Index No:________________ SEC24/1.14m

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA

SECONDARY EDUCATION CERTIFICATE LEVEL

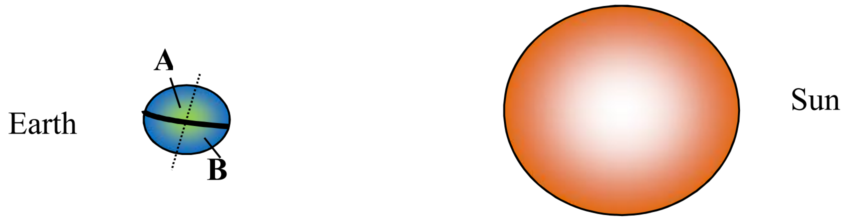
MAY 2014 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	29th April 2014
TIME:	4:00 p.m. to 6:00 p.m.

Answer all Questions.
You are requested to show your working and to write the units where necessary.
When necessary, take g, acceleration due to gravity, as 10m/s^2.

Density	$m = \rho V$		
Pressure	$F = p A$	$p = \rho g h$	
Moments	Moment = F × perpendicular distance		
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$
	Work Done = energy converted		$E = P t$
Force and Motion	$m a$ = unbalanced force	$W = m g$	$v = u + a t$
	average speed $= \frac{\text{total distance}}{\text{total time}}$		$s = (u + v)\frac{t}{2}$
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$	momentum $= m v$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$		$v = f \lambda$
	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$	Magnification $= \frac{\text{image distance}}{\text{object distance}}$	
	Magnification $= \frac{\text{image height}}{\text{object height}}$		$T = \frac{1}{f}$
Electricity	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{1}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$	$V_p I_p = V_s I_s$	
Heat	$Q = m c \Delta\theta$		
Radioactivity	$A = Z + N$		
Other equations	Area of a triangle $= \frac{1}{2} b h$	Area of a trapezium $= \frac{1}{2}(a + b) h$	
	Area of a circle $= \pi r^2$		

1. Galileo and Copernicus were two famous scientists who worked hard to convince the world about the movements of the Earth and the Sun.



a. Valentina is standing on point A on the Earth while Martin is standing on point B.

   i. State if it is day or night where Martin is standing (point B).

(1 mark)

   ii. Who would be during the night 36 hours later, Valentina or Martin?

(1 mark)

   iii. Is it summer or winter in Martin's point? Explain.

(3 marks)

b. How long would it take the Earth to spin once round the sun?

(1 mark)

c. All the following form part of the Universe.

Milky Way **Solar System** **Earth** **Sun**

   i. Place the above terms in a list according to their size, smallest first.

(2 marks)

   ii. The diameter of a galaxy is measured in light years. What is a light year?

(1 mark)

d. Identify one economic benefit of space exploration.

(1 mark)

10

2. Male mosquitoes beat their wings approximately 36000 times in 1 minute and fly at a speed of 6.5 m/s. The speed of sound of wing beats is 330 m/s.

a. Calculate the frequency of the sound waves produced by the mosquitoes.

(2 marks)

b. Calculate the wavelength of the sound wave produced by the mosquito.

(1 mark)

c. Calculate the time taken for a mosquito to travel 1500 m.

(1 mark)

d. Every year a number of hedgehogs are run over by vehicles. It has been suggested that a whistle emitting a sound wave of 45000 Hz is attached to the front of a car. The movement of the car forces air into the whistle and creates the sound. When the hedgehog hears the whistle it will remain at the side of the road.

i. State and explain how the sound travels from the whistle to the hedgehog.

(2 marks)

ii. People might complain that in this way roads are going to be noisier. Do you agree? Explain.

(2 marks)

iii. What do you think will happen to the sound produced if the car moves faster? Explain

(2 marks)

10

3. Nuclear power plants use Uranium-238 to produce energy.

a. The atom of Uranium-238 is represented as:

$$^{238}_{92}U$$

i. Which particles does the number 238 represent?

(1 mark)

ii. What is this number usually called?

(1 mark)

iii. What is the charge of the particles mentioned in part (i)?

(2 marks)

iv. Why is the net charge of an atom of Uranium-238 neutral?

(2 marks)

b. The table below shows the daily count rate of another radioactive element X:

Day	0	1	2	3	4	5	6	7
Count Rate	6000	4601	3604	3005	2300	1800		

i. From the table above estimate the half-life of the radioactive element X. Explain your reasoning.

(2 marks)

ii. Hence, deduce the values for the count rate for day 6 and day 7.

(2 marks)

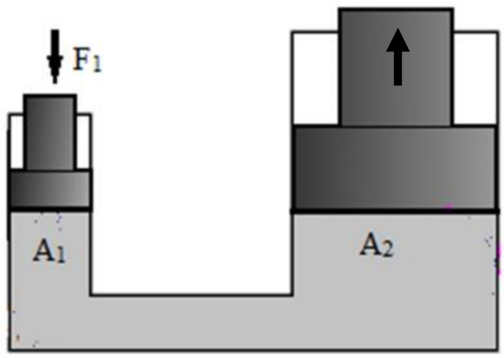
10

4. a. Define the term *pressure*. State its units.

(2 marks)

b. The diagram shows a hydraulic press used for crushing waste paper.

Force done by hand Force done on waste paper



i. Explain in terms of pressure, how the hydraulic press works.

(2 marks)

ii. The area of piston A_1 is 0.4 m^2. A force of 50 N is used to push the handle in. Calculate the pressure exerted by the piston A_1.

(2 marks)

iii. The area of piston A_2 is 2.0 m^2 calculate the force piston A_2 exerts on the waste paper.

(2 marks)

iv. Which fluid would you recommend between air and oil in the hydraulic system? Explain.

(2 marks)

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5. The table shows the braking distance for a car at different speeds and kinetic energy.

braking distance (m)	5	9	18	28	40
speed of Car (m/s)	10	15	20	25	30
Kinetic Energy of Car (kJ)	20	45	80	125	180

a. Use one set of values from the above table to calculate the mass of the car.

(2 marks)

b. Jeremy suggests that the braking distance is directly proportional to the kinetic energy.

i. Draw a graph of braking distance (m) on the x-axis and kinetic energy (kJ) on the y-axis.
(5 marks)

ii. Does the graph show that Jeremy's suggestion is correct or not? Give **one** reason for your answer.

(2 marks)

c. Explain how energy is conserved during braking.

(1 mark)

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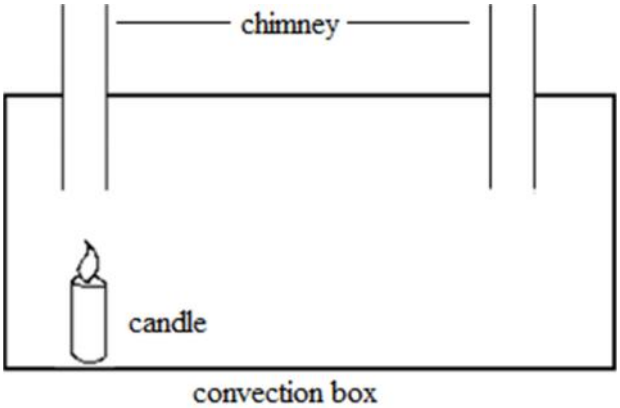
6. a Sean and Carol demonstrate convection currents in air in their school laboratory by means of the convection box shown in the diagram. They light a candle under one of the chimneys.



i. On the diagram, draw arrows to show the direction of air flow in and out of the box.

(1 mark)

ii. Use the kinetic theory to explain the movement of air particles in this experiment.

(2 marks)

iii. Explain why convection cannot take place in a solid.

(2 marks)

b. In very warm countries some traditional houses have two wind towers. Wind towers are built high above the ground where wind velocity is greater.

i. Explain how the air currents keep the residential houses cool.

(2 marks)

ii. The breeze increases evaporation from the skin of the people inside the building. Explain how this evaporation helps to reduce the body temperature.

(2 marks)

iii. Shading, vegetation close to the building, and use of reflective outside paint coatings are other features of buildings. State how a building is kept cool using **one** of these features.

(1 mark)

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7. Joanne went with her class for a visit to the Power Station.

a. They were told that the Power Station generates a.c. for the whole country and is supplied through the mains to our households.

i. What does a.c. stand for?

(1 mark)

ii. Give one characteristic of a.c.

(1 mark)

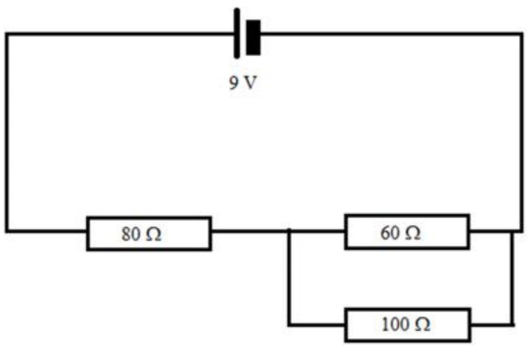
iii. The a.c. supplied to our houses flows through two wires – one BLUE and one BROWN. What are these wires called?

BLUE: ____________________

BROWN: ____________________

(2 marks)

b. The circuit diagram shows three resistors connected to a 9 V battery.



i. State the type of connection between the 60 Ω and the 100 Ω resistor.

(1 mark)

ii. Calculate the total resistance in the circuit.

(3 marks)

iii. Hence find the current coming out of the battery.

(2 marks)

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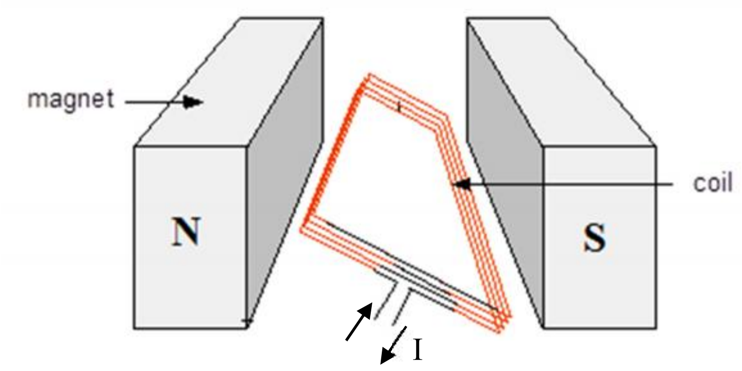
8.a Joe and Caroline searched for a picture of an electric motor on the internet and found the one below.



i. Draw an arrow on the diagram to show the direction in which the coil turns (use Fleming's left hand rule). (1 mark)

ii. Explain why the coil turns.

____

____

____

(3 marks)

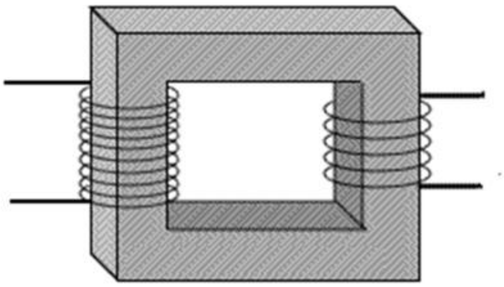
iii. Name **two** changes that can be done to the electric motor to increase its speed.

____

____

(2 marks)

b. The diagram below shows an iron core transformer. The primary and secondary coils of the transformer have 4000 and 200 turns, respectively. The primary circuit is connected to a 240 V a.c. supply.



i. Calculate the voltage across the secondary.

____

____

(2 marks)

ii. Explain why the primary current must be alternating.

____

____

(2 marks)

10

9. The greatest achievement of the Italian physicist, Alessandro Volta, was the invention of the electric battery in 1794.

a. In the space below, draw the appropriate circuit symbol of a battery and indicate the positive terminal with a "+".

(2 marks)

b. A battery is used to push charge round a circuit.

i. Charge is measured in ____________________________________. (1 mark)

ii. State the energy conversion in a battery.

____

(1 mark)

c. A 2.4 V battery is capable of delivering 1.5 A for 2 days.

i. How much charge will the battery push round the circuit, if 1.5A flow for 2 days?

____

____

____

____

(2 marks)

ii. How much energy is supplied by the battery? Give your answer in kJ.

____

____

____

(3 marks)

d. Some calculators can be operated using batteries or a renewable source of energy. Mention a suitable source of renewable energy.

____

(1 mark)

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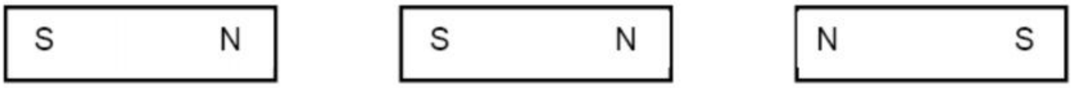
10. a. Three bar magnets are placed next to each other as shown below. Draw magnetic lines of force in the spaces **between** the poles of the magnets.



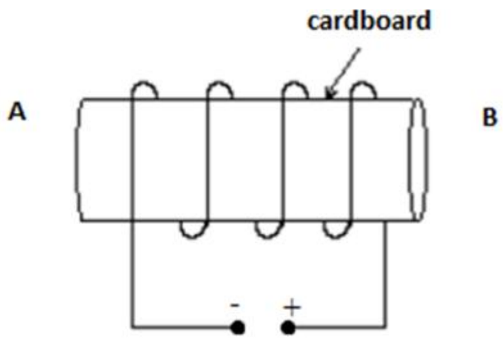
(3 marks)

b. A coil is wound around a cylindrical cardboard as shown in adjacent diagram.

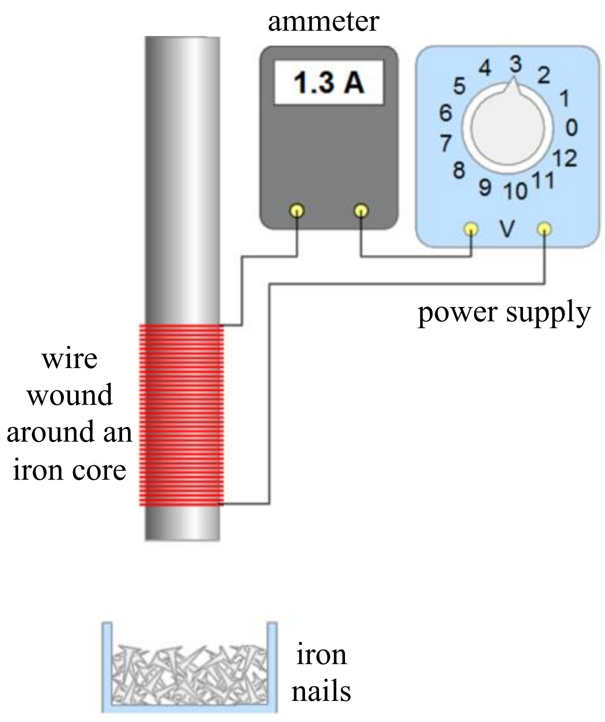
Mark on the diagram,

i. the direction of the current;
ii. the magnetic polarity of the ends A and B.

(2 marks)



c. James and Rachel set up an experiment in the school laboratory as shown below.



i. What did they observe when the circuit is switched on?

____

____

(1 mark)

ii. Describe what happens when they increase the number of turns of wire around the iron core and switch on the circuit. Explain.

____

____

____

(2 marks)

iii. Assuming resistance is constant and without changing anything to the setup in part (ii) James and Rachel reduce the voltage in the circuit. Explain what is observed.

____

____

(2 marks)

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SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2014 SESSION

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Radioactivity	$A = Z + N$		
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	Area of a circle $= \pi r^2$		

1. ***This question is about the properties of an LDR.***

John is a farmer. He is having a problem with birds since they are eating away his crops during the day. He has bought a bird scaring device which he needs to switch on from sunrise till sunset. To do this, the supplier gave John an LDR. John needs your help in installing the apparatus.

a. What does LDR stand for?

____

(1 mark)

b. In the space below draw the circuit symbol of an LDR.

(1 mark)

c. Apart from John's LDR you are given a power supply, an ammeter, a torch with three levels of brightness and connecting wires.

i. Using the correct circuit symbols, in the space below, draw a diagram showing the circuit you would use to show John how a LDR works.

(2 marks)

ii. Describe how, using the above circuit, you can show John how the LDR works. Indicate the variables you are investigating.

____

____

____

____

____

____

(5 marks)

iii. Mention one precaution you would take.

(1 mark)

iv. Following your investigation, what is the relationship between the resistance of an LDR and current in a circuit?

(2 marks)

v. What changes should John do to the circuit in c(i) when he installs the bird scaring device?

(2 marks)

d. When the farmer went to install the bird scaring device he got confused. So, he went to the nearest ironmonger and bought an electronic timer, so that the device switches on and off automatically at a particular time. He plugged the device in the timer and made the following settings:

ON	**7.00 am**
OFF	**7.00 pm**

i. Is this setting suitable for the whole year? Why?

(2 marks)

ii. How would the LDR set up be more effective?

(2 marks)

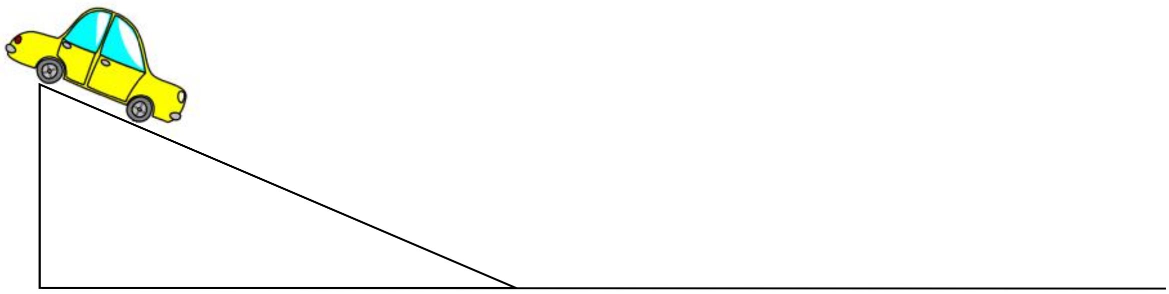
e. Give one other situation where the LDR might be useful and explain its function.

(2 marks)

20

2. ***This question is about forces and motion.***

a. Julie and Edward investigate the factors that determine the stopping distance of a toy car after it rolls down a ramp. They investigate how the height of the ramp determines the stopping distance of the toy car on horizontal ground.



i. Describe how this investigation can be conducted.

____

____

____

(3 marks)

ii. Name **two** physical quantities which must be kept constant during this investigation.

____

____

(2 marks)

iii. Name the **two** variables which should be tabulated.

____

____

(2 marks)

iv. Predict the result of this investigation.

____

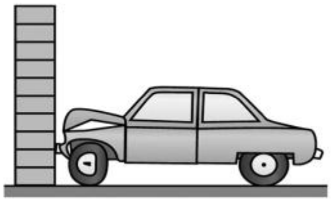
(1 mark)

v. Name **one** precaution the students should take during the investigation.

____

(1 mark)

b. In an experiment at an accident research laboratory, a car is made to collide with a brick wall.



i. What do you expect to happen to the dummy driver when the car collides with the brick wall? Explain using one of Newton's Laws.

(3 marks)

ii. The car of mass 800 kg moves at 14 m/s as it hits the brick wall and bounces back initially with the same speed. Calculate the change in momentum of the car.

(3 marks)

iii. During collision, the car decreases its speed from 14 m/s to 0 m/s in 1.4 s. Calculate the impact force of the brick wall on the car.

(3 marks)

iv. Explain how the use of a seat belt increases the safety of the dummy.

(2 marks)

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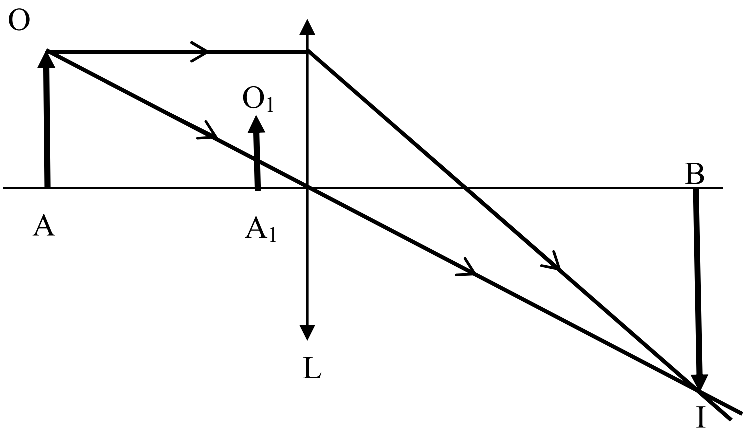
3. ***This question is about light and lenses.***

a. Complete the paragraph below by filling in the blanks with the most appropriate word.

There are two types of lenses -; convex and ______________________________. Lenses work by the process of ______________________________. Lenses are made by using a piece of ______________________________ or perspex. A convex lens is also known as a ______________________________ lens since it brings together the rays whilst concave lenses ______________________________ the rays. (5 marks)

b. Maria places an object in front of a lens and measures the image distance. She then draws a ray diagram. The figure shows two rays from the top of the object OA which pass through the lens L to the top of image IB.



i. Mark on the diagram the focal point of the lens with an F and measure the focal length.

____

(2 marks)

ii. Describe the image IB.

____

____

(2 marks)

iii. Calculate the magnification of IB.

(1 mark)

iv. Name a practical use of such an image.

(1 mark)

v. Draw two rays from the top of the smaller object O_1A_1 which pass through the lens; hence find the image of O_1A_1 and label it I_1B_1. (2 marks)

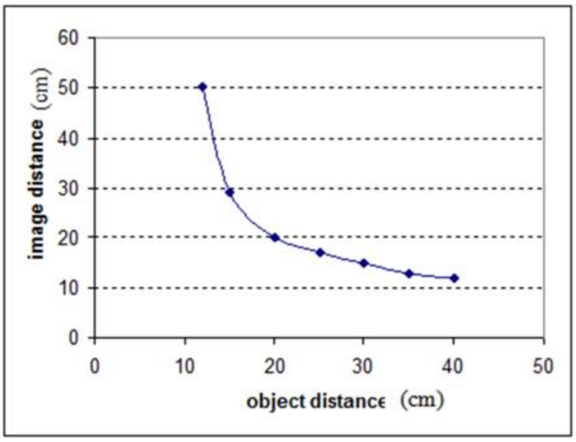
vi. State two differences between the image IB and the image I_1B_1.

(2 marks)

c. Maria took various measurements each time varying the object distance and measuring the respective image distance. She plotted the graph as shown.

i. From the graph state the relation between the object distance and image distance?

(1 mark)



ii. From the graph find the focal length of the lens. Show any calculations.

(2 marks)

iii. Explain why Maria cannot obtain values for image distance when the object distance is 1 cm and the focal length of a convex lens is 5 cm.

(2 marks)

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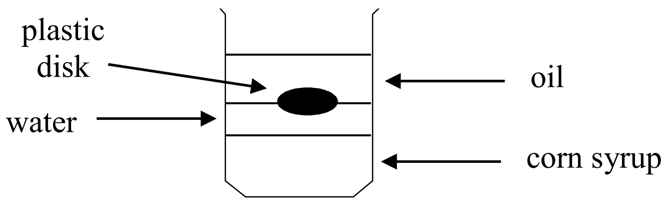
4. ***This question is about specific heat capacity.***

a. Lisa pours corn syrup into the bottom of an empty beaker. She carefully adds a layer of water and oil as shown in the diagram.



i. Lisa concludes that the corn syrup is the least dense liquid in the beaker. Do you agree? Explain.

____

____

(2 marks)

ii. A solid plastic disk is observed to float between the oil and the water. Explain.

____

____

(2 marks)

b. Andrea investigates the specific heat capacity of an unknown liquid.

i. Draw and label a diagram of the apparatus required to conduct this experiment. (2 marks)

ii Describe how the experiment is conducted and the specific heat capacity calculated.

____

____

(3 marks)

iii. Name **two** precautions that are required during the experiment.

(2 marks)

iv. Would you expect the value for the specific heat capacity obtained to be above or below the value given in data books? Explain.

(2 marks)

c. A block of copper of mass 1 kg at a temperature of 18 ^oC is heated for 4 minutes using a Bunsen burner which produces 14 kJ per minute. The specific heat capacity of copper is 385 J/kg^{o}C. Assuming that all the heat produced by the Bunsen burner is absorbed by the copper, calculate:

i. the total amount of heat absorbed by the copper;

(2 marks)

ii. the final temperature of the copper.

(2 marks)

d. The specific heat capacity of solid aluminium is 904 J/kg^{o}C and that of solid iron is 449 J/kg^{o}C. 1 kg of both solids is heated equally for the same amount of time. What would you expect to observe? Explain.

(3 marks)

20

5. ***This question is about moments and centre of gravity.***

Monique is placing library books on top of each other. She decides to place them in the form of a staircase.

a. Explain with the **aid of diagrams** why will the books eventually topple over if more books are placed in this way.

(2 marks)

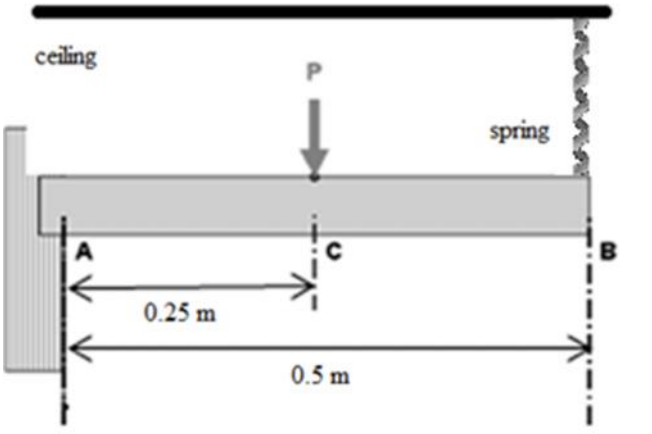
b. She then decides to find the mass of one of the books using known weights she found in the physics lab and a pivoted metre ruler.

i. Draw a diagram showing how Monique can use this simple apparatus in order to find the unknown mass of the book. Mark on your diagram any forces. (2 marks)

ii. Describe in detail the method Monique has to perform in order to find the unknown mass of the book, including any formula/working or calculation she has to work out.

(4 marks)

c. Jean Paul built a small uniform trapdoor which is 0.5 m long. It is held by hinges at A and has a mass of 0.4 kg. A spring is attached from the ceiling to point B. He places a pen of mass 0.1 kg at C, 0.25 m away from A.



i. Mark all the forces on the diagram. (3 marks)

ii. Calculate the force exerted by the spring.

(3 marks)

iii. Hence calculate the reaction force at A.

(1 mark)

iv. Would the reaction force at A and the force exerted by the spring be the same as the answers in (ii) and (iii), had the pen been placed closer to A? Explain.

(2 marks)

v. What happens to the spring when a force is exerted on it? Why?

(2 marks)

vi. What could happen to the spring if a large mass is placed on top of the trapdoor? Explain.

(1 mark)

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	$P = I V$	$R \propto \frac{1}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$	$V_p I_p = V_s I_s$	
Heat	$Q = m c \Delta\theta$		
Radioactivity	$A = Z + N$		
Other equations	Area of a triangle $= \frac{1}{2} b h$	Area of a trapezium $= \frac{1}{2}(a + b) h$	
	Area of a circle $= \pi r^2$		

1. ***This question is about the properties of an LDR*.**

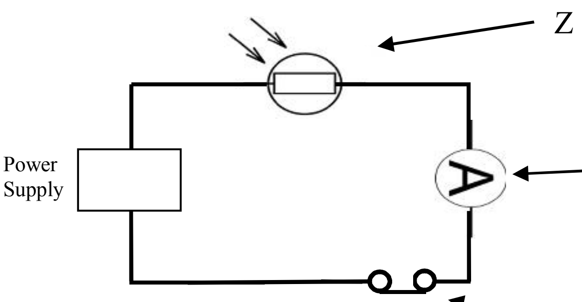
John is a farmer. He is having a problem with birds since they are eating away his crops during the day. He has bought a bird scaring device which he needs to activate from sunrise till sunset. The supplier gave John an LDR. He needs your help in installing the apparatus.

a. What does LDR stand for?

____

(1 mark)

b. The diagram below shows one way of connecting an LDR.



Z ____________________

X ____________________

Y ____________________

i. Label components X, Y and Z (3 marks)

ii. Indicate on the diagram with the letter **'T'** the position you would place a torch in order to test the LDR. The torch can provide different levels of brightness.

(1 mark)

iii. Put the following steps in order so that John can follow and understand the function of the LDR in the circuit. The torch has three levels of brightness. The first one has been done for you. (4 marks)

	The torch is then switched on higher levels of brightness; the reading on component X is checked again.
	The torch is switched on the first level of brightness; reading on component X is checked.
1	All the components are connected as above and the connections checked.
	The torch is off and the reading on component X is noted.
	The torch is switched off .

iv. Mention one precaution that should be taken.

(1 mark)

v. What quantity will component X measure? State in full the unit of this quantity.

(2 marks)

vi. Will the reading on device X be a maximum or a minimum when the torch is switched on the lowest level of brightness? Explain your answer.

(2 marks)

vii. What changes should John do to the circuit in b(i) when he installs the bird scaring device?

(2 marks)

c. When the farmer went to install the bird scaring device he got confused. So, he went to the nearest ironmonger and bought a timer so that the device switches on and off automatically. He plugged the device in the timer and made the following settings:

ON	**7.00 am**
OFF	**7.00 pm**

i. The above setting is not suitable for the whole year. Explain.

(1 mark)

ii. How would the LDR set up be more effective?

(2 marks)

d. Give one other situation where the LDR might be useful.

(1 mark)

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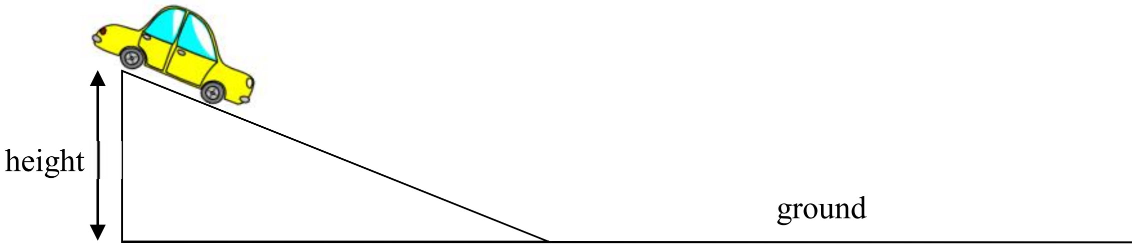
2. ***This question is about forces and motion.***

a Julie and Edward investigate how the height of the ramp determines the stopping distance of the toy car on horizontal ground.



i. Explain the meaning of 'stopping distance'.

____

(1 mark)

ii. Name an instrument used to measure the stopping distance.

____

(1 mark)

iii How can the height of the ramp be changed?

____

(1 mark)

iv. Can different cars be used during this investigation? Explain.

____

____

(2 marks)

v. Explain why repeated readings should be taken.

____

____

(2 marks)

vi. Complete this prediction:

As the height of the car increases, the stopping distance ______________________________.

(1 mark)

vii. Name **one** precaution, besides repeated readings, that the students should take during the investigation.

____

(1 mark)

b. In an experiment at an accident research laboratory, a car is made to collide with a brick wall.

i. What do you expect to happen to the dummy driver when the car collides with the brick wall? Explain.

(2 marks)

ii. Complete the following:

Newton's 1st law of motion states that a body will remain at rest or continue to move at constant velocity, ____________________________

(2 marks)

iii. A car decreases its speed from 7 m/s to 0 m/s as it hits the brick wall and stops in 1.4 s. Calculate the deceleration of the car during the collision.

(2 marks)

iv. The mass of the car is 800 kg. Calculate the change in momentum of the car during the collision.

(3 marks)

v. Calculate the impact force of the car on the wall.

(2 marks)

20

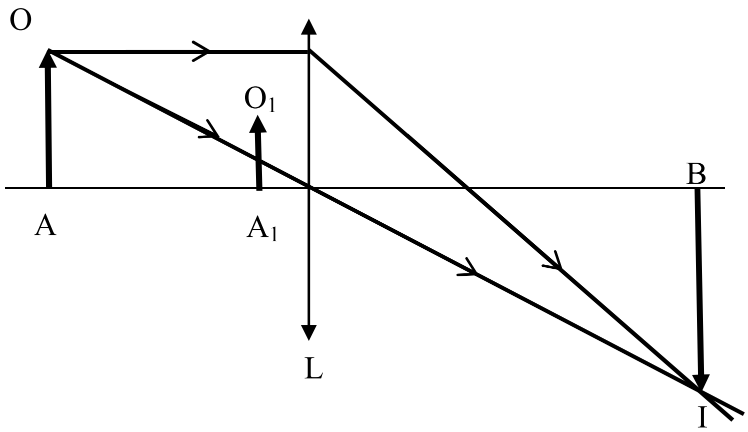
3. ***This question is about light and lenses.***

a. Choose appropriate words to fill in the gaps below. Each word may only be used once.

convex **glass** **converging** **refraction** **short** **concave** **virtual** **diverging**

There are two types of lenses -; convex and ______________________________. Lenses work by the process of ______________________________. Lenses are made by using a piece of ______________________________ or perspex. A convex lens is also known as a ______________________________ lens since it brings together the rays whilst ______________________________ lenses spread out the rays. (5 marks)

b. Maria is doing some experiments using lenses. She places an object in front of a convex lens and measures the image distance. She then draws a ray lens diagram. The figure shows two rays from the top of an object OA which pass through the lens L to the image IB.



i. Mark on the diagram the focal point of the lens with an F and measure the focal length. (2 marks)

ii. Mark on the diagram the optical centre of the lens with an C. (1 mark)

iii. Describe the image IB.

(2 marks)

iv. Calculate the magnification of IB.

(1 mark)

v. Name a practical use of such an image.

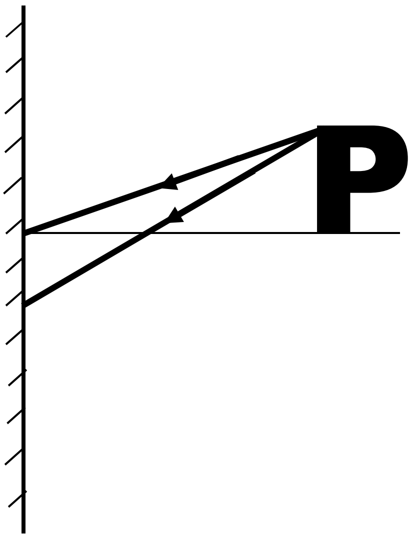
(1 mark)

vi. Draw two rays from the top of the smaller object O_1A_1 which pass through the lens; hence find the image of O_1A_1 and label it I_1B_1. (2 marks)

vii. State two differences between the image IB and the image I_1B_1.

(2 marks)

c. Complete the image below to show the properties of an image formed by a plane mirror.

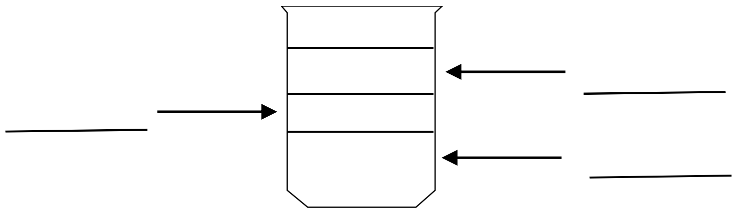


(4 marks)

20

4. ***This question is about specific heat capacity.***

a. Jeremy pours three liquids A, B and C in an empty beaker as shown in the diagram.



Liquid	Density
A	0.6 g/cm^3
B	1.8 g/cm^3
C	1.0 g/cm^3

i. With reference to the table above, mark with A, B and C, the position of the liquids in the beaker.
(2 marks)

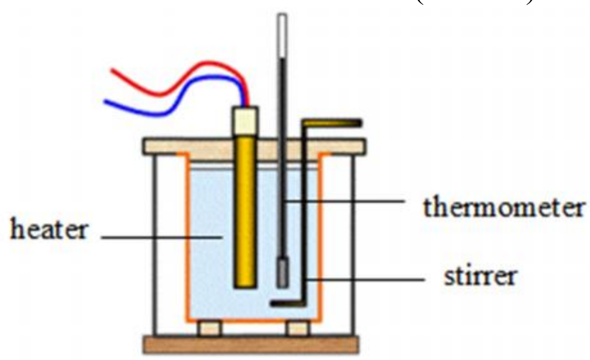
ii. A solid plastic disk (⬬) has a density of 0.9 g/cm^3. Draw the position of this plastic disk in the beaker.
(1 mark)

iii. The mass of liquid A is 15 g. Calculate the volume of liquid A.

___

___
(2 marks)

b. Andrea investigates the specific heat capacity of an unknown liquid using the apparatus shown in the diagram.



i. Name **two** ways how heat losses are reduced.

___

___

___
(2 marks)

ii. State why heat losses should be kept to a minimum.

___
(1 mark)

iii. Why is a stirer used during the experiment?

___
(1 mark)

iv. The heater is rated at 250 W. Calculate the total energy provided to the liquid in 4 minutes.

____

____

(2 marks)

v. The specific heat capacity is found using the equation $c = \frac{\Delta Q}{m\,\Delta\theta}$. What does each of the following represent?

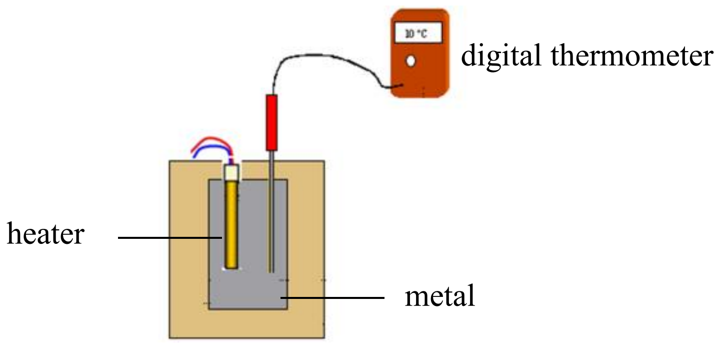
- ΔQ ____________________
- m ____________________
- $\Delta \theta$ ____________________ (3 marks)

vi. The experimental value obtained for 'c' is higher than that given in data books. Explain why.

____

(1 mark)

c. John investigates the effect of equally heating 1 kg of aluminium and 1 kg of iron for the same amount of time. The specific heat capacity of solid aluminium is 904 J/kg°C and that of solid iron is 449 J/kg°C.



i. Why did John use equal masses of each metal?

____

(1 mark)

ii. Would you expect the digital thermometer to show the **same** temperature rise for aluminium and for iron? Explain.

____

____

(2 marks)

iii. The temperature of aluminium rises from 20 °C to 46 °C in 100 s. Calculate the change in temperature per second.

____

____

(2 marks)

20

5. *This question is about moments and centre of gravity.*

a. Define the term ‘centre of gravity’.

(2 marks)

b Monique is placing library books on top of each other. She decides to place them in the form of a staircase. With the **aid of the diagram** explain why the books will eventually topple over if more books are placed in this way.

(2 marks)

c. She then decides to find the mass of one of the books, using known weights she found in the physics lab and a suspended metre ruler. She suspends the book at one side of the metre ruler and the known weights on the other side of the ruler.

i. Draw a diagram to show how Monique can use this simple apparatus in order to find the unknown mass of the book. (2 marks)

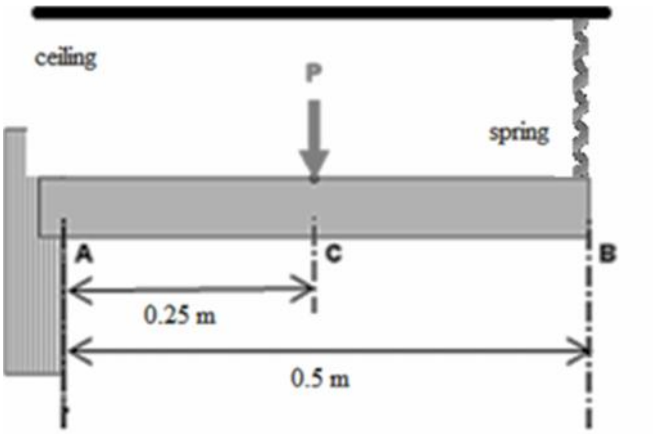
ii. Describe three steps Monique has to perform in order to find the unknown weight of the book.

(2 marks)

iii. What calculation needs to be done in order to find the mass of the book when the weight is found?

(1 mark)

d. Jean Paul built a small uniform trapdoor which is 0.5 m long as shown below. It is held by hinges at A and has a mass of 0.4 kg. A spring is attached from the ceiling to point B. He places a pen of mass 0.1 kg at C 0.25 m away from A.



i. Mark all the forces on the diagram. (4 marks)

ii. Calculate the size and state the direction of the moment created by the spring about point A.

(2 marks)

iii. Hence calculate the Force exerted by the spring.

(2 marks)

iv. If the system is in equilibrium calculate the reaction Force at A.

(1 mark)

v. A second identical pen is placed on the trapdoor 0.25 m from A. If the trapdoor is still in equilibrium, what happens to the force exerted by the spring and the Reaction Force at A? Explain.

(2 marks)

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