Index Number:________________ SEC24/1.19m

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

L-Università ta' Malta

SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION

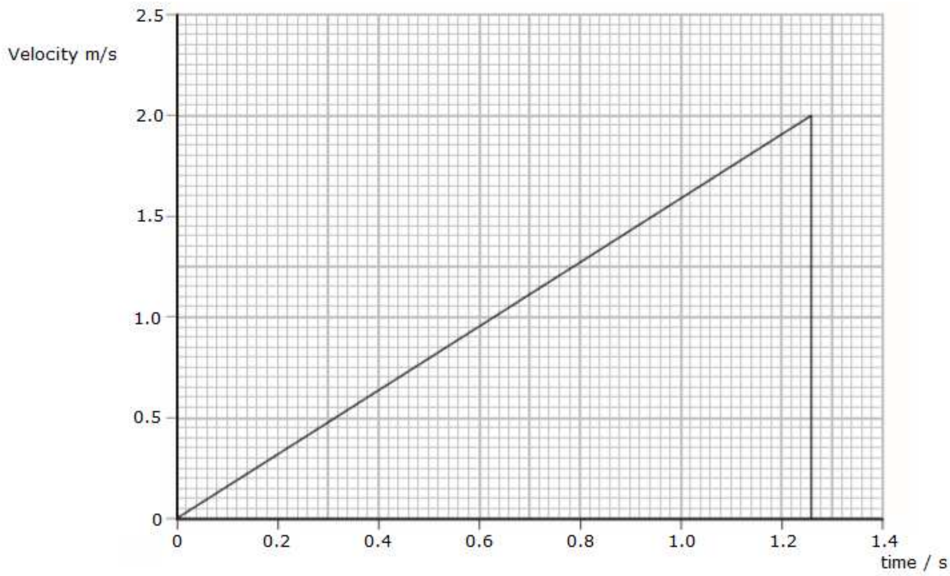
SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	27th April 2019
TIME:	9:00 a.m. to 11:05 a.m.

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 10 m/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	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{L}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$V_p I_p = V_s I_s$	
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. At the end of the last Apollo 15 mission, Commander David Scott performed a live demonstration on the Moon. He dropped a hammer and a feather from the same height, and these touched the ground at the same time. One reason for this is the lack of air resistance.

a. The graph shows how the velocity of the feather changed over time as it fell on the Moon.



i. Use the graph to find the acceleration due to gravity on the Moon.

____

____(2)

ii. The mass of the feather is 30 g. Calculate the downward force acting on it.

____

____(2)

iii. Calculate the height from which the feather was dropped.

____

____(2)

b. The experiment was repeated on Earth, and this time the hammer reached the ground before the feather because of the presence of air resistance.

i. The acceleration due to gravity on Earth is much larger than that on the Moon. Give **ONE** reason for this.

____(1)

ii. At a particular point, the force of air-resistance acting on the falling feather is 0.27 N. Calculate the acceleration of the feather at that point.

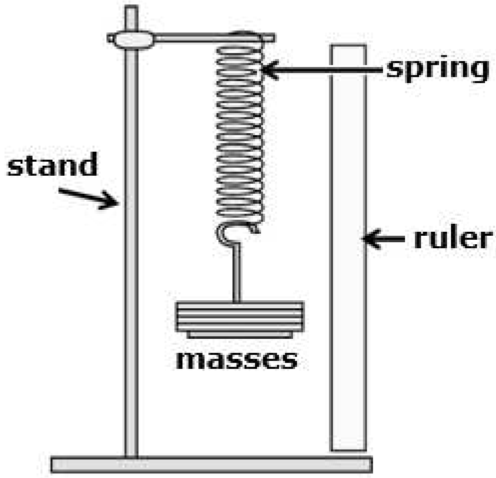
____

____(3)

(Total: 10 marks)

10

2. Isaac and Anna have been asked by their teacher to carry out an experiment to verify Hooke's Law.



a. They set up the apparatus as shown in the diagram.
   i. State Hooke's Law.

____

____

____ (2)

   ii. When they start the experiment, Isaac finds it difficult to take measurements accurately from the ruler with the apparatus given and suggests adding an extra piece of apparatus. What other apparatus do they need?

____ (1)

   iii. Draw this other piece of apparatus mentioned in part (ii) on the diagram above. (1)

   iv. State **ONE** precaution they should take to ensure accurate results.

____ (1)

   v. They noted the initial length of the spring without any mass loaded to it. Each time a new mass was added, the new length of the spring was recorded. In the spaces (i) and (ii) below, fill in the headings of the TW0 other quantities required for this investigation. Include **BOTH** quantities and units.

Mass/kg	**(i)**	**New length of spring/m**	**(ii)**

(2)

b. They noted that the length of the spring without any mass loaded to it was 5.0 cm. With a mass of 0.2 kg loaded to it, the spring's new length is 12.5 cm. Assuming Hooke's law is obeyed, calculate the new length of the spring when a mass of 0.5 kg is used.

____

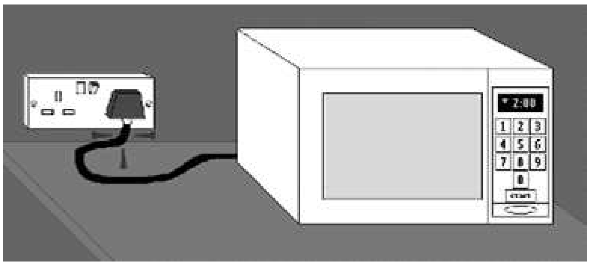
____

____(3)

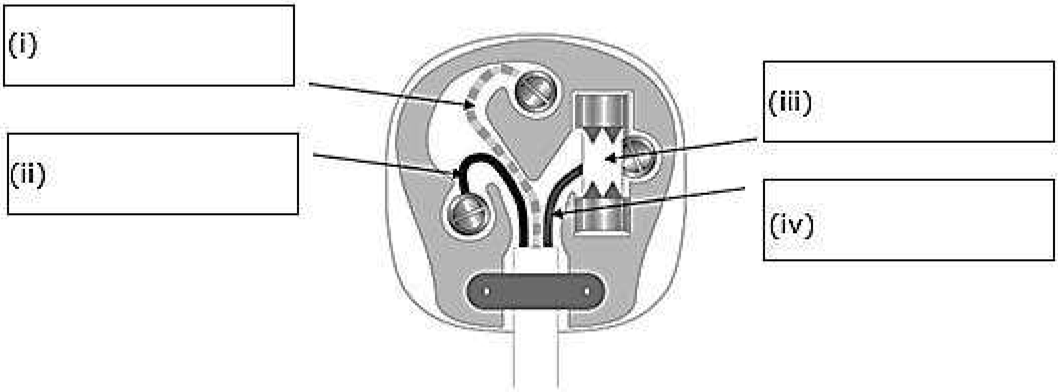
(Total: 10 marks)

10

3. The figure shows a microwave oven connected to the mains supply by a three-pin plug.



a. The diagram below shows the inner wiring of a three-pin plug. Label the **FOUR** parts indicated. (4)



b. The microwave oven has a power input of 1270 W when used with a 230 V supply.

i. Calculate the current flowing through the microwave oven.

____

____(2)

ii. Determine the total cost when the oven is turned on for 30 minutes, given that one kWh of electricity costs 11 c.

____

____

____(3)

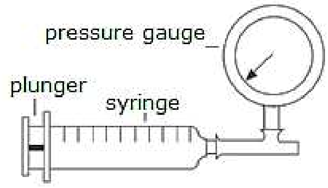
c. To which part of the appliance is the wire labelled as (i) in the diagram connected?

____(1)

(Total: 10 marks)

10

4. a. A syringe containing air at room temperature is connected to a pressure gauge, which is an instrument that shows the pressure of liquids and gases.



i. Explain how the air particles inside the syringe create a pressure on its walls.

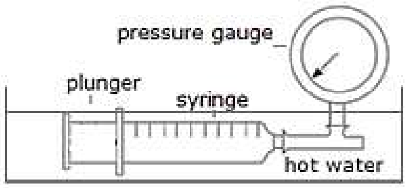
____ (1)

ii. The plunger is then pulled outward, to increase the volume of air. State what happens to the reading on the pressure gauge, and explain your answer, in terms of the behaviour of the air particles.

____

____ (2)

iii. The plunger is now locked in position, to keep a constant volume. The syringe is placed in a container of hot water. State what happens to the pressure of air inside the syringe, and explain your answer, in terms of the behaviour of the air particles.



____

____ (2)

b. The Earth is surrounded by a layer of air. The table below shows how the value of atmospheric pressure varies with height above the Earth's surface.

Height/km	0	5	10	15	20	25
Pressure/ kPa	101	54	27	12	5.5	2.5

i. State the value of atmospheric pressure, in Pa, at a height of 5 km. __________ (1)

ii. State what happens to the atmospheric pressure with increase in height above the Earth's surface. Give **ONE** reason why this happens.

____ (2)

iii. Aircrafts normally fly at a height of about 10 km. The inside of the aircraft is kept at atmospheric pressure. Explain why the doors and windows of the aircraft need to be air tight.

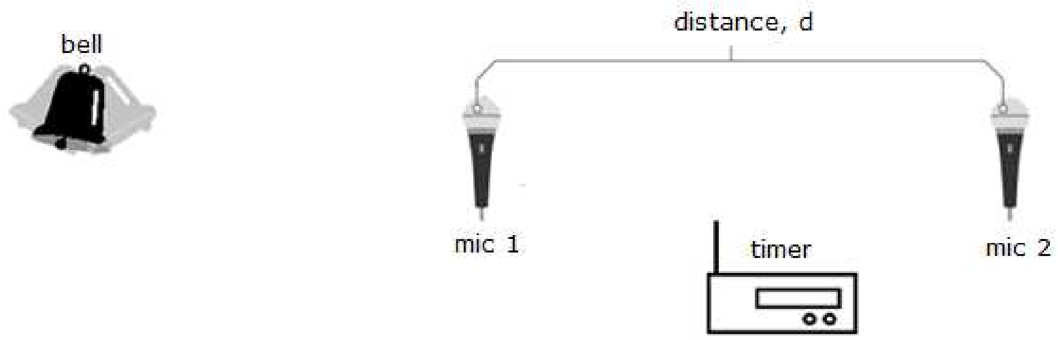
____

____ (2)

(Total: 10 marks)

10

5. An experiment to measure the speed of sound in air was carried out in an open field.



As the bell rings, the sound is received by the two wireless microphones placed at a measured distance, d, apart. The timer records the time taken by the sound wave to travel from microphone 1 to microphone 2.

a. What type of wave is a sound wave? ________________________________ (1)

b. Explain how these waves travel through air.

____

____(1)

c. The following set of data was recorded.

Measured distance d/m	15	25	35	45	55	65
Time t/s	0.05	0.08	0.11	0.14	0.17	0.20

i. Plot a graph of measured distance d/m (y-axis) against time t/s (x-axis). (4)

ii. Use your graph to calculate the speed of sound in air.

____

____

____ (2)

iii. The experiment is repeated under water, where the microphones can still detect the sound of the bell. State and explain any changes in the time of travel of the wave.

____

____(2)

(Total: 10 marks)

10

6. The radioactive isotope Technetium-99 is used in stress tests to monitor blood flow. Technetium-99 emits gamma rays and its half-life is six hours.

(https://bit.ly/2M7Nnk8)

a. What is meant by the term isotope?

____

____ (2)

b. The symbol for Technetium-99 is $^{99}_{43}\mathrm{Tc}$. Give the value of the:

i. proton number;

____(1)

ii. neutron number;

____(1)

iii. electron number.

____(1)

c. State **ONE** property of gamma radiation.

____ (1)

d. Name **ONE** other practical use of gamma radiation.

____ (1)

e. Why is it necessary to use an isotope with a short half-life in this case?

____ (1)

f. If 2 g of Technetium-99 is injected into a patient, what would be the mass of the remaining radioactive sample after 18 hours?

____

____ (2)

(Total: 10 marks)

10

7. a. A mineral water plastic bottle contains 2.0×10^{-3} m^3 of water and has a total mass of 2.04 kg.

i. Calculate the mass, in kg, of the water in the bottle given that the density of water is 1000 kg/m^3.

____

____ (2)

ii. Hence, calculate the mass, in kg, of the empty plastic bottle.

____ (1)

iii. If around 50 million of these water bottles were to be collected for recycling every year, calculate the volume, in m^3, of plastic collected yearly. Take the density of plastic used to be 1380 kg/m^3.

____

____ (2)

iv. Empty plastic bottles collected in bulk for recycling are usually compressed using a hydraulic press so that it takes up less space. What effect does this have on the density of the waste collected?

____ (1)

b. Underline **ONE** correct answer for the given situation.

Lisa puts some ice cubes in a glass of water and notices that ice floats. This happens because the spacing of the particles in ice is:

- smaller than that in water;
- larger than that in water;
- at the same distance as that in water. (1)

c. Some water is poured into a glass, and it is left exposed directly to the Sun. After a few hours, the level of the water is considerably reduced. Explain why and how this happens.

____

____

____

____ (3)

(Total: 10 marks)

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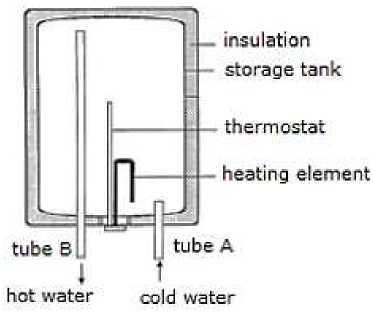
8. The electrical water heater shown in the diagram contains 80 kg of water. Cold water at 20 °C enters from tube A and is heated by the heating element. The hot water produced leaves the heater from tube B.



(https://www.researchgate.net)

a. Show in the diagram below, the energy changes occurring in the heating element. (1)

[ ] ⇨ [ ]

b. Hot water flows from the bottom to the top inside the tank. What is this process called?

____ (1)

c. Calculate the energy required to heat the water in the tank to 60 °C, given that the specific heat capacity of water is 4200 J/kg°C.

____

____ (2)

d. Calculate the time taken to heat the water, given that the power of the heater is 1500 W.

____

____ (2)

e. In practice, the time required is longer than the amount calculated in part (d) as not all the heat produced by the heating element is absorbed by the water. Give **TWO** reasons for this, stating clearly where the 'lost' energy is being transferred to.

i. ____ (1)

ii. ____ (1)

f. A solar water heater could also be used to heat water in our households.

i. State **ONE** advantage of using this method.

____ (1)

ii. Why are some surfaces of a solar water heater painted black?

____ (1)

(Total: 10 marks)

10

9. The Earth is one of the planets in our solar system.

a. i. Why do we refer to it as the solar system?

____ (1)

ii. State the name of a dwarf planet in our solar system.

____ (1)

iii. This dwarf planet is around 0.000624 light years away from the Earth. Explain the meaning of the term light year.

____ (1)

b. The following table shows the average distances of the Earth and Mars from the Sun, and the force of gravity acting on each kilogram placed at their surface.

	Average distance from Sun (million km)	Force of gravity acting on each kilogram (N/kg)
Earth	150	10.0
Mars	230	3.7

i. Which of the two planets has the longest year? Explain.

____

____ (2)

ii. On which of the two planets would you experience a larger weight? Explain.

____

____ (2)

c. Mars' axis of rotation is tilted, just like the Earth's. What does this tilt cause on these planets?

____ (1)

d. Scientists have recently sent a spacecraft, named InSight, to Mars. It will send useful information about the planet using radio signals. Calculate how long radio waves travelling at 3×10^8 m/s would take to reach us from Mars, if the average distance between Earth and Mars is 2.25×10^{11} m.

____

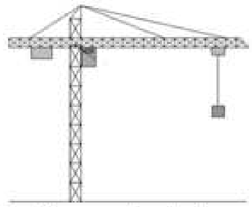
____ (2)

(Total: 10 marks)

10

10.

a. Tower cranes such as the one shown in the diagram are common at construction sites. These are used to lift and carry heavy loads, using the principle of moments to keep in equilibrium. State this principle.

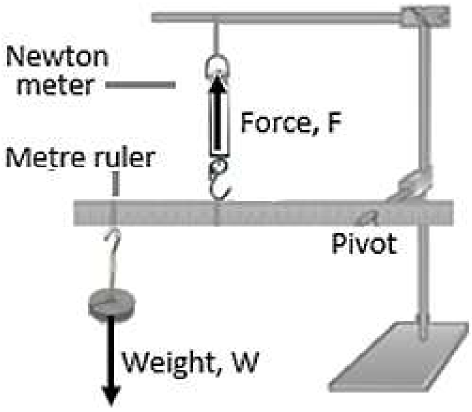


(https://www.cyberphysics.co.uk)

____

____ (2)

b. The setup shown is used to investigate the principle of moments. A uniform metre ruler is hung from a pivot and is supported by a Newton meter that produces an upward force, F. When a weight, W is hung in the position shown, the ruler is perfectly horizontal.



i. Include an arrow in the setup to show the weight of the ruler. Label this as R. (1)

ii. The mass of the ruler used is 0.12 kg. Calculate the moment produced by the weight of the ruler, if it acts at 0.35 m from the pivot. Give your answer in Nm.

____

____ (2)

iii. The value of W is 2.0 N and its distance from the pivot is 0.75 m. Use the principle of moments, to calculate the upward force F, produced by the Newton meter to keep the ruler horizontal. The distance between the Newton meter and the pivot is 0.50 m.

____

____

____

____ (4)

c. If the weight, W is moved closer to the pivot, would the Newton meter have to produce a larger or smaller force F, to keep the ruler horizontal?

____ (1)

(Total: 10 marks)

10

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION

SUBJECT: **Physics**
PAPER NUMBER: IIA
DATE: 27th April 2019
TIME: 4:00 p.m. to 6:05 p.m.

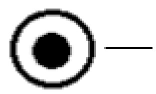
Answer ALL questions.
You are requested to show your working and to write the units where necessary.
When necessary, take g, acceleration due to gravity, as 10m/s^2.

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	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{L}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$V_p I_p = V_s I_s$	
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 = πr^2		

1. The following diagram shows a marksman on top of a building, firing a bullet horizontally towards a wooden target of mass 100 g. This target was thrown upward from a launching device placed at ground level.

a. The launching device threw the wooden target to a vertical height of 9 m. Ignore the effects of air-resistance.

i. On the diagram below, draw and label the **TWO** forces acting on the wooden target at the instant it is being thrown upwards by the device. (2)



ii. State the value of the acceleration due to gravity acting on the wooden target as it moves upwards.

____ (1)

iii. Calculate the resultant force acting on the wooden target as it is moves upwards.

____

____ (2)

iv. What is the velocity of the wooden target at the top of its motion? ______________ (1)

v. Calculate the velocity with which the wooden target was launched.

____

____ (2)

vi. Find the time taken for the target to reach this maximum height.

____

____ (2)

20

b. In practice, air resistance acts on the wooden target as it moves upwards.

State how air-resistance will affect the deceleration and the maximum height reached by the wooden target.

Deceleration ______________________________ (1)

Maximum height ______________________________ (1)

c. Just as the wooden target reaches its maximum height, a bullet of mass 42 g, hits it with a speed of 300 m/s.

i. Calculate the momentum of the bullet before it hits the wooden target.

____

______________________________ (2)

ii. The bullet becomes embedded in the wooden target. Calculate the combined velocity of the bullet and wooden target after the collision.

____

______________________________ (2)

d. As the marksman fires the bullet, the rifle recoils backwards and hits his shoulder.

i. Explain why the rifle recoils backwards, naming a law used to support your answer.

____

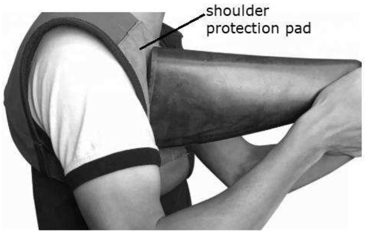
______________________________ (2)

ii. A shoulder protection pad with a layer of foam inside is worn by the marksman. Explain how this affects the force of impact on the shoulder.

____

____

______________________________ (2)



https://www.alibaba.com

(Total:20 marks)

20

2.

a. The table below shows different telescopes used to detect radiations from different sources. All these radiations travel at 3×10^8 m/s.

Telescope	Type of radiation detected	Wavelength detected
Mauna Kea Observatory (Hawaii)	Infrared	25×10^{-6} m
Mount Graham (Arizona)	Visible light	600×10^{-9} m
Effelsberg Observatory (Bonn, Germany)	Radio Waves	0.21 m

i. Name **TWO** other properties common to the radiations detected.

____

____ (2)

ii. Mention **TWO** other electromagnetic radiations whose wavelengths are smaller than the radiations captured by the telescopes mentioned above.

____ (2)

iii. Calculate the frequency of the infrared waves detected by the Mauna Kea Observatory.

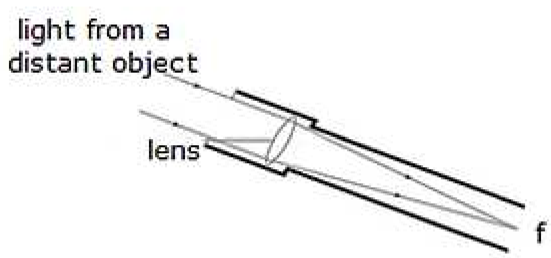
____

____ (2)

iv. State a use of each of the radiations listed below.

- Infrared: ______________________________________ (1)
- Radio waves: ______________________________________ (1)

b. The diagram shows part of a telescope. Light from a distant object is captured by a lens and focused at a point f, as shown.



i. What type of lens is used in this telescope? ______________________ (1)

ii. When parallel rays pass through the lens, they ______________ and meet at the focal point, f. (1)

20

iii. The telescope's lens has a focal length of 120 mm. Describe briefly how a student can do a rough verification of the focal length of a lens.

____

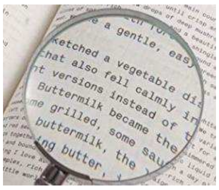
____

____ (3)

c. The student wants to use the same lens as a magnifying glass, to be able to read some small text.

i. Suggest a distance, at which the lens should be placed away from the text for this to happen.

____ (1)



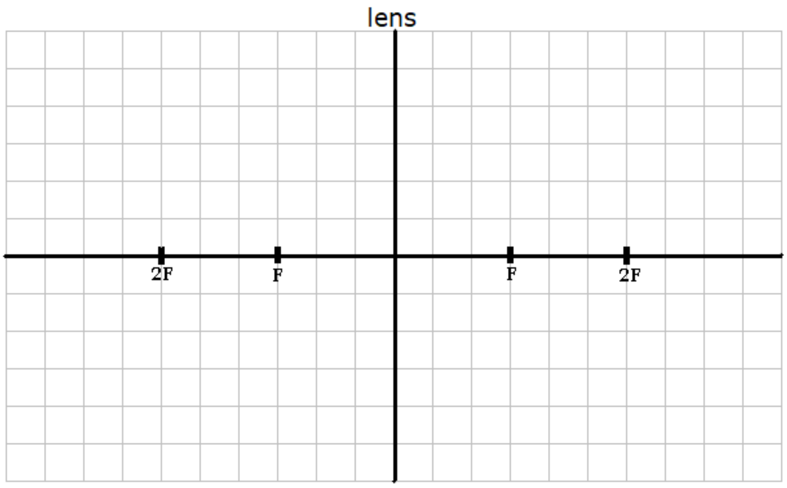
(https://www.amazon.com)

ii. An object whose actual height is 1.5 cm, appears to be enlarged when viewed through the lens. If the magnification of the lens is 4, find the height of the image.

____

____ (2)

iii. In the space below, draw a ray diagram to show how the lens produces an image when used as a magnifying glass. Label the object O and the image I. (2)



iv. The image produced is enlarged. Mention **TWO** other characteristics of the image formed.

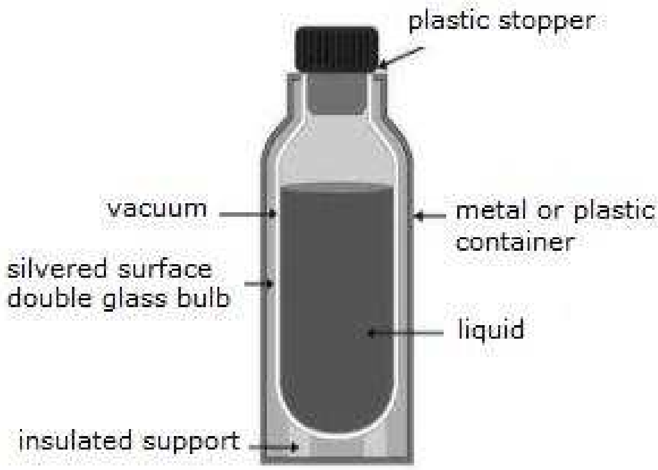
____ (2)

(Total: 20 marks)

20

3. This question is about energy transfer.

a. Lisa is going out on a picnic and she prepares a hot drink in a vacuum flask, designed to keep liquid warm for some time. The diagram below shows the inside of such a flask.



(https://www.123rf.com)

State which method of heat transfer is being reduced by the parts of the flask listed below:

i. glass bulb; ____ (1)

ii. silvered surface; ____ (1)

iii. plastic stopper; ____ (1)

iv. vacuum between walls. ____________________ and ____________________ (2)

b. During the Physics lesson Lisa is told that there are also vacuum flasks with an inside bulb made of stainless steel, instead of glass. She wants to carry out an experiment to investigate which of the two flasks keeps liquids warm for a longer time. She is provided with a stainless steel flask and a glass flask of the same size, two thermometers, a stopwatch and hot water.

i. Describe how she should carry out the experiment.

____

____

____

____

____ (4)

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ii. State **TWO** important precautions necessary in this experiment.

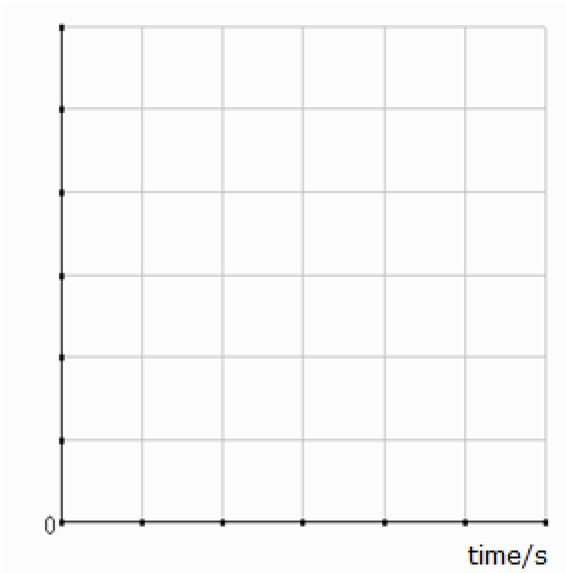
____

____ (2)

iii. The table below contains the three columns used to record the readings taken. Fill in the other **TWO** column headings, with the quantities measured and their units. (2)

Time/s		

iv. Label the y-axis of this graph and draw a rough sketch of the **TWO** graphs expected for the two materials. You are **not** expected to identify which graph is for glass and which for stainless steel. (3)



v. Why is it better to plot the two graphs on the same axes and not on separate ones?

____ (1)

vi. How can Lisa use her graphs to decide which flask is better at keeping hot liquids warm for a longer time?

____ (1)

c. Vacuum flasks are also used to keep certain liquids at very low temperatures. In industry, they can be used to keep liquid air at -200 ^{o}C. Explain, in terms of heat transfer, how a flask can keep cold liquids at low temperatures.

____

____ (2)

(Total:20 marks)

20

4.

a. Michael wants to investigate the relationship between the thickness of copper wires and the current at which they melt. This indicates their fuse rating, if they had to be used as a fuse in a circuit. The following apparatus has been provided from the school laboratory:

- Connecting wires
- Switch
- Battery
- Ammeter
- Variable resistor
- Copper wires, of given different thickness and same length, used as a fuse.

i. Draw the circuit required to measure at which current the copper wires would melt. (3)

ii. Write a brief description of how they will use the circuit in part (a)(i) to check the relationship between the thickness of the wire and the approximate value of the current needed to melt the wire.

____

____

____

____ (4)

iii. State **ONE** precaution needed when conducting the experiment.

____

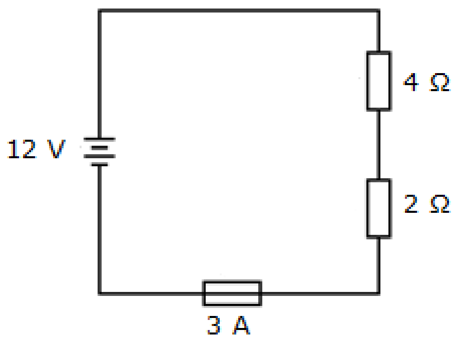
____ (1)

iv. Predict the relationship between the thickness of the wires and the current they can withstand before melting.

____ (1)

20

b. The fuse shown in the figure below allows a current of 3 A to flow before melting. The fuse is connected to a 12 V battery and in series with two resistors of 4 Ω and 2 Ω.



i. Will the fuse melt? Show your working.

____

____

____ (3)

ii. The two resistors are now connected in parallel. Will the fuse melt? Show your working.

____

____

____ (3)

c. Which **THREE** other factors apart from the thickness of the wire, can affect the value of its resistance?

____

____

____ (3)

d. Mention **TWO** safety measures used at home to prevent electric shocks.

____

____ (2)

(Total: 20 marks)

20

5.

a. Describe how a steel bar can be made into a permanent magnet using the electrical method.

____

____

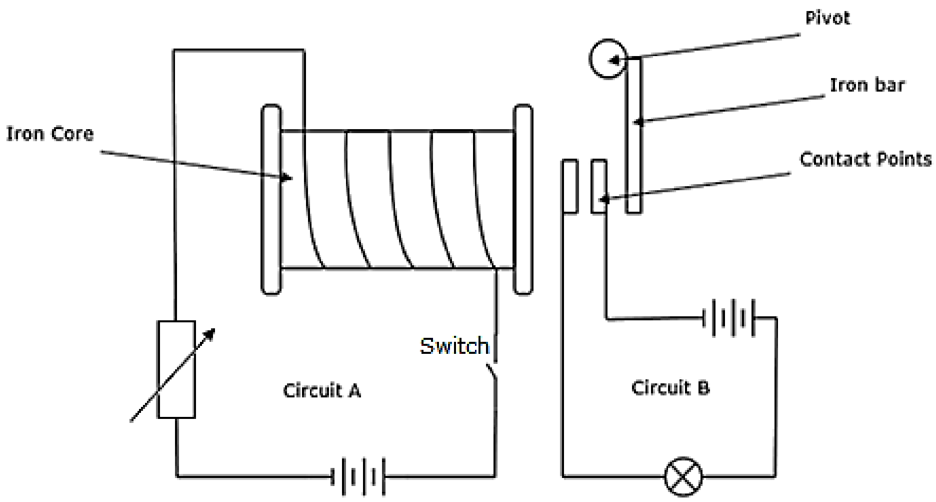
____ (3)

b. Draw the magnetic field pattern around the permanent bar magnet produced in the previous question. Show clearly the poles of the magnet. (3)

c. Give **ONE** method used to demagnetise the steel bar.

____ (1)

d. Kimberley wants to produce a model of a magnetic relay switch to light the bulb in circuit B. The circuit she sets up is shown below:



i. What happens to the iron core as current flows in circuit A?

____ (1)

20

ii. When circuit A was switched on the first time, Kimberley noticed that the iron bar did not move, and the light bulb in circuit B did not switch on. List **TWO** changes she can make to circuit A, to make the iron bar move towards the iron core. State the effect of these changes.

____

____

____ (3)

iii. After the necessary changes are done, circuit A is switched on again, and the bulb in circuit B lights up. Explain how this happens.

____

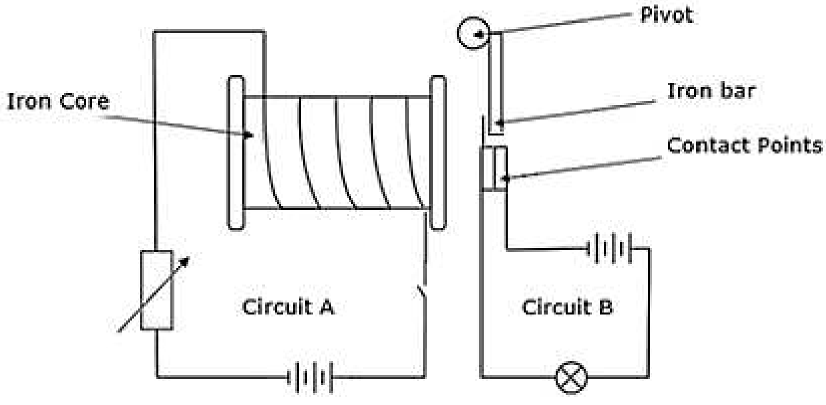
____

____

____

____ (4)

iv. Kimberley now modifies circuit B as shown below. Explain what happens when circuit A is switched on.



____

____

____ (3)

v. Explain how the above set-up could be used as a safety device of our homes.

____

____ (2)

(Total: 20 marks)

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Index Number:________________ SEC24/2B.19m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2019 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIB
DATE:	27th April 2019
TIME:	4:00 p.m. to 6:05 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.

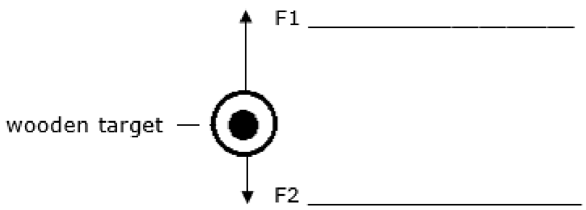
Density	$m = \rho V$		
Pressure	$F = p A$	$p = \rho g h$	
Moments	Moment = F × perpendicular distance		
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$
	Work Done=energy converted		$E = p t$
Force and Motion	m a = unbalanced force	$W = m g$	$v = u + a t$
	average speed $= \frac{\text{total distance}}{\text{total time}}$		$s = (u + v)\frac{t}{2}$
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$	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	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{L}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$V_p I_p = V_s I_s$	
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.

The following diagram shows a marksman on top of a building, firing a bullet horizontally towards a wooden target. This target was thrown upward from a launching device placed at ground level.

a. The wooden target reaches a maximum height of 9 m, before it starts falling again. Ignore the effects of air-resistance.

i. Label F1 and F2, the forces acting on the wooden target at the instant it is being thrown upwards by the device. (2)



ii. State the value of the acceleration due to gravity acting on the wooden target as it moves upwards.

____ (1)

iii. The mass of the wooden target is 0.1 kg. Calculate the resultant force acting on the wooden target.

____

____

____ (2)

iv. What is the velocity of the wooden target at the top of its motion? ________________ (1)

v. Calculate the initial velocity with which the wooden target was launched.

____

____ (2)

vi. Find the time taken for the target to reach the maximum height.

____

____ (2)

20

b. Just as the wooden target reaches its maximum height, a bullet of mass 0.042 kg, hits it with a speed of 300 m/s.

i. Calculate the momentum of the bullet before it hits the wooden target.

____

____ (2)

ii. The law of conservation of momentum states that the total momentum ______________

____

____ provided that

____ (2)

iii. The bullet gets stuck into the wooden target. Calculate their total mass.

____ (1)

iv. Calculate the velocity of the wooden target and bullet after they stick together.

____

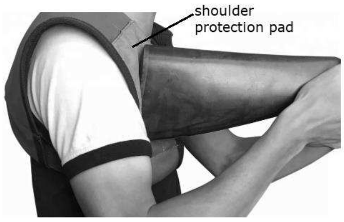
____ (2)

c. As the marksman fires the bullet, the rifle recoils backwards and hits his shoulder.

i. A law that explains why the rifle recoils backwards is Newton's 3rd law of Motion, which states that:

____ (1)

ii. A shoulder protection pad with a layer of foam inside is worn by the marksman. Explain how this reduces the force of impact on the shoulder.



https://www.alibaba.com

____

____ (2)

(Total: 20 marks)

20

2.

a. The table below shows different telescopes used to detect radiations from different sources.

Telescope	Type of radiation detected	Wavelength detected
Mauna Kea Observatory (Hawaii)	Infrared	25×10^{-6} m
Mount Graham (Arizona)	Visible light	600×10^{-9} m
Effelsberg Observatory (Bonn Germany)	Radio Waves	0.21 m

i. Name **TWO** common properties of the radiations detected.

____

____ (2)

ii. Calculate the frequency of the infrared waves detected by the Mauna Kea Observatory if these waves travel at 3×10^{8} m/s.

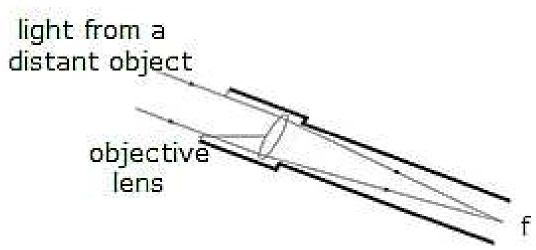
____

____ (3)

iii. List **TWO** other electromagnetic radiations apart from those mentioned above.

____ (2)

b. The diagram shows part of a telescope. Light from a distant object is captured by the lens and focused at point f, as shown.



Underline **ONE** correct word from inside the brackets, for each of the below sentences.

- The lens used is a (concave / convex) lens. (1)
- When parallel rays pass through the lens, they (converge / diverge / diffract) and meet at the focal point, f. (1)

20

c. The telescope's lens has a focal length of 12 cm.

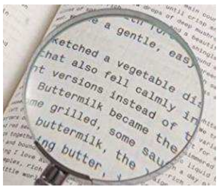
i. What do you understand by focal length of 12 cm?

____ (1)

ii. Put the following statements in order by using the number 1, 2 and 3 to explain how the student can do a rough measurement of the focal length of the lens. (3)

Move the lens towards and away from the screen until a sharp image of the distant object is obtained on the screen.	
Position the lens between a distant bright source of light and a screen.	
Measure the distance between the lens and the screen.	

d. The student wants to use the same lens as a magnifying glass, to be able to read some small text.



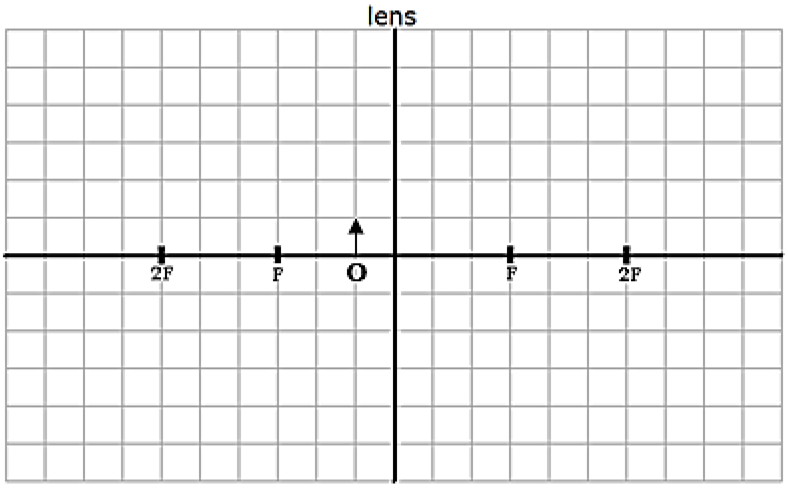
(https://www.amazon.com)

i. A picture whose actual height is 1.5 cm, is seen as an image with a height of 6 cm. Calculate the magnification of the lens.

____

____ (2)

ii. The diagram below shows a vertical line representing the lens, and an upright arrow showing an object, O. Complete the ray diagram to show how the lens produces an image when used as a magnifying glass. Label the image I. (3)



iii. The image produced is virtual. Mention **TWO** other characteristics of the image formed.

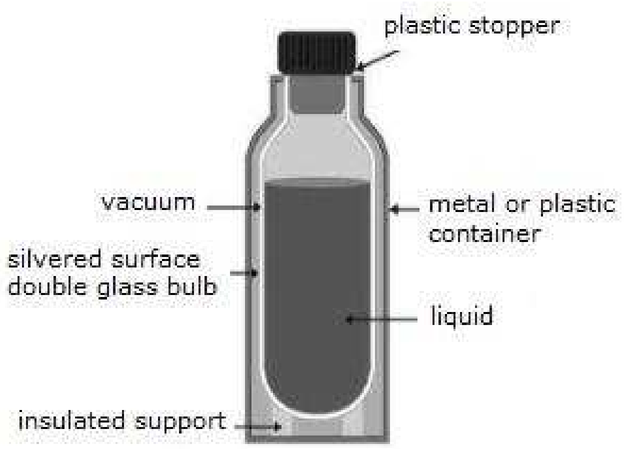
____ (2)

(Total: 20 marks)

20

3.

a. Lisa is going out on a picnic and she prepares a hot drink in a vacuum flask, designed to keep liquid warm for some time. The diagram below shows the inside of such a flask.



(https://www.123rf.com)

State which of conduction, convection and radiation, is being reduced by the parts of the flask listed below, to help keep the liquid warm. Each mode of heat transfer can be listed more than once.

i. glass bulb; ______________________________ (1)

ii. silvered wall; ______________________________ (1)

iii. plastic stopper; ______________________________ (1)

iv. vacuum between the walls. ______________ and ______________ (2)

b. During the Physics lesson, Lisa is told that there are also vacuum flasks with an inside bulb made of stainless steel, instead of glass. She wants to carry out an experiment to investigate which of the two flasks keeps liquids warm for a longer time. She is provided with a stainless steel flask and a glass flask of the same size, two thermometers, a stopwatch and hot water.

i. Describe how she should carry out the experiment, by numbering the following statements in order from one to four. (4)

Switch on the stopwatch and take the temperature of water at regular intervals.	
Repeat the same method, using the second flask containing the same volume of water, at the same initial temperature.	
Read the initial temperature of the water, using a thermometer.	
Fill the first flask with a known volume of hot water.	

20

ii. State **TWO** important necessary precautions, other than the ones listed in the method.

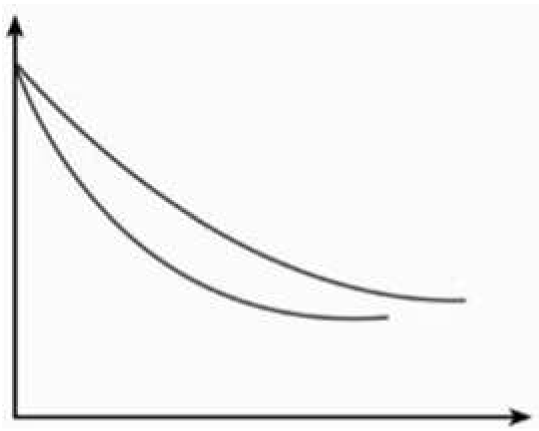
____

____ (2)

iii. The table below contains three columns used to record the readings taken. Fill in the heading of the first and third column, with the quantities measured and their units.
(3)

	Temperature of water in the glass flask (°C)	

iv. The graphs plotted are shown below. Label the **TWO** axes of this graph. (2)



v. Why is it better to plot the two graphs on the same axes and not on separate ones?

____ (1)

vi. Mark with an **X** the curve for the flask that keeps the liquid warm for a longer time.
(1)

c. Vacuum flasks are also used to keep certain liquids at very low temperatures. Explain, in terms of heat transfer, how flasks can keep cold liquids at low temperatures.

____

____ (2)

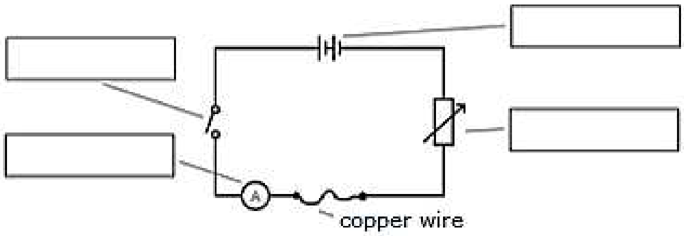
(Total: 20 marks)

20

4.

a. Michael wants to investigate the relationship between the thickness of copper wires and the current at which they melt.

i. The following circuit has been set up as shown below. Label the **FOUR** components indicated. (4)



ii. Use the words below to complete the method used for this investigation. Each word can be used only once.

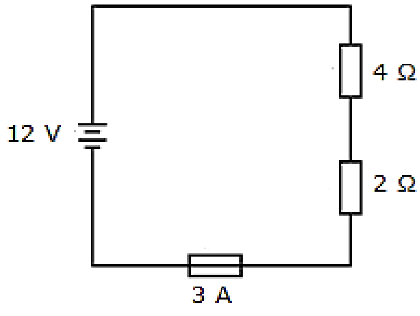
decreased	current	melted	wire	variable resistor

The apparatus was set up as shown above. The first ____________________ was attached to the crocodile clips. The circuit was switched on and the ____________________ was set to maximum resistance as to have the least ____________________ flowing. The resistance was ____________________ gradually until the copper wire melted. The current reading was taken just before the wire ____________________. This procedure was repeated each time by varying the thickness of the copper wire. (5)

iii. Predict the relationship between the thickness of the wires and the current they can withstand before melting.

____ (1)

b. The fuse shown in the figure allows 3 A of current to flow before melting. The fuse is connected to a 12 V battery and in series with two resistors of 4 Ω and 2 Ω.



20

i. What is the total resistance of the circuit?

____

____ (1)

ii. What is the current flowing through the circuit?

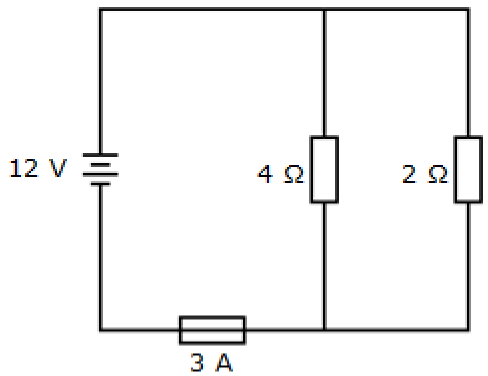
____

____ (2)

iii. Will the fuse melt at this current?

____ (1)

iv. If the two resistors are now connected in parallel as shown. Calculate the total resistance of the circuit.



____

____ (2)

v. Calculate the total current flowing in the parallel circuit.

____

____ (2)

vi. Will the fuse melt in this case?

____ (1)

c. Mention **ONE** other safety measure used at home to prevent electric shocks.

____ (1)

(Total: 20 marks)

20

5.

a. Underline the correct word from the ones in brackets, to complete the method used to create a permanent magnet.

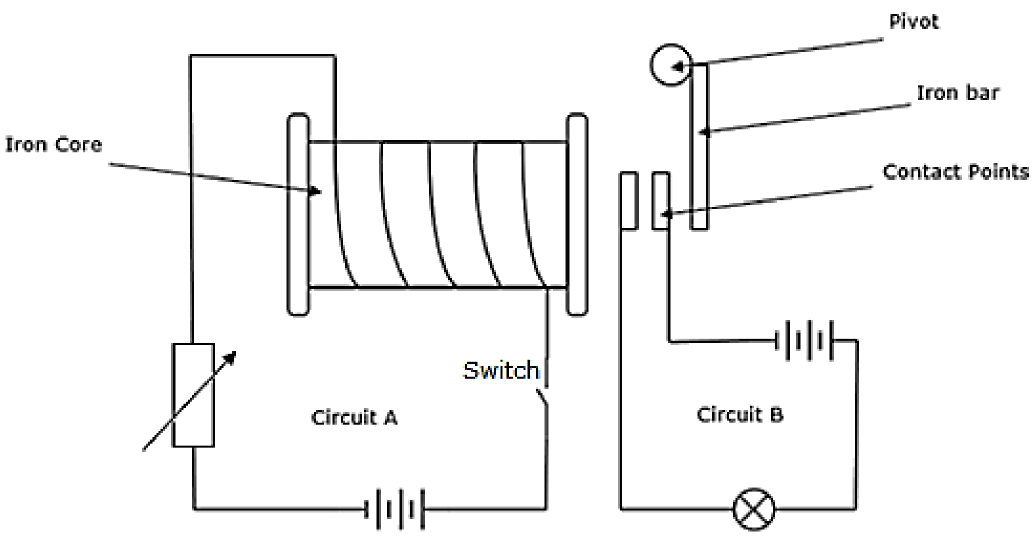
A wire is wrapped around a (steel / iron) bar. (Alternating / Direct) current is passed through the wire. The circuit is switched off and the wire is unwrapped leaving a permanent magnet. (2)

b. Draw the magnetic field pattern around the permanent bar magnet produced in the previous question. Show clearly the poles of the magnet. (3)

c. Give **ONE** method used to demagnetise the bar.

____ (1)

d. Kimberley wants to produce a model of a magnetic relay switch, to light the bulb in circuit B. The circuit she sets up is shown below:



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i. What will happen to the iron core as soon as the switch in circuit A is closed?

____

____ (2)

ii. Use numbers one to five, to rearrange the following list in order and obtain the correct sequence of events as circuit A is switched on. (5)

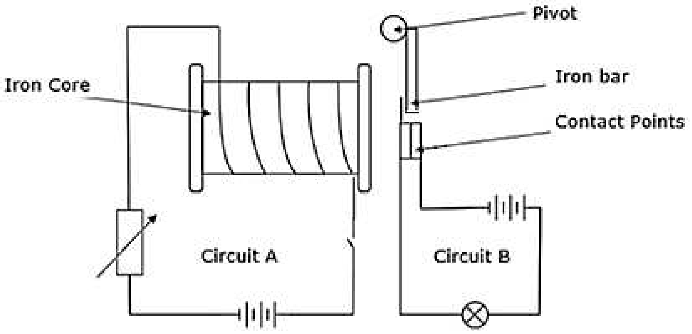
Current flows around the iron core.	
The iron bar is attracted towards the temporary magnet.	
The switch in circuit A is switched on.	
The contact points make contact.	
A complete circuit is now formed in circuit B, and the bulb lights up.	

iii. List **TWO** changes Kimberley can make to circuit A, to obtain a stronger attraction between the iron bar and the iron core.

____

____ (2)

iv. Kimberley now modifies circuit B as shown below. Explain what happens when circuit A is switched on.



____

____

____ (3)

v. This set-up can be used as a circuit breaker. Explain how this is used as a safety device in our homes.

____

____ (2)

(Total: 20 marks)

20

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