JUNIOR LYCEUM ANNUAL EXAMINATIONS 2008

Educational Assessment Unit - Education Division

FORM 5 | **PHYSICS** | **TIME: 1 hr 45 min**

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	$Q = I t$	$W = Q V$
	$V = I R$	$R = R_1 + R_2 + R_3$
	$P = I V = I^2 R = \frac{V^2}{R}$	$R \propto \frac{\text{length}}{\text{area}}$
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 marks**

1. a. Complete the table by choosing **four** appropriate types of forces from the list: *weight; electrical; magnetic; electrostatic; elastic; frictional; gravitational*

No.	**Event**	**Type of force**	
i.	A satellite orbiting Earth		**1**
ii.	A compass pointing towards the North pole of a magnet		**1**
iii.	Dust particles attracted to a clean dry glass window		**1**
iv.	The brake pads of a car becoming warm during braking		**1**

b. An apple of mass 200 grams falls from a tree on to the ground.

i. Calculate the mass of the apple in kg. **1**

ii. Calculate the weight of the apple on Mars in newtons given that the force of gravity on Mars is 4 N/kg. **1**

iii. Give a reason to explain why the force of gravity on Mars is less than that on Earth. **1**

iv. Name the natural satellite, which orbits Earth once every 28 days. ________________ **1**

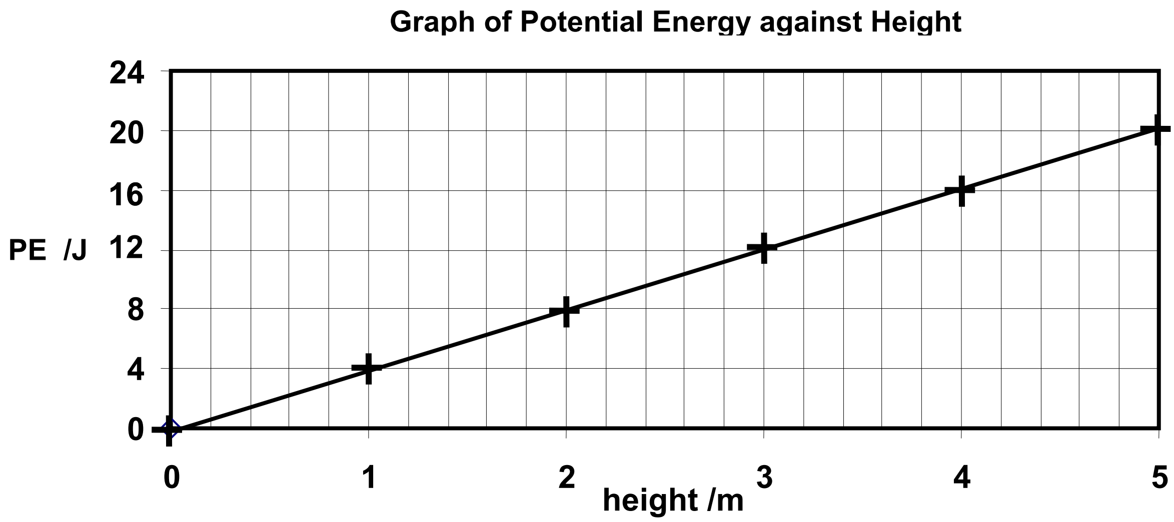
2. During a football game**,** Andrew of mass 72 kg runs after the ball at 2 m/s for 6 s.

a. Calculate:

i. Andrew’s kinetic energy in joules, **1**

ii. the power generated by Andrew. **2**

b. The graph below shows how the potential energy of the ball changes as Andrew kicks it vertically upwards.



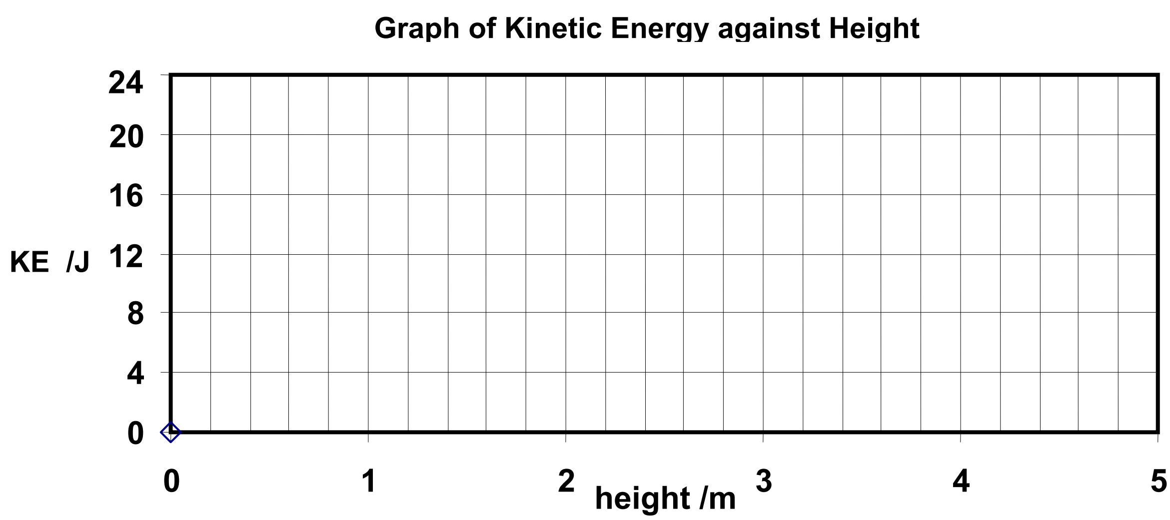
Use the graph to find the:

i. greatest height reached by the ball in meters, **1**

ii. potential energy in joules of the ball when it reaches its greatest height above the ground, **1**

iii. the mass of the ball in kg. **1**

c. On the grid below, draw a graph to show how the KE of the same ball changes as it is kicked to the same height. **2**



3. Figure 1 below shows Maria standing on a platform of a climbing frame in a children's playground. Maria steps off the platform and falls freely to the ground in 0.4 s.

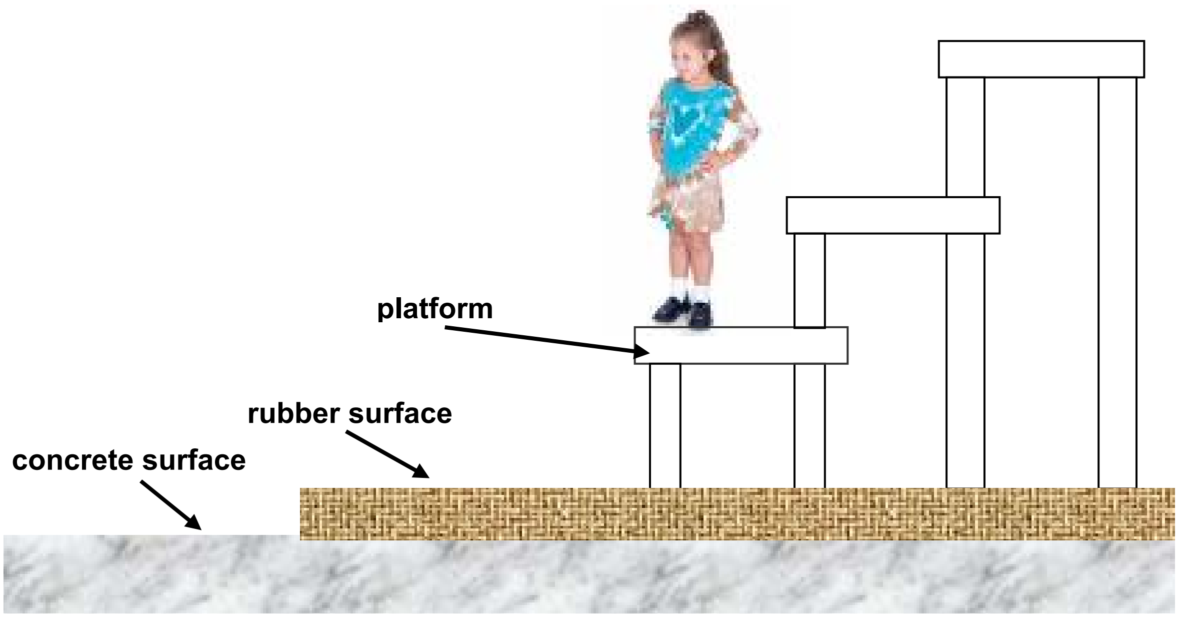


Figure 1

a. Find:

i. Maria's initial velocity is __________ m/s, **1**

ii. the distance fallen by Maria in m, **1**

iii. the velocity at which her feet hit the rubber surface in m/s **1**

b. For safety, the ground around the climbing frame is covered by a layer of soft rubber as shown in figure 1. The time interval between Maria hitting the rubber surface and coming to a stop is 0.5 s.

i. Calculate Maria's momentum in kgm/s as she hits the rubber surface given that her mass is 50 kg. **1**

ii. What is Maria's momentum 0.5 s after impact? _____ kgm/s **1**

iii. Calculate the force with which Maria hits the rubber surface. **1**

c. The soft rubber is removed so that it could be replaced. Maria ignores the sign not to use the climbing frame. She steps off the platform and falls freely on to the concrete ground below.

i. Does the time interval between Maria hitting the concrete ground and coming to a stop decrease, increase or remains the same? ______________________ **1**

1

ii. What effect could this have on Maria?

4. A uniform metal bar 1 m long is balanced at the 0.3 m mark when a load of 5 N is placed at the 0 m mark as shown in figure 1.

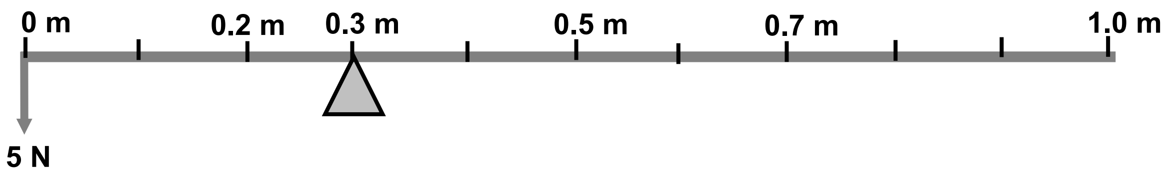


Figure 2

a. On figure 2: **1**

i. Mark with a 'C' the position of the centre gravity of the metal bar. **1**

ii. Draw an arrow to show the position of the weight W of the metal bar.

2

b. Calculate the:

i. weight of the metal bar in N, using the Law of Moments **1**

ii. total downward force acting on the pivot, **1**

iii. upward reaction force by the pivot, **1**

iv. the mass of the metal bar in kg,

1

v. the density in kg/m^3 of the metal bar given that its volume is 0.0001 m^3.

5. The figure below shows the experimental set-up to find the specific heat capacity **c** of aluminium. The immersion heater is inserted in an aluminium block, which holds a thermometer as shown in figure 3 below.

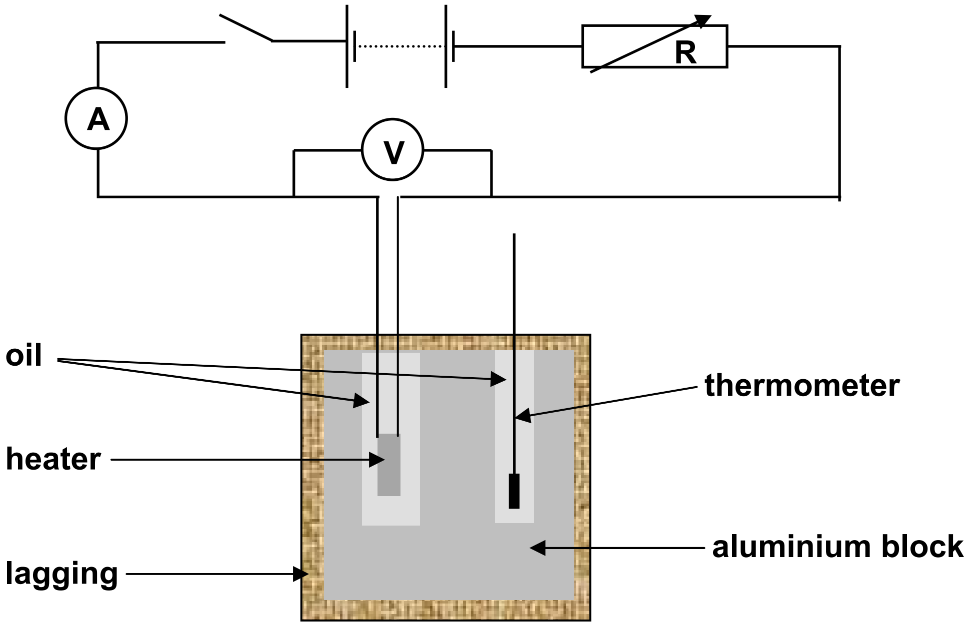


Figure 3

a. In figure 3:

i. The heater and the rheostat **R** are connected in ________________. **1**

ii. The ammeter **A** is connected in _____________ with the heater and the rheostat. **1**

iii. The voltmeter is connected in _______________ with the ______________. **2**

b. The ammeter reads 2 A during the experiment while the voltmeter reads 25 V. Calculate the:

i. power of the heater in watts, **1**

ii. energy supplied by the heater in 5 minutes in Joules **1**

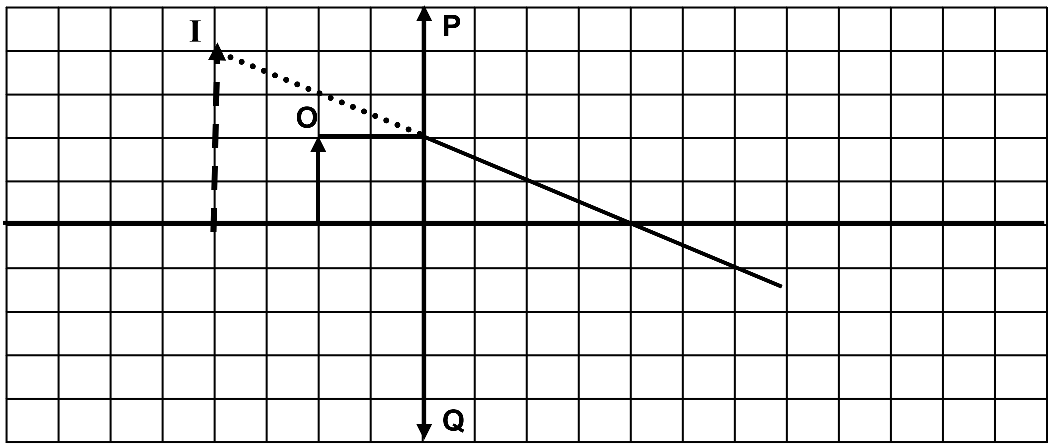
iii. specific heat capacity **c** of aluminium in J/kg°C, given that the temperature of the aluminium block of mass 2 kg, rises by 8 °C in 5 minutes. **2**

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

6. This question is about Converging Lenses.

a. The figure represents an object O placed in front of a converging lens PQ. A ray of light from the top of the object O is drawn to indicate the position of the image I.

Note: 1 square represents 1 cm.



i. Draw **another** ray of light from the top of the object O to show how the position of the image I has been located. **1**

ii. Why is the image **I** of the object O represented in broken lines? **1**

iii. List two **other** properties of the image **I**. **2**

iv. The ray diagram shows the converging lens PQ being used as a ______________________________ **1**

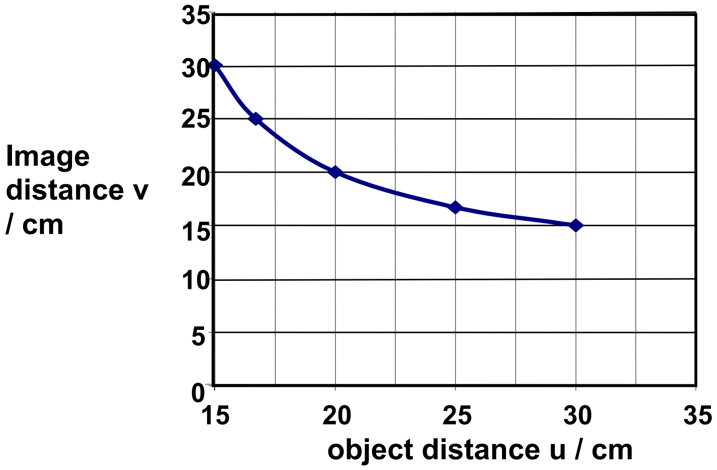
b. Use the ray diagram to determine:

i. the magnification of the converging lens PQ. **2**

ii. the focal length of the lens PQ. **2**

iii. a value for the object distance if the lens PQ is used in a camera. **2**

c. The graph below shows the image distances obtained when a pin is placed at different object distances from the optical centre of a converging lens RS.



From the graph find the:

i. image distance **v** in cm when the object distance **u** is 15 cm, ________________ **1**

ii. magnification at an object distance of 15 cm, **1**

iii. the height of the image obtained at an object distance of 15 cm, given that the height of the pin (the object) is 3 cm. **2**

7. This question is about static electricity.

a. David rubs a polythene strip with a duster. Both the polythene strip and the duster become charged.

i. What kind of charge does the polythene strip acquire? __________________________ **1**

ii. What is the charge on the duster? __________________________ **1**

iii. Name the force causing the polythene strip and the duster to become charged. __________________ **1**

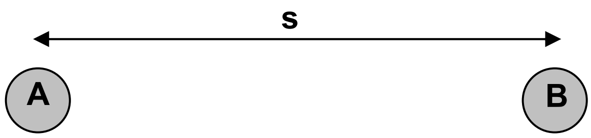
b. David then holds the charged polythene strip from one of its ends.

i. Does the charged polythene strip lose its charge? _________________ **1**

ii. Explain your answer. **1**

c. David now charges a copper strip holding it from the rubber handle at one end. Explain why the charged copper strip looses its charge when David touches it. **1**

d. Two identical **polythene** balls A and B are equally charged and placed at a distance **s** away from each other as show in the figure below:



The distance **s** between the equally charged balls A and B in the figure above is changed, and the force **F** between them is measured each time. The results obtained are shown in the following table.

s /m	4	6	8		12	14	16	18
F /N	11	7.5	5.5	4.0	2.8		1.6	1.2

i. Plot a graph of the force F (y-axis) against the distance s (x-axis) on the graph paper provided. **4**

ii. Use your graph to complete the missing values in the above table. **2**

iii. What conclusion can you draw about the relationship between the size of the force **F** and the separating distance **s** between similarly charged objects? **1**

iv. Is **F** directly proportional to **s**? _____. **1**

v. Give a reason for your answer to question iv. **1**

8. This question is about magnets, electromagnets and electromagnetic induction.

a. The figure below shows a bar magnet.

i. Draw the magnetic field of the bar magnet, showing clearly its **direction.** **2**

ii. Which apparatus can be used to determine the direction of the field? **1**

____

b. You are supplied with: a thick soft iron nail, a length of insulated wire, a switch, a 9 V battery, a rheostat, an ammeter and some small soft iron paper clips.

Briefly describe how you would use this apparatus to set up an electromagnet. Your description should include:

i. a **labelled** diagram of the experimental set up, **3**

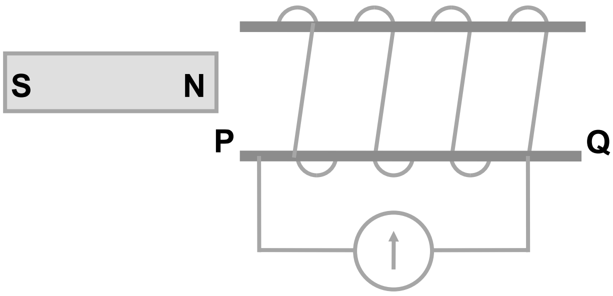
2

ii. a **very** brief description of the method,

iii. **two ways** of increasing the strength of the electromagnet, **2**

iv. **state** how you would investigate the effect of the size of current on the strength of the electromagnet, **1**

c. The diagram shows an apparatus that can be used to show that a current is induced in a coil when it cuts a magnetic field.



i. State the magnetic polarity induced at the end **P** of the coil while the magnet **is pushed** inside the coil. __________.

1

ii. Explain why there is no deflection of the galvanometer pointer when the magnet is at rest inside the coil. **1**

iii. State **two ways** of increasing the size of the induced current in the coil. **2**