JUNIOR LYCEUM 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.

Equations for Annual Exam Physics

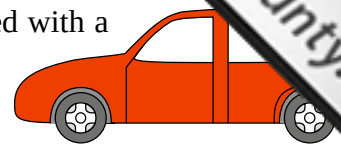
Density	$m = \rho V$	
Pressure	$P = h \rho g$	$P = F/A$
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$
	$E \text{ (or } W) = P t$	$W \text{ (or } WD) = F s$
Force	$F = m a$	$W = m g$
Motion	$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$	$v = u + a t$
	$s = \frac{(u +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

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 mar**

1. Maria drives her car at 4 m/s in a straight line and increases the speed with a constant acceleration of 2 m/s^2 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/s^2 **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/s^2 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 and resistance acting against the motion of the ball as it travels towards the goalkeeper. 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 **positively / negatively** charged. **1**

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

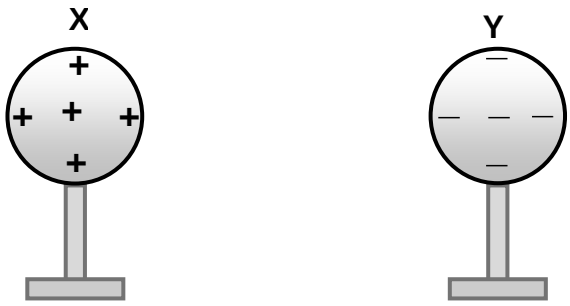
iv. Charge is measured in **coulombs / amperes**. **1**

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?

_____

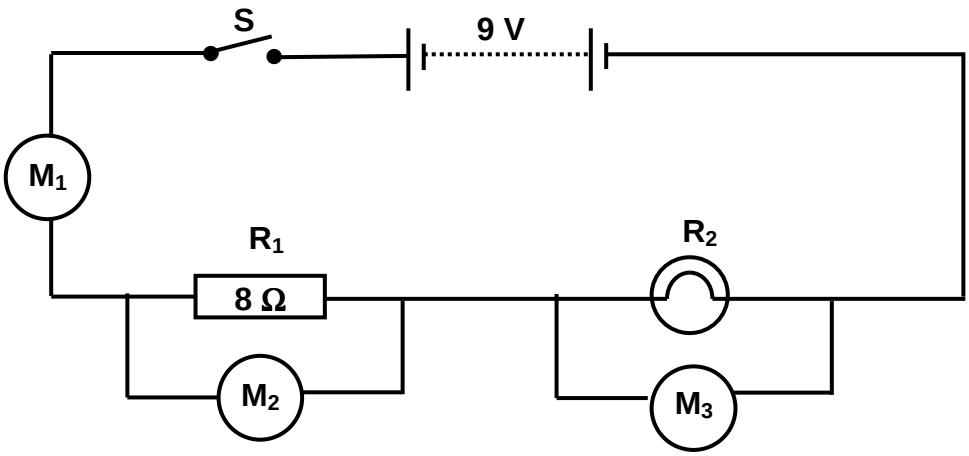
1

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 $\mathbf{M_1}$ is the _____ measuring total current flowing through the circuit. **1**

ii. Meter $\mathbf{M_2}$ is the _____measuring the potential difference across resistor $\mathbf{R_1}$**.** **1**

iii. Electrical components $\mathbf{R_1}$ and $\mathbf{R_2}$ are connected in _____. **1**

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

i. **potential difference** across resistor $\mathbf{R_1}$ in volts,

_____

1

ii. **potential difference** across the electrical component $\mathbf{R_2}$ in volts,

_____

1

iii. **resistance** of electrical component $\mathbf{R_2}$ in Ω,

_____

1

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

_____

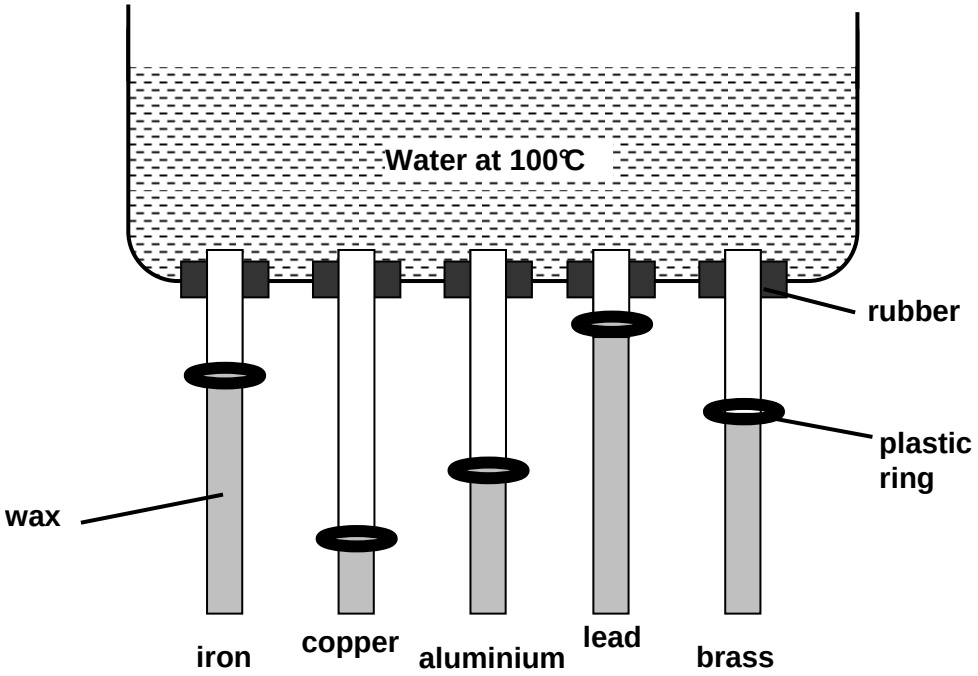
_____

2

5. a. Complete:

_____ is the flow of heat energy through a material from places of high temperature to places of lower temperature without any movement [or flow] of the material 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 advise him to choose for the fork?

_____

1

ii. Give a reason for your answer.

_____

1

Section B. **This section carries 45 marks**

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. Calculate the:

i. time taken in seconds for the crate to reach the ground.

_____

_____

2

ii. final velocity of the crate in m/s,

_____

_____

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. From the graph or otherwise calculate Gregg's acceleration during the first 4 s of his fall.

_____

1

iii. From your graph, determine the time taken for Gregg's parachute to open up.

_____

1

iv. Calculate the height in m fallen by Gregg before the parachute opens up.

_____

_____

2

v. Gregg's acceleration between the 12^{th} and the 16^{th} second of his fall is _____ m/s^2.

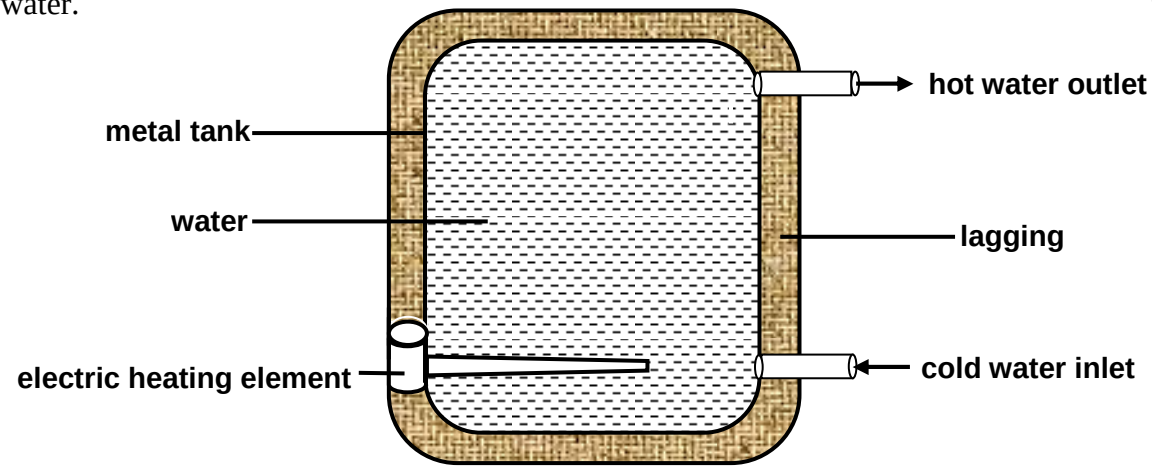
1

vi. Gregg's constant velocity between the 12^{th} and the 16^{th} 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 water.



a. 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 (4200J/kg K),

_____

_____

2

iii. the time taken in seconds for the 250 kg of water to heat up from 20°C to 45°C given that the power of the heating element is 3000 W.

_____

_____

2

b. In practice the time taken for 250 kg of water in the water heater shown above to heat up from 20°C to 45°C is actually around 5 minutes (300 s) more than that calculated in question a. iii. Give a reason for this.

_____

1

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.

_____

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?

_____ **1**

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. **Complete:** Ohm's law states that an electric _____ flowing through a metallic conductor maintained at constant _____ is directly proportional to the potential difference across its ends. **2**

b. You are required to investigate whether a filament lamp obeys Ohm's Law. You are provided with the following apparatus: battery, switch, variable resistor, ammeter, voltmeter, a filament lamp and connecting wire.
Describe how you would carry out the investigation.

Your answer should include:

i. a circuit diagram of the experimental set-up,
ii. a **brief** account of how you would carry out the experiment,
iii. a table of results to record the list of observations made,
iv. the result you expect from your investigation,
v. a sketch of an appropriate graph showing the expected results,
vi. one precaution in order to obtain a reliable conclusion.

i. Circuit diagram

3

ii. Method

_____

_____

_____

_____

3

iii. Table of results

2

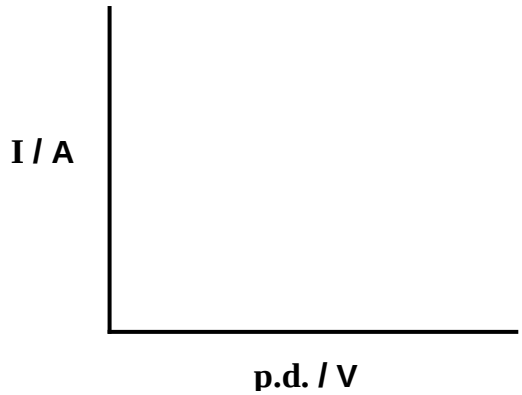
iv. Result expected

_____

_____

2

v. Expected graph



2

vi. One precaution

_____

1