JUNIOR LYCEUM ANNUAL EXAMINATIONS 2005

Educational Assessment Unit – Education Division

FORM 4 PHYSICS Time: 1 hr. 30 min.

NAME: _____ CLASS _____

Answer all the questions of Section A in the spaces provided on the Exam Paper. Answer all questions in Section B on the sheets provided. All working must be shown. The use of a calculator is allowed.

Where necessary take the acceleration due to gravity, g = 10m/s^2

You may find some of these formulae useful

Pressure = force/area

Force = mass x acceleration

P = IV

Voltage rise = total voltage drop

V = IR

Energy = power x time

Momentum = mass x velocity

Force = $\frac{\text{Change in momentum}}{\text{Time taken}}$

Heat energy = mass x specific heat capacity x temperature change

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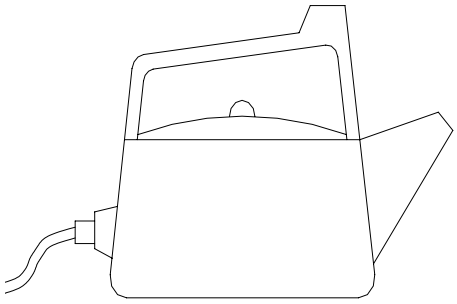
Section A Answer all questions in the spaces provided.
This section carries 55 marks.

1 Fill in

A force is a push or a pull. It is measured in _____ . When a force acts on an object, the object accelerates. If a force acts against the moving object (eg air resistance), the object _____ . The force that the Earth exerts on an object is called the Force of _____ . This force produces an acceleration of _____ . When an object moves with a constant velocity, the resultant force on a moving object is _____ .

5 marks

2



A student wants to find the specific heat capacity of water using an electric kettle. She fills it with water and connects it to a joulemeter connected to the electrical supply.

a Complete:

i To find the mass of the water she can use a _____ . 1 mark

ii She can find the temperature of the water by using a _____. 1 mark

b i Before starting heating, the water's temperature is 20^{o}C. Why is it not 0^{o}C?

_____

_____ 1 mark

ii She heats the water to 100^{o}C. The temperature rise is _____^{o}C 1 mark

iii At 100^{o}C the water normally _____ . 1 mark

c In the experiment, the mass of the water was 1.5kg and the heat energy supplied was 5.4 x 10^{5} J (540 000J).

i Calculate the specific heat capacity of water.

_____

_____

_____ 3 marks

ii Give one reason why your answer is different form the correct value of 4200J/kg^{o}C.

_____

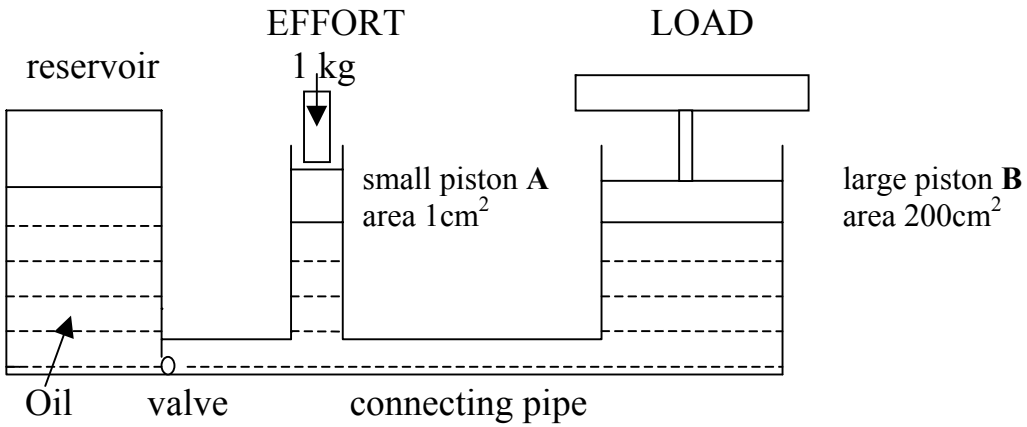
_____ 1 mark

iii State one way of improving the accuracy of the experiment.

_____

_____ 1 mark

3



The figure represents a simple hydraulic jack. The pistons may be considered weightless and frictionless. A mass of 1kg is placed on the small piston A. The cross-sectional area of A is 1cm^2 while that of B is 200cm^2

ai Calculate the force acting on piston A

_____ 1 mark

ii Calculate the pressure on the liquid in N/cm^2 just under piston A.

_____

_____ 2 marks

bi What property of liquids is responsible for transferring this pressure from piston A to B?

_____

_____ 2 marks

ii Would the pressure in B be different if the connecting tube were wider?

_____ 1 mark

iii Why is the reservoir important?

_____

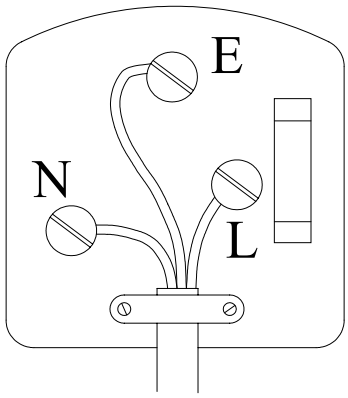
_____ 2 marks

iv Calculate the maximum load in N that can be raised by this jack?

_____

_____ 2 marks

4



The cable used to connect a fan heater to the mains is made of copper and plastic.

a Which of the two, copper or plastic, is the electrical conductor? _____ 1 mark

b The cable was connected to a 3-pin plug fitted with a fuse. The cable had 3 plastic covered wires, one coloured yellow and green, one brown while the third one blue. Each was connected to one of the three pins labelled L, N and E.

Complete:
L means _____ and the colour of the wire is _____
N means _____ and the colour of the wire is_____
E means _____ and the colour of the wire is _____ 3 marks

c When the fan heater is 'on' it uses a current of 10A from the 230V mains supply.

i Of the 3 fuses available, 5A, 10A and 13A which is a suitable one? _____ 1 mark

Calculate the power of the heater:

ii In watts (W)_____ 1 mark

iii in kilowatts (kW) _____ 1 mark

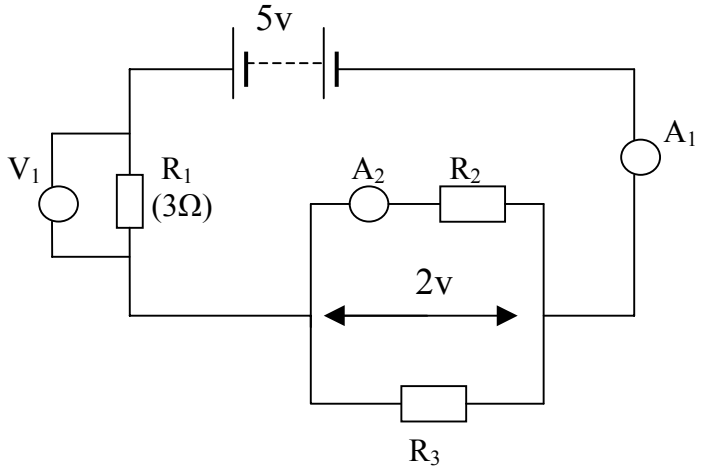
d The heater is switched on for 3 hours daily for 7 days.

i How many kWh has the heater used?

_____
_____2 marks

ii If electrical energy costs 5c every kWh, what is the total cost of switching on the heater for 7 days? _____
_____1 mark

5



a Complete:

i Resistor R_1 is connected in _____ ,

ii while R_2 and R_3 are connected in _____ . 2 marks

b The voltage drop across R_2 and R_3 is 2v.

i Calculate the voltmeter reading V_1.

_____ 2 marks

ii If the resistance of R_1 is 3Ω calculate the current flowing through R_1.

_____

_____ 2 marks

iii The resistance of R_2 is 6Ω. Calculate the reading of ammeter A_2.

_____

_____ 2 marks

ci To the above circuit add a switch labelled S_1 so that all the three bulbs can be switched on or off at the same time. 1 mark

ii The batteries normally used in such circuits are not environmentally friendly. Why?

_____

_____ 1 mark

6a

CLOTH

POLYTHENE

When a polythene strip is rubbed with a dry cloth, both the polythene and cloth become charged because electrons are being transferred.

On the above diagram:

i Mark + and – to show the charge on the cloth and on the polythene. 2 marks

ii Draw an arrow to show the direction in which the electrons are moving. 1 mark

An insulated copper strip was charged by rubbing. The charged copper and polythene strips were then earthed. Only the copper strip lost its charge. Which of the two strips was:

iii the conductor? _____ 1 mark

iv the insulator? _____ . 1 mark

b

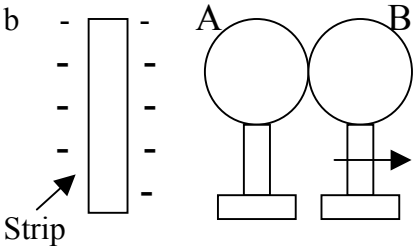


figure 1

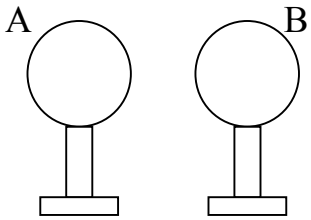


figure 2

The above method shows one way of charging 2 insulated metal spheres, by separation.
The strip is <u>negatively</u> charged.

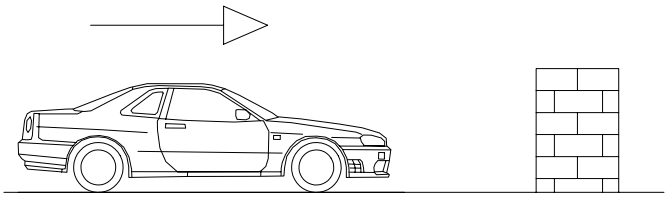
i Mark the charges on A and B in figure 1. 2 marks

ii Underline the correct phrase in the brackets:
The charge on sphere A is (greater than, equal to, smaller than) the charge on sphere B. 1 mark

iii Sphere B was momentarily earthed. First the earth connection and then the strip was removed. Then sphere B was separated from sphere A.
Mark the charges on spheres A and B in figure 2 2 marks

Section B Answer all questions on the foolscap provided.
Each question carries 15 marks.

7 This question is about momentum and passenger safety in cars.



Two students wanted to test the safety of cars. A toy car of mass 0.8kg travelling at 5m/s crashes into a wall and takes 0.01s to stop after hitting the wall.

ai Name an apparatus used in the lab to find the velocity of a moving object. 1 mark

ii Calculate the momentum of the car just before the crash. 2 marks

iii What is the momentum of the car after the crash? 1 mark

iv Calculate the change in momentum. 1 mark

v Using the equation: $\text{Force} = \frac{\text{Change in momentum}}{\text{Time to stop}}$

calculate the force that develops. 2 marks

vi What object is causing this force? 1 mark

vii Is this force increasing or decreasing the velocity of the moving car? 1 mark

b Now they attach a piece of plasticene to the front of the car and they observe that the car takes 0.2s to stop as the plasticene gets squeezed between the car and the wall.

i Using the equation in section 7a above, calculate the new force. 2 marks

ii Copy and complete the statement in your foolscap:
If the time of stopping _____ , the force acting against the car _____ . 2 marks

iii Besides crumple zones name two other features in cars that ensure better safety for the driver and passengers. 2 marks

8 This question is about designing an experiment.

Two students want to investigate whether the outer colour of a container affects the radiant heat entering it. They use two identical copper containers each filled with the same mass of tap water. They paint one container dark brown while they polish the other one. Describe the way they carry on their investigation.

Your answer should include:

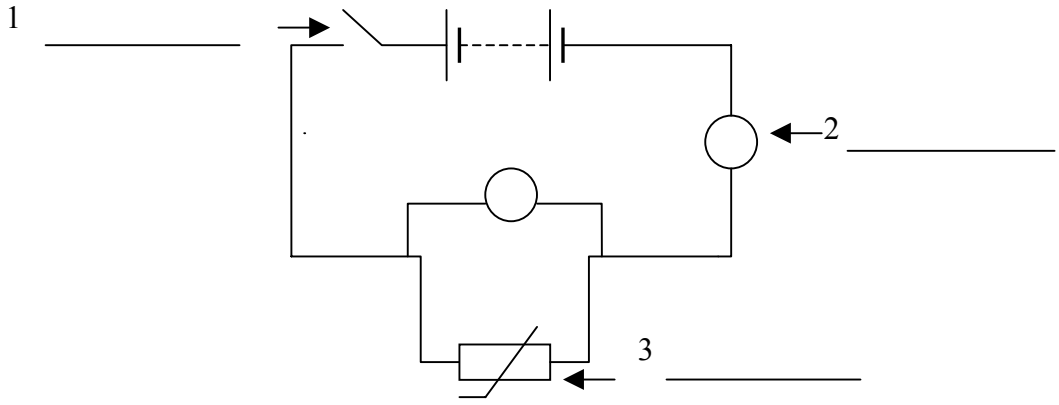
i any additional apparatus, including any measuring instruments they may require. 3 marks

ii a well labelled diagram 2 marks

iii	a brief description of the method used.	4 marks
iv	any measurements taken	2 marks
v	the graph they plot	2 marks
vi	a precaution to increase accuracy	1 mark
vii	the expected result.	1 mark

9 This question is about a component whose resistance changes with temperature.

In an experiment to calculate the resistance of a thermistor, two students used the following apparatus.



ai Label the items marked 1, 2 and 3. (Write them down in your foolscap.)
3 marks

ii They want to heat the thermistor to 50°C. Suggest the best method to do this.
1 mark

iii How can they be sure the thermistor's temperature is actually 50°C?
1 mark

iv What readings should they take to calculate the resistance of the thermistor?
1 mark

b In doing the above experiment they obtained the following readings:

Resistance R/Ω	900	730	600	490	410	340	290	240	180
Temperature θ/°C	15	20	25	30	35	40	45	50	60

i Plot a graph of resistance on the y-axis against temperature on the x-axis.
You are advised to use the following scale:
y-axis: 1 cm to represent 50Ω
x-axis: 1 cm to represent 5°C 6 marks

ii What would the resistance of the thermistor be at 70°C? 1 mark

iii By looking at your graph what can you conclude about the resistance of the thermistor and its temperature? 2 marks