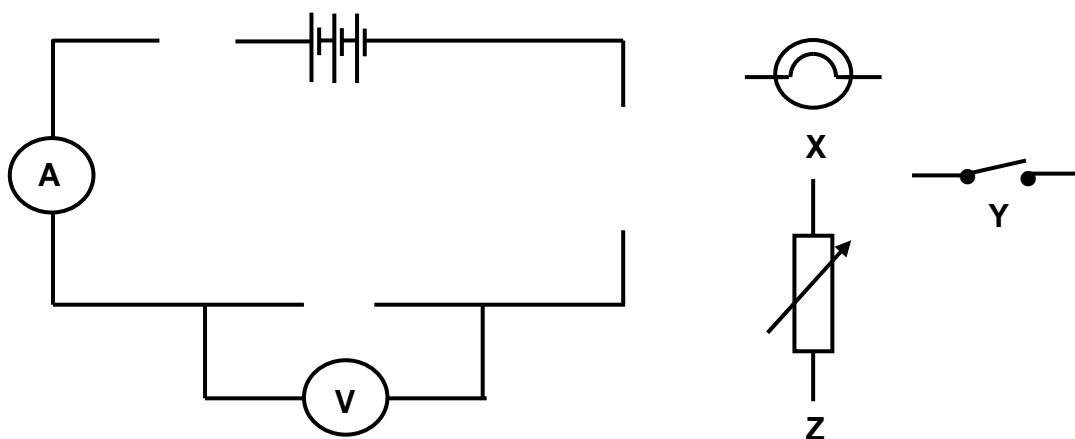
i. Component X is the _____ **1**

ii. Component Y is the _____ **1**

iii. Component Z is the _____ **1**

iv. Draw the electrical components X, Y and Z in their correct positions in the incomplete circuit. **3**

v. State the purpose of electrical component **Y** in the circuit.

_____

1

**vi.** State the purpose of electrical component **Z** in the circuit.

_____

1

c. Rachel and Robert noted the current flowing through the filament lamp for five di...
values of the p.d. across it.   Fill in the **missing heading** (symbol and units) of the th...
column of the following Table of Results where Rachel and Robert can record their list...
observations made.

missing head...

Reading	I / A	
1		
2		
3		
4		
5		

2

d. The diagram below is a sketch of the graph plotted by Rachel and Robert based on their
results obtained during their experiment

I / A

p.d. / V
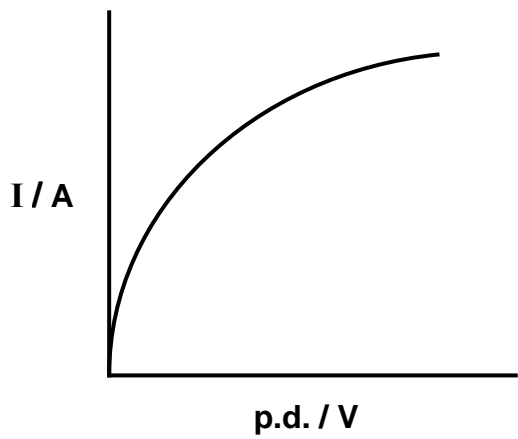
    i. Does the filament lamp obey Ohm's law?

_____
1

    ii. Give a reason to your answer.

_____
1

e. Give **one** precaution taken by Rachel and Robert in order to obtain the most possible accurate
readings.

_____
1