Index Number:_____ SEC24/1L1-2-3.25m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2025 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I – Level 1-2-3
DATE:	17th May 2025
DURATION:	2 hours 5 minutes

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	$\rho = \frac{m}{V}$			
Pressure	$p = \frac{F}{A}$	$p = h \rho g$		
Moments	Moment = F × perpendicular distance			
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$	$P = \frac{E}{t}$
Force and Motion	resultant force = m a	$W = m g$	$p = m v$	$F = \frac{(mv-mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$	$v = u + a t$	$s = (u + v)\frac{t}{2}$	
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$		
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$		
	Magnification = $\frac{\text{image height}}{\text{object height}}$	Magnification = $\frac{\text{image distance}}{\text{object distance}}$		
	$v = f\lambda$	$T = \frac{1}{f}$		
Electricity	$I = \frac{Q}{t}$	$V = I R$	$P = I V$	
	$E = Q V$	$E = I V t$		
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$		
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		

Section A

1. Kyle was investigating pressure in liquids in a lab.

a. Complete the following:

Pressure in a liquid is transmitted _____ in all _____. (2)

b. While investigating the relationship between the pressure caused by liquid L and the height of the liquid, the following readings were obtained.

height of liquid L, h / _____	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35
Pressure, P / _____	0	355	725	1070	1440	1810	2150	2500

i. Write the SI units of height and Pressure in the table above. (2)
ii. Plot a graph of Pressure on the y-axis against height of liquid L on the x-axis. (4)
iii. Interpret the conclusion Kyle can make from the shape of the graph obtained.

_____

_____

_____ (1)

iv. Apply this conclusion to **TWO** situations in everyday life.

_____

_____

_____

_____ (2)

v. Determine the value of the density of liquid L from the graph.

_____

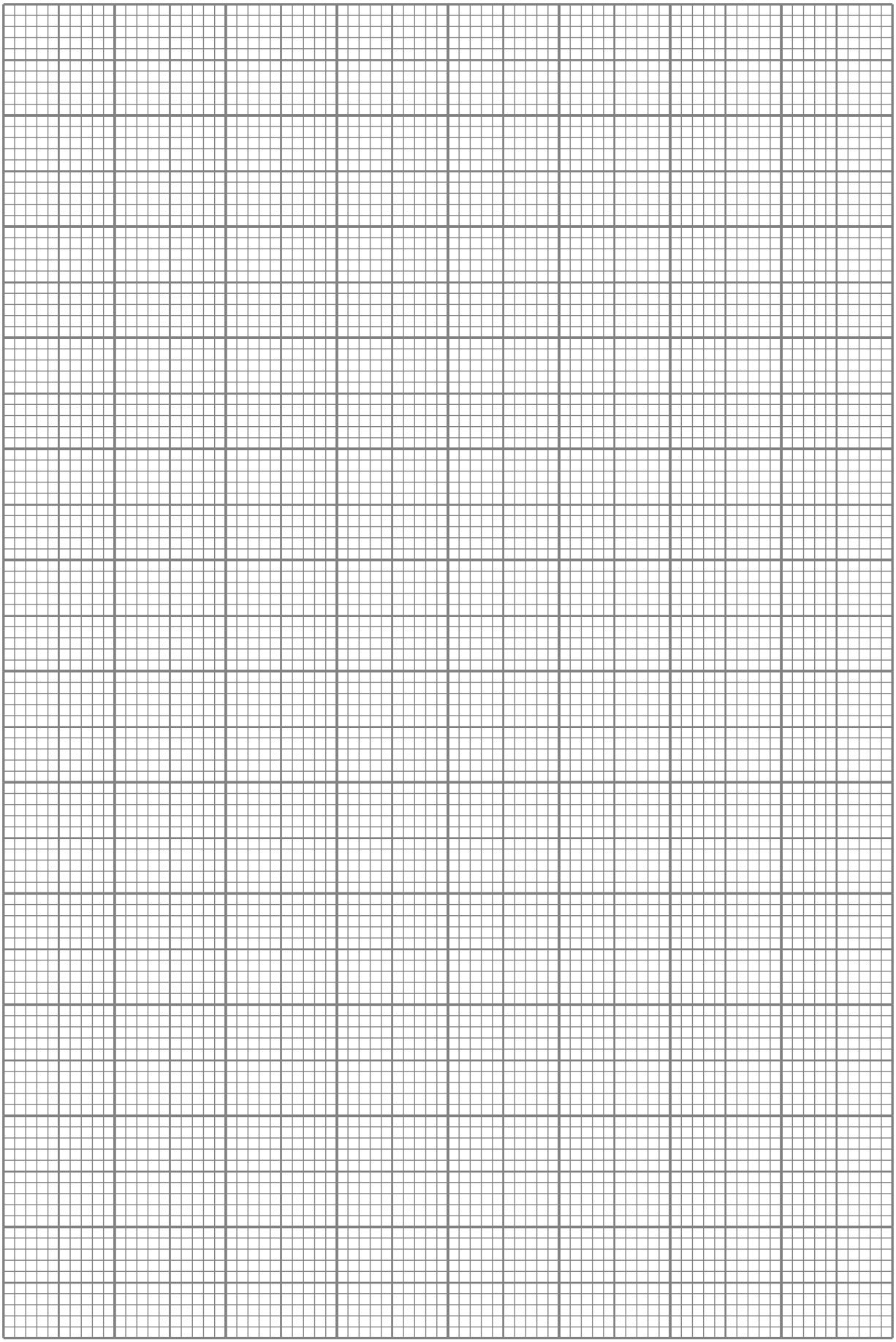
_____

_____

_____

_____ (4)

(Total: 15 marks)



2. Galileo Galilei and Sir Isaac Newton were two key scientists who studied free falling objects.

a. Describe the motion of a free falling object on Earth.

_____

_____ (1)

b. The apparatus in Figure 1 is used in an experiment to measure the value of g, acceleration due to gravity.

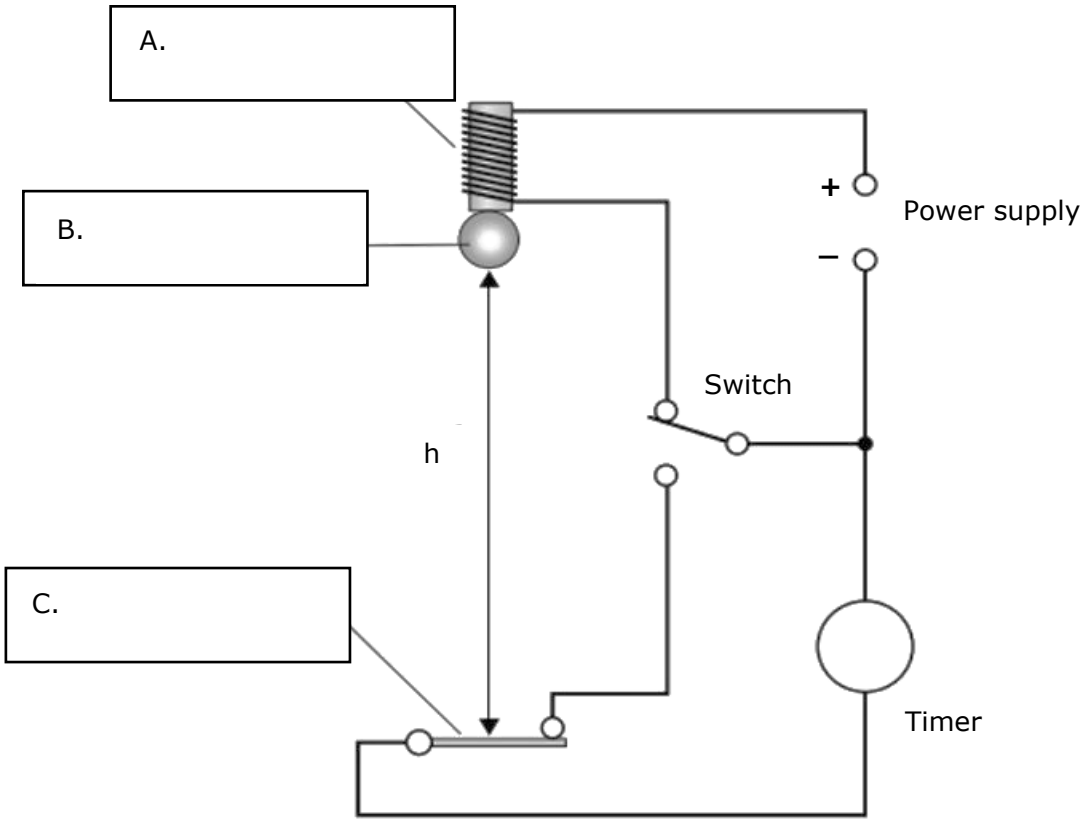


Figure 1

i. Label the **THREE** parts of the apparatus A, B and C indicated in the diagram. (3)

ii. Describe the method, one should follow to carry out the experiment.

_____

_____

_____

_____

_____ (3)

iii. State **TWO** precautions necessary when doing this experiment.

_____

_____

_____ (2)

iv. State **ONE** source of error in this experiment.

_____

_____ (1)

v. Explain how the measurements obtained can be used to determine the value of g, acceleration due to gravity.

_____

_____

_____

_____

_____ (3)

c. Compare the motion of a falling object on Earth and on the moon.

_____

_____

_____ (2)

(Total: 15 marks)

3. a. The data given in the table below was obtained from an investigation which Theresa carried out into the refraction of light at an air-to-glass boundary.

Angle of incidence / °	20	30	40	50
Angle of refraction / °	13	19	25	30

i. Describe refraction in terms of speed of light in air and in glass.

_____

_____(2)

ii. Give **TWO** examples of refraction in everyday situations.

_____

_____(2)

This question continues on next page.

iii. List **THREE** main apparatus that were used in this investigation.

_____(3)

iv. Describe the procedure that Theresa carried out to obtain the data given in the table.

_____

_____

_____

_____(4)

v. Suggest **ONE** main precaution to ensure accurate results.

_____(1)

b. White light can also disperse as it enters a prism as shown in Figure 2.

i. Complete Figure 2 to show dispersion of white light. (1)

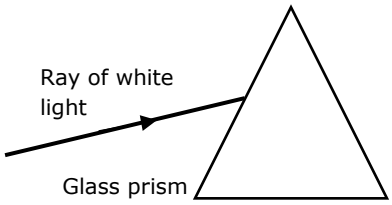


Figure 2

ii. Explain what causes the dispersion of white light when it is incident at an angle on an optically denser medium.

_____

_____(2)

(Total: 15 marks)

4. Chloe is investigating the rate of heat emission from different surfaces. Figure 3 shows some of the apparatus used.

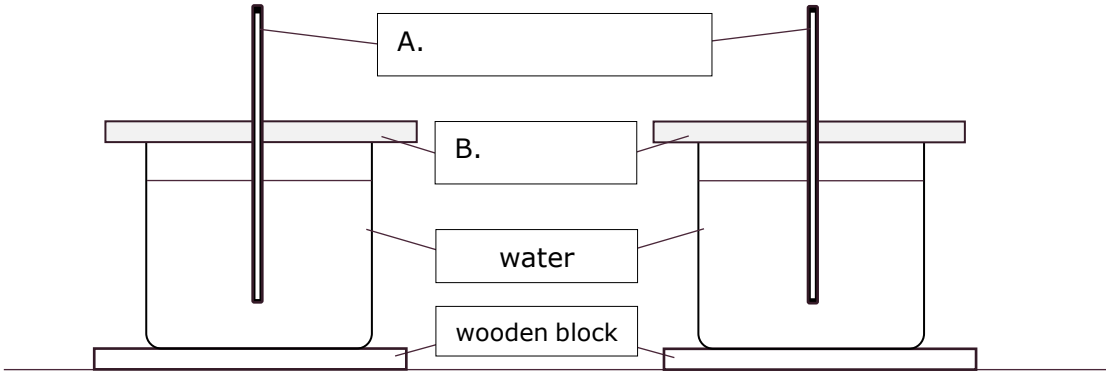


Figure 3

a. i. Label the apparatus A and B in Figure 3. (2)

The thermometer in Figure 4 shows the room temperature (in °C), at the beginning of the experiment.

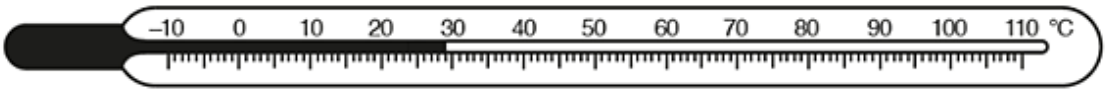


Figure 4

ii. State the SI Unit of temperature.

_____ (1)

iii. Read the room temperature from the thermometer in °C.

_____ (1)

b. Chloe pours the same volume of hot water into two different beakers; shiny and matt black surface. She records the initial temperature of the water and immediately starts a stop watch. She records the temperature reading every 1 minute. The tables below show some of the results obtained.

Table 1: Shiny surface beaker

	0	1	2	3	4	5
	94	92	90	89	88	87

Table 2: Matt black surface beaker

	0	1	2	3	4	5
	94	91	88	86	84	82

i. Complete the headings in the tables above. (2)

ii. State **ONE** precaution which should be taken whilst reading the thermometer.

_____

_____ (1)

iii. Draw a conclusion about the rate of emission in these two beakers, by referring to the readings in tables 1 and 2.

_____

_____

_____ (2)

This question continues on next page.

iv. Food serving dishes usually have a shiny silver surface. Explain.

_____

_____

_____(2)

c. Explain why a wooden block is used underneath each beaker.

_____

_____

_____

_____(2)

d. Describe **ONE** improvement to the experiment, to achieve more accurate results.

_____

_____

_____(2)

(Total: 15 marks)

5. During a Physics lesson, Anna and Kaya are asked to carry out an experiment to investigate the relationship between voltage and current in a filament lamp. They are given a filament lamp, power supply, variable resistor, ammeter, voltmeter, switch, and suitable connecting wires.

a. State Ohm's Law.

_____

_____ (2)

b. Draw a circuit diagram of the experimental setup. (3)

c. Describe briefly the method they would use to carry out this investigation.

_____

_____

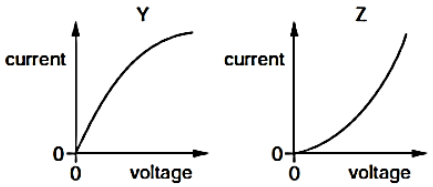
_____ (4)

d. State **ONE** safety precaution that should be taken in this investigation.

_____ (1)

e. State how they can display their results. _____ (1)

f. Anna and Kaya then plot a graph of current and voltage. Which of the two graphs shown here, Y or Z, is obtained?



_____ (1)

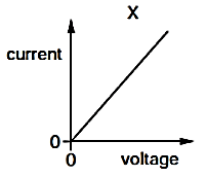
g. Interpret the relationship between voltage and current from the graph obtained.

_____ (1)

h. State how the value of the resistance of the lamp varies throughout this experiment.

_____ (1)

i. Identify the ohmic conductor that would result in graph X when used in the same investigation. _____ (1)



(Total: 15 marks)

Section B

6. a. Copper and nichrome are two metals. The resistance of a copper wire of a certain thickness is 0.10 Ω per meter. The resistance of a nichrome wire of the same thickness is 6.50 Ω per meter. Explain which of copper and nichrome is the better conductor of electricity.

_____

_____(2)

b. Figure 5 shows a piece of nichrome wire stretched over a ruler. The left end of the wire is connected to a circuit while its right end is connected to the circuit via a crocodile clip C. The clip C can be moved to make contact anywhere along the wire.

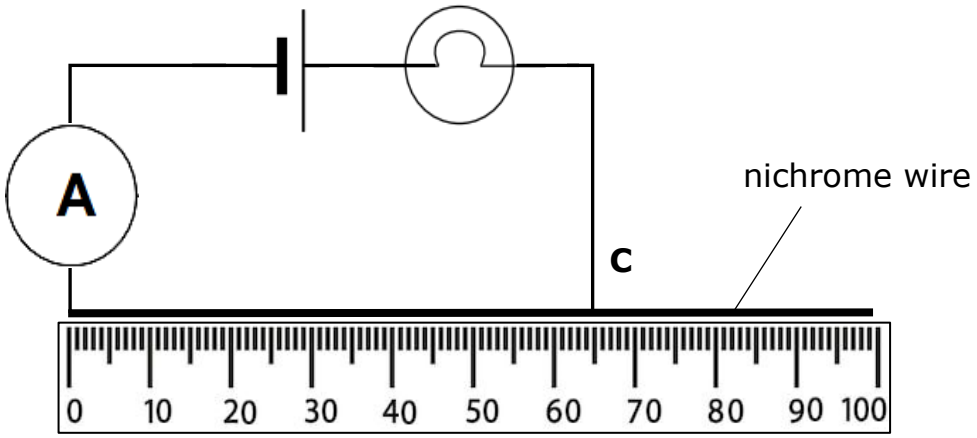


Figure 5

i. State whether the circuit in Figure 5 is open or closed. _____ (1)

ii. Clip C is moved to the right. State any changes observed in the brightness of the bulb.

_____ (1)

iii. The ammeter reading when clip C is on length 80 cm of the wire is noted to be 0.50 A. If the nichrome wire were to be replaced by a thinner one of the same material, state whether the ammeter reading using the same length of thinner wire would be smaller or greater than 0.50 A.

_____ (1)

iv. Underline the correct word in the two following statements showing the expected results from parts (i) and (ii) above.

As the length of a metallic conductor increases, its resistance (decreases/increases). (1)

As the thickness of a metallic conductor increases, its resistance (decreases/increases). (1)

v. Apart from length, thickness and type of metallic conductor, state **ONE** other factor which effects the resistance of the conductor.

_____ (1)

c. Nichrome is the metal of choice used as the heating element of several household appliances such as electric kettles, toasters, grillers and water heaters. A toaster is rated at 230 V, 1.0 kW.

i. Calculate the current flowing through the circuit.

_____

_____(2)

ii. State an ideal fuse rating for this circuit.

_____ (1)

iii. Draw the electronic symbol of a fuse in the space below. (2)

(Total: 13 marks)

7. a. Magnet A is placed on a top-pan balance as shown in Figure 6. The balance is calibrated in newtons and reads 2.0 N.

A second magnet B, not shown and attached to a clamp stand, is placed a short distance vertically above magnet A. The reading of the balance increases to 3.5 N.

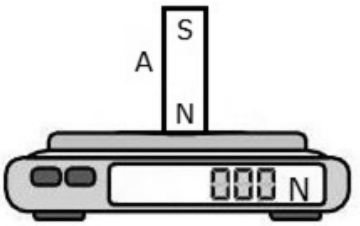


Figure 6

i. State what the initial reading of 2.0 N refers to.

_____ (1)

ii. The balance reading increases when magnet B was placed on top of and close to magnet A. Deduce the type of magnetic pole closer to the South end of the magnet shown in Figure 6.

_____

_____ (2)

iii. Calculate the magnetic force in this case between the two magnets.

_____ (1)

b. Ella is asked by her Physics teacher to investigate the relationship between the magnetic force between two magnets and the distance from each other. Ella uses ideas taken from part (a) above to help her do this.

i. Apart from all objects mentioned so far, state **ONE** additional piece of apparatus needed.

_____ (1)

ii. In the space provided below draw a setup of the apparatus needed. On your diagram indicate the measurement taken using the apparatus mentioned in part (i). (2)

This question continues on next page.

iii. Describe the method Ella would use to carry out this investigation.

_____

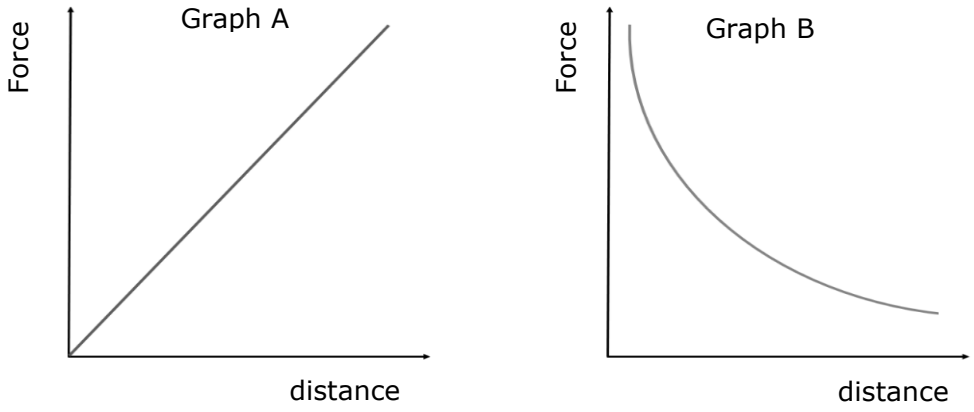
_____

_____

_____

_____ (3)

iv. It was observed that the closer the magnets are to each other, the stronger the magnetic force between them. State which of the two graphs, A or B, represents this observation. Explain.



_____

_____ (2)

(Total: 12 marks)

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L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2025 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	II – Level 1-2
DATE:	17th May 2025
DURATION:	2 hours 5 minutes

Answer **ALL** questions.

You are requested to show your working and to write the units where necessary.

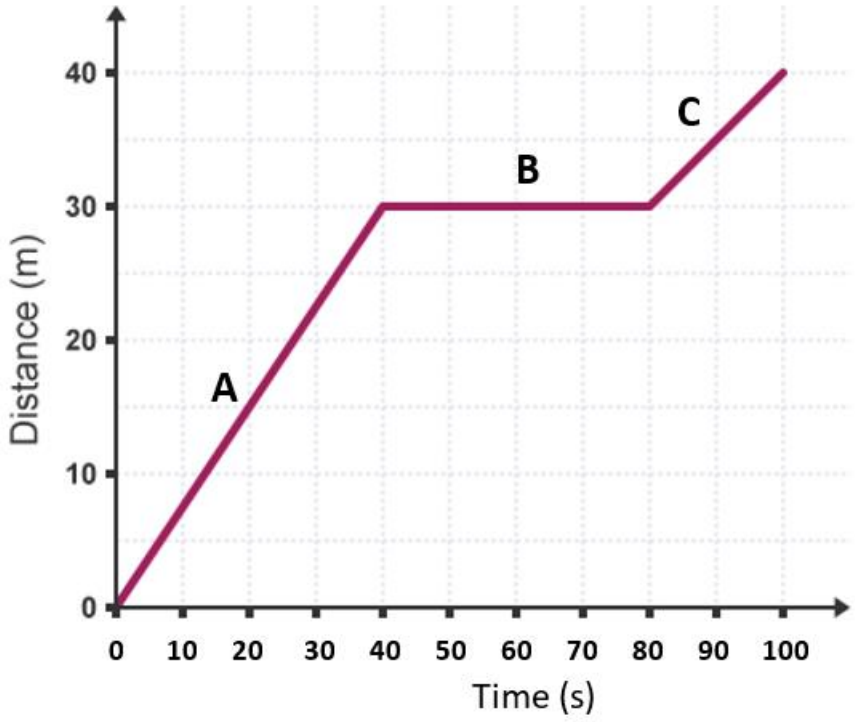
When necessary, take g, acceleration due to gravity, as 10 m/s^2.

Density	$\rho = \frac{m}{V}$			
Pressure	$p = \frac{F}{A}$	$p = h \rho g$		
Moments	Moment = F × perpendicular distance			
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$	$P = \frac{E}{t}$
Force and Motion	resultant force = m a	$W = m g$	$p = m v$	$F = \frac{(mv-mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$	$v = u + a t$	$s = (u + v)\frac{t}{2}$	
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$		
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$		
	Magnification = $\frac{\text{image height}}{\text{object height}}$	Magnification = $\frac{\text{image distance}}{\text{object distance}}$		
	$v = f\lambda$	$T = \frac{1}{f}$		
Electricity	$I = \frac{Q}{t}$	$V = I R$	$P = I V$	
	$E = Q V$	$E = I V t$		
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$		
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		

Section A

1. This question is about motion.

   The following distance – time graph shows part of the journey taken by Martina while walking on her way to school.



a. Distinguish between distance and displacement.

_____

_____(2)

b. State the part of the graph, A, B or C, which shows that Martina was:

   i. resting _____ ; (½)

   ii. walking at constant speed _____. (½)

c. Calculate Martina's average speed during her whole journey.

_____

_____(2)

(Total: 5 marks)

2. This question is about momentum.

a. i. Define linear momentum.

_____

_____ (1)

ii. State the SI units of momentum. _____(1)

b. A vehicle, of mass 2250 kg, is moving at a constant speed of 3.2 m/s. Calculate the momentum of the vehicle.

_____

_____ (2)

c. One of the safety features of the vehicle is the seat belt. Explain how the seat belt is useful when there is an impact.

_____(1)

(Total: 5 marks)

3. This question is about pressure in liquids.

a. Underline the correct word in the brackets to complete the following statements. (3)

i. The pressure on a diver (increases / decreases) when diving deeper under the sea to recover some items from the seabed.

ii. When large trucks make use of wide tyres instead of thin ones, the pressure on the ground (increases / decreases).

iii. The pressure on a shelf in a grocer will (increases / decrease) if half of the tomato paste cans are removed.

b. A tank is filled with water to a depth of 1.2 m. Calculate the pressure at the bottom of the tank due to the water. (Density of water = 1000 kg/m^3).

_____

_____

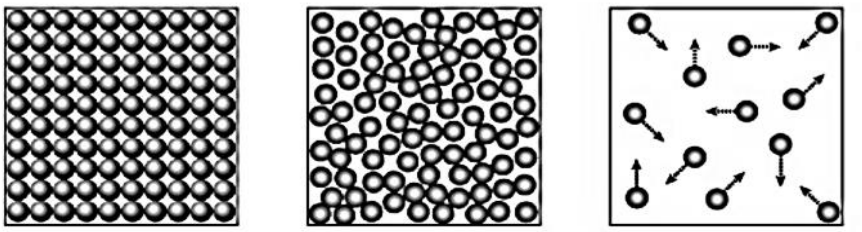
_____ (2)

(Total: 5 marks)

Please turn the page.

4. This question is about particle movement.

All matter exists in three states. The particle arrangement of all three states is shown below.



A: _____ B: _____ C: Gas

Figure 1

a. Complete the missing labels A and B in Figure 1. (2)

b. Explain in terms of molecules why it is possible to compress a gas but **not** a liquid.

_____

_____(2)

c. Puddles of water form on a path after rainfall. The sun is shining on the puddles. Underline the correct word in the brackets to complete the following statement.

As the water molecules at the surface of the puddle (gain, lose) energy they escape from the water surface. (1)

(Total: 5 marks)

5. This question is about electromagnetic waves.

There are different groups of waves in the electromagnetic spectrum.

Gamma rays	A	B	Visible light	C	Microwaves	Radiowaves

Increasing wavelength

a. Name the **THREE** groups of waves represented by A, B and C.

A _____ B_____ C_____ (3)

b. Electromagnetic waves have many practical uses.
Give **ONE** use for each of the regions below:

i. Gamma Rays _____ (1)

ii. Microwaves _____(1)

(Total: 5 marks)

6. This question is about static electricity

a. Underline the correct words in the brackets to complete the following statements.

Polythene is an example of (a conductor / an insulator). When a polythene rod is rubbed with a cloth the rod acquires a (positive / negative) charge. (2)

b. Fill in the following table with the correct force (**attraction** or **repulsion**) acting between two objects A and B having the following charges:

Object A	Object B	Force
positive	negative	
positive	positive	
positive	neutral	

(3)

(Total: 5 marks)

7. This question is about the atom.

a. Draw the model of an atom and label the nucleus, protons, neutrons and electrons. (2)

b. State the charge of the:

protons _____ neutrons _____ electrons _____ (1)

c. Complete the following:

When an atom becomes unstable, nuclear radiation is emitted from the _____ of the atom. This is a _____ and spontaneous process. (2)

(Total: 5 marks)

8. This question is about space physics.

a. Draw lines to match the following:

Jupiter		star
Sun		galaxy
Milky Way		planet

(3)

b. State the names of **TWO** instruments used by astronomers to observe celestial bodies.

_____ (2)

(Total: 5 marks)

Please turn the page.

Section B

9. This question is about lenses.
Timothy investigated the magnification produced by a convex lens using the apparatus shown.

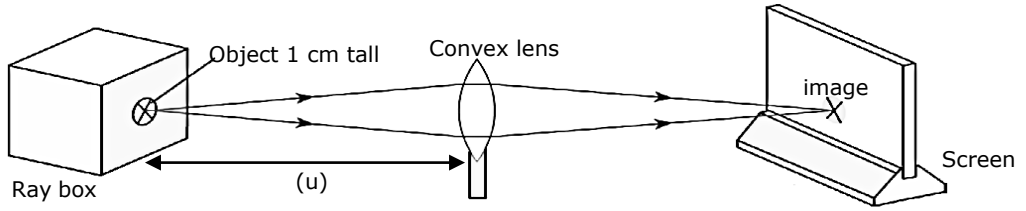


Figure 2 Diagram not to scale

(www.ecclesbourne.derbyshire.sch.uk)

a. i. State what (u) in Figure 2 represents.

_____ (1)

ii. h_o is the height of the object. Use Figure 2 to state its value. _____ (1)

iii. h_i is the height of the image. Mark h_i in Figure 2. (1)

b. State the application of a converging lens for an object placed:
i. beyond 2F;

_____ (1)

ii. between F and the lens;

_____ (1)

iii. between F and 2F.

_____ (1)

c. Timothy records data from his investigation in the table below.

Distance between the object and the lens/cm	25	30	40	50	60
Magnification	4.0	2.0	1.0	0.7	0.5

i. Plot a graph of magnification on the y-axis against distance between the object and the lens (cm) on the x-axis. (5)

ii. Use the graph to obtain the magnification when the distance between the object and the lens is 35 cm. _____ (1)

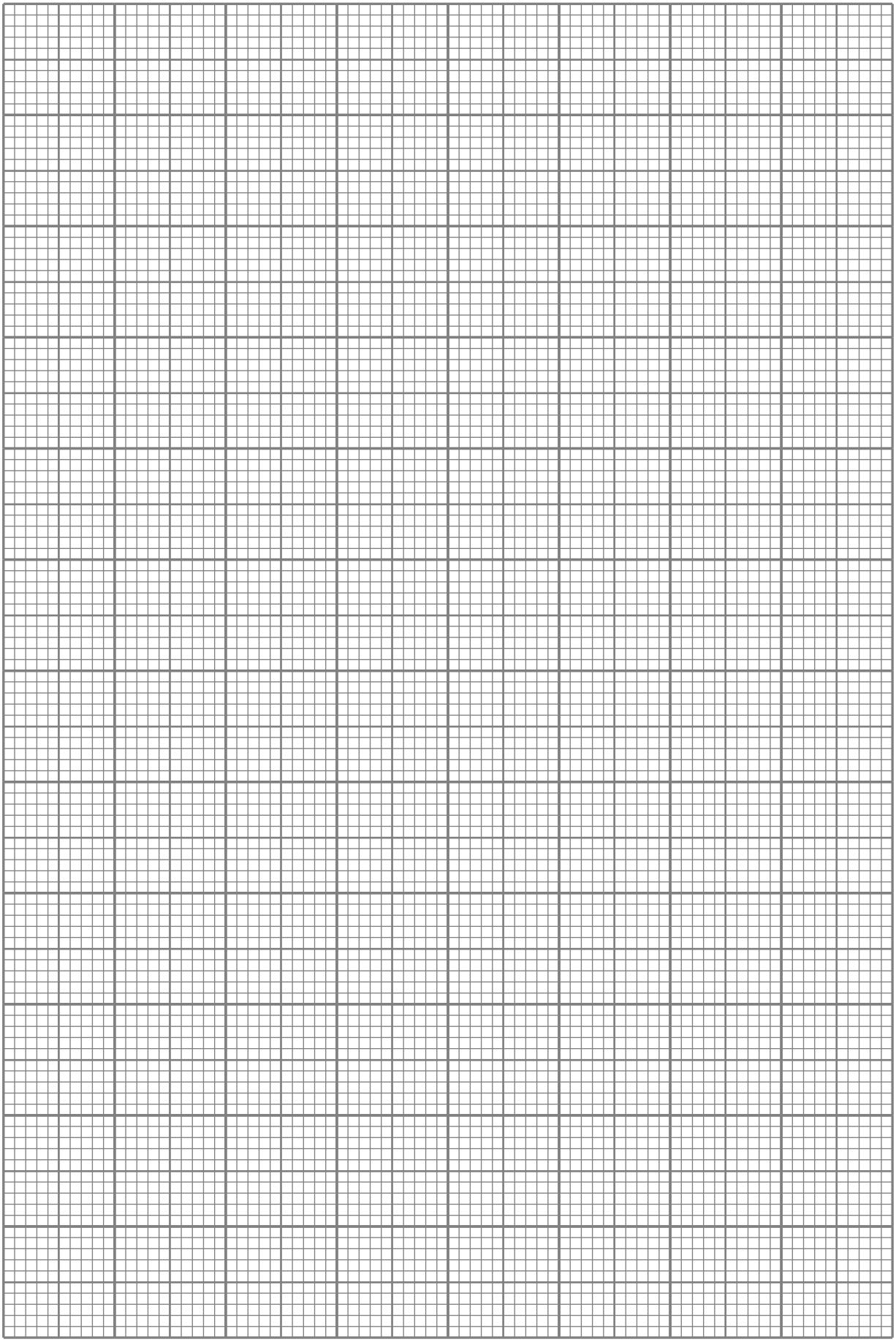
d. Timothy decides to find the focal length of the convex lens. Describe how he can carry out a rough method experiment to find the focal length.

_____

_____

_____ (3)

(Total: 15 marks)



Section C

10. This question is about the motion of a vehicle.

a. Define thinking distance.

_____

_____ (1)

b. Underline **TWO** factors which may affect the thinking distance. (1)

Driver's attention	Speed of the vehicle	Condition of the brakes

c. Define braking distance.

_____

_____(1)

d. Underline **TWO** factors which may affect the braking distance. (1)

Condition of the road	Driver's reaction time	Mass of the vehicle

A car of mass 2320 kg travelling at a speed of 25 m/s is approaching a zebra cross. The driver's reaction time is 1.2 s and the car takes 12.6 s to stop.

e. State the meaning of human reaction time.

_____

_____(1)

f. After the brakes are applied, the car takes 12.6 s to stop. Calculate the stopping distance of the car.

_____

_____

_____(3)

g. Calculate the kinetic energy of the car while it is moving at 25 m/s.

_____

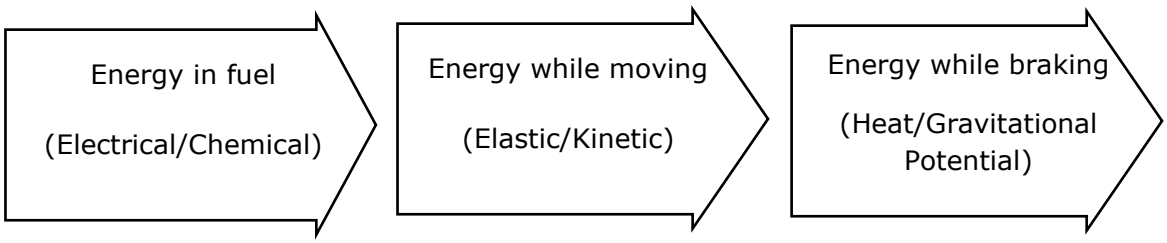
_____(2)

h. State the Law of Conservation of Energy.

_____

_____(2)

i. Energy is transformed while the car is moving. Underline the correct type of energy in each of the three stages below. (3)



(Total: 15 marks)

11. This question is about thermal energy.

a. Figure 3 shows a fridge with a freezer compartment. The temperature of the air inside the freezer compartment is –18 °C. Underline the correct word in the brackets for (i) to (iii).

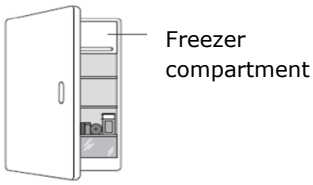


Figure 3

When the air near the freezing compartment is cooled, the:

i. energy of the air particles is (unchanged, decreased, increased); (1)

ii. spaces between the air particles are (unchanged, decreased, increased); (1)

iii. density of the air is (unchanged, decreased, increased). (1)

b. Describe how the air inside the freezer compartment exerts pressure when the freezer is closed.

_____

_____ (2)

c. Figure 4 shows a moving metal grid. Uncooked biscuits are placed on the grid, and they are cooked as they pass between two hot electrical heating elements inside an oven.

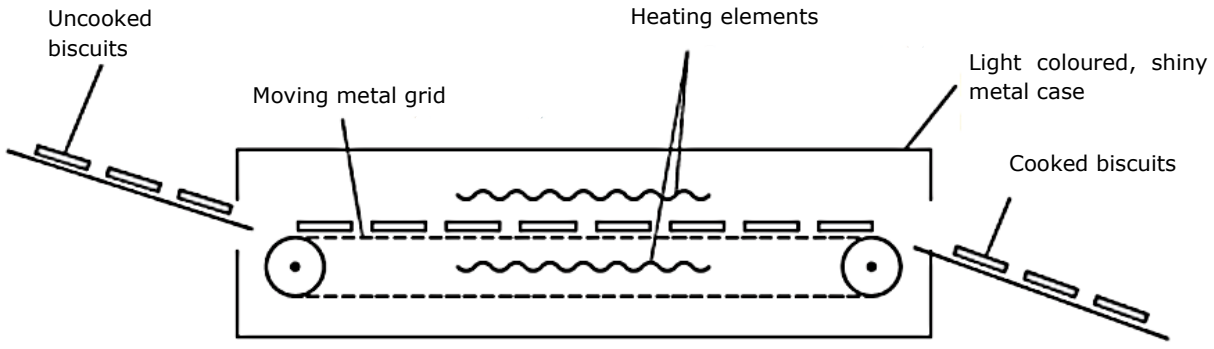


Figure 4

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

This question continues on the next page.

i. Thermal radiation is one type of heat transfer. Define radiation.

_____ (1)

ii. The biscuits absorb the infra-red radiation emitted by the heating elements and are cooked, hence turning brown. State another use of infra-red radiation.

_____ (1)

iii. The inside surfaces of the oven are light-coloured and shiny. If a dark, matt surface is used instead of a shiny, light-coloured surface, describe the changes, if any, in the rates of emission and absorption of heat.

_____

_____

_____ (2)

iv. Convection currents are also created inside the oven. Define convection.

_____ (2)

d. Figure 5 shows the direction of heat transfer through a single-glazed window.

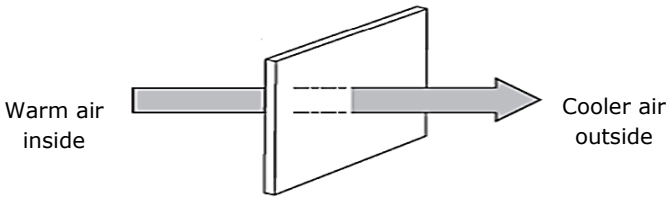


Figure 5

i. Heat is transferred as shown by conduction. Define conduction.

_____ (2)

ii. A homeowner plans to replace the single-glazed windows in his home with double-glazed windows. These are made with two panes of glass separated by a gap filled with air as shown in Figure 6.
Explain why the gap is filled with air.

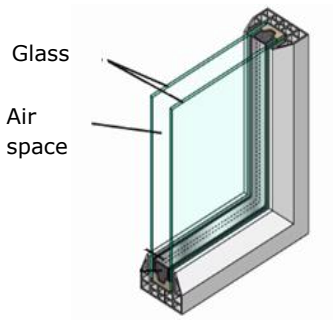


Figure 6

_____

_____

_____ (2)

(Total: 15 marks)

12. This question is about electricity and magnetism.

a. i. Name circuit symbols A and B in Figure 7.

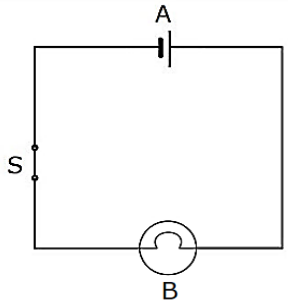


Figure 7

A:_____ B: _____ (2)

ii. Draw a line in this diagram to shortcut the bulb. (1)

iii. Explain the effect of a short circuit on the flow of current through the bulb.

_____ (1)

b. A magnetic field is present around the connecting wires of the circuit in Figure 7 when switch S is closed.

i. Describe a magnetic field.

_____

_____ (1)

ii. State how one can demonstrate the direction of the field around a single long straight current-carrying conductor.

_____

_____ (2)

iii. In the space below, draw the magnetic field lines around the single long straight current-carrying conductor shown in Figure 8. The direction of the magnetic field lines is not required. (2)

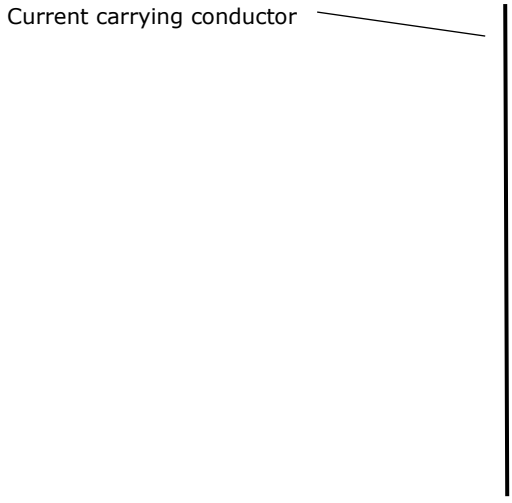


Figure 8

This question continues on the next page

c. Figure 9 shows two circuits, C and D.

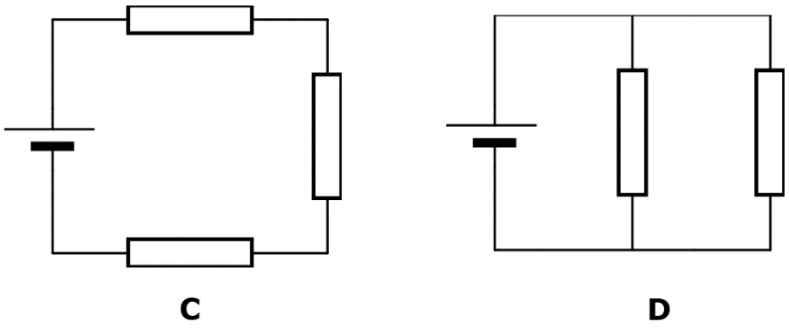


Figure 9

i. State whether each is a series or parallel circuit.

Circuit C _____

Circuit D _____ (1)

ii. In diagram C the values of the resistors are 2 Ω, 3 Ω and 4 Ω. Calculate the total resistance.

_____

_____(2)

iii. Underline the correct words in the brackets in the following statements to describe the behavior of both current and voltage in these two circuits:
In C, the current in the resistor is (the same/shared) while the voltage is (the same/shared). (1)

In D, the current in the resistor is (the same/shared) while the voltage is (the same/shared). (1)

iv. Draw a voltmeter in diagram D, to show how it could be connected to read the voltage across the resistors. (1)

(Total: 15 marks)

Index Number:_____ SEC24/2L2-3.25m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2025 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	II – Level 2-3
DATE:	17th May 2025
DURATION:	2 hours 5 minutes

Answer **ALL** questions.

You are requested to show your working and to write the units where necessary.

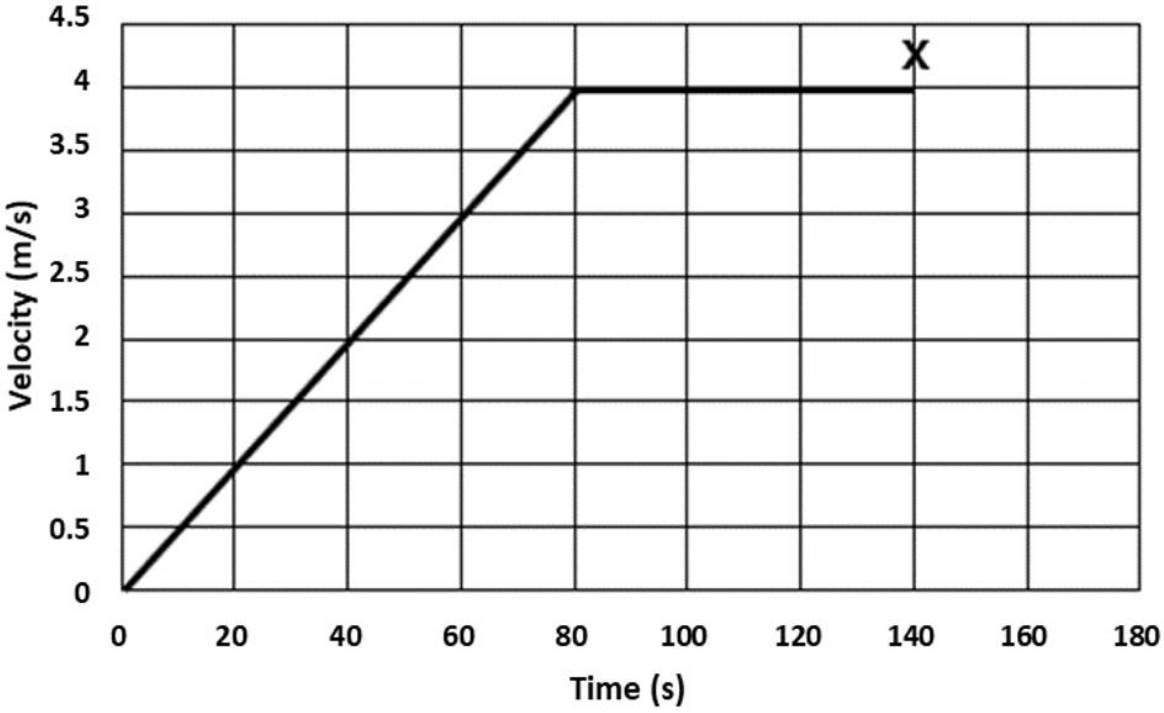
When necessary, take g, acceleration due to gravity, as 10 m/s^2.

Density	$\rho = \frac{m}{V}$			
Pressure	$p = \frac{F}{A}$	$p = h \rho g$		
Moments	Moment = F × perpendicular distance			
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$	$P = \frac{E}{t}$
Force and Motion	resultant force = m a	$W = m g$	$p = m v$	$F = \frac{(mv-mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$	$v = u + a t$	$s = (u + v)\frac{t}{2}$	
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$		
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$		
	Magnification = $\frac{\text{image height}}{\text{object height}}$	Magnification = $\frac{\text{image distance}}{\text{object distance}}$		
	$v = f\lambda$	$T = \frac{1}{f}$		
Electricity	$I = \frac{Q}{t}$	$V = I R$	$P = I V$	
	$E = Q V$	$E = I V t$		
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$		
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		

Section A

1. This question is about motion.

The following graph shows how the velocity of an athlete varies while participating in a race.



a. Calculate the acceleration of the athlete during the first 80 s.

_____

_____ (2)

b. At point X, the athlete starts decelerating constantly and the race finishes after 180 s. Complete the graph above to represent how the athlete finished the race. (1)

c. Calculate the athlete's deceleration during the last part of the race.

_____

_____ (2)

(Total: 5 marks)

2. This question is about Newton's Second Law of Motion.

a. State Newton's Second Law of Motion.

_____

_____ (2)

b. Calculate the acceleration of an object of mass 125 kg which is being pushed by a force of 900 N.

_____

_____

_____ (3)

(Total: 5 marks)

3. This question is about energy.

Paul charged his mobile phone and then he was using it to watch a short video.

a. Explain how energy is converted while using a mobile phone to watch a video.

_____

_____

_____ (2)

b. Paul left his mobile phone of mass 500 g on a cupboard. Calculate the height of the cupboard if the gravitational potential energy of the mobile phone is 5.75 J.

_____

_____

_____ (3)

(Total: 5 marks)

Please turn the page.

4. This question is about thermal energy.

A solar panel is mounted on the roof of a house. Figure 1 shows a section through part of the solar panel.

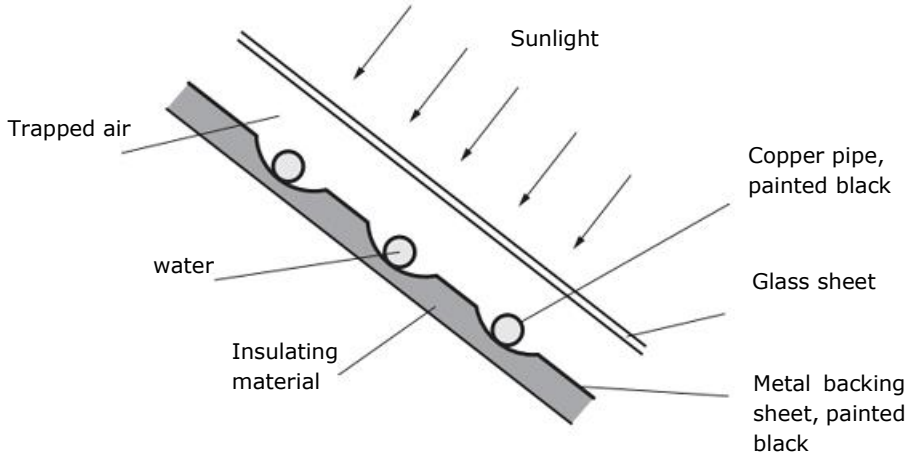


Figure 1

(https://www.gauthmath.com/)

A pump makes water flow through the copper pipes. The water is then heated by passing through the solar panel.

a. The solar panel is manufactured with features that maximise the heating efficiency of the system.

i. The pipes are made of copper. Explain how this maximises the heating process.

_____

_____ (2)

ii. State the name of an insulating material that could be used in the setup shown in Figure 1.

_____ (1)

b. On one day, 300 kg of water is pumped through the solar panel. The temperature of the water rises from 20 °C to 65 °C. The specific heat capacity of water is 4200J /(kg °C). Calculate the heat energy of the water inside the copper pipes on that day.

_____

_____

_____(2)

(Total: 5 marks)

5. This question is about water waves.
Caleb studied some features of waves using a ripple tank as shown in Figure 2.
He found that on average 1.23 waves passed through the same mark in 1 s.

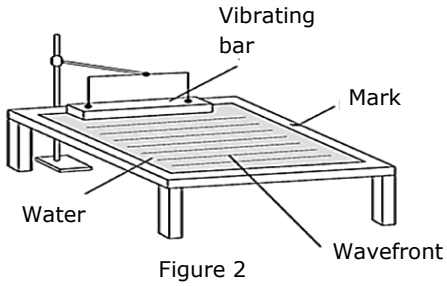


Figure 2

a. Calculate the periodic time of the wave.

_____

_____

_____(2)

b. In a different investigation Caleb wanted to determine the speed of water waves in the ripple tank. He did not measure the wavelength of the wave. Explain how he can determine the speed of the wave.

_____

_____

_____(3)

(Total: 5 marks)

6. This question is about static electricity.

a. During a lesson about electrostatics, a student was given an acetate rod, a copper rod and a piece of cloth.

i. The student first rubs the acetate rod with the cloth. In terms of movement of charges, explain why opposite charges are left on the rod and cloth.

_____

_____(1)

ii. Copper is a conductor of electricity. Distinguish between conductors and insulators in terms of free electrons.

_____(1)

iii. The student then holds the copper rod in his hand and rubs it with the cloth. Explain why this time no charge is left on the rod.

_____(1)

This question continues on the next page.

b. Figure 3 shows an electrostatic precipitator installed inside a power station chimney intended to reduce the emission of dust particles in air. Exhaust gases and dust from the burning of fuel rise up the chimney.

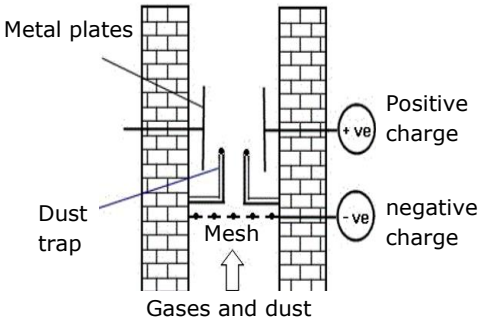


Figure 3

(https://enviraj.com/)

i. The dust particles become negatively charged as they pass through the metal mesh. What happens when these charged particles rise further upwards above the mesh?

_____ (1)

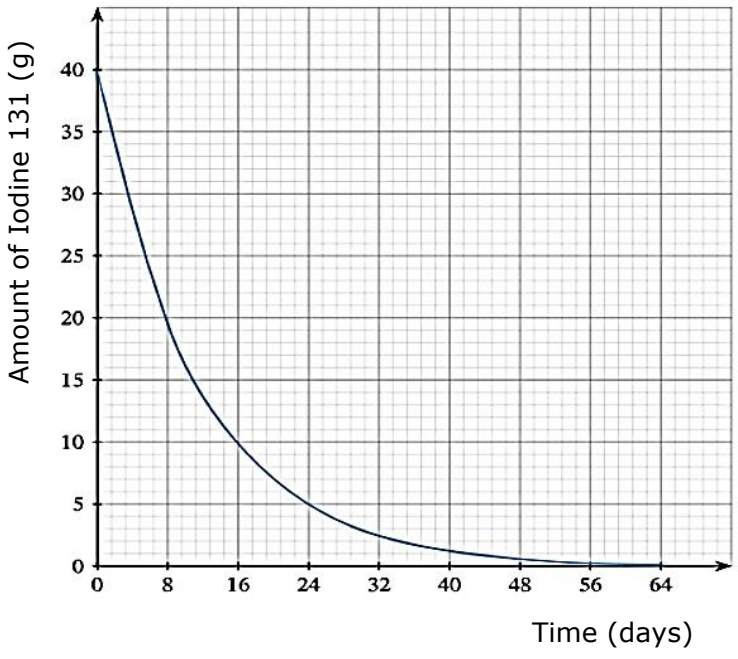
ii. Explain why it is found that some dust particles would still be attracted to the charged plates when the metal mesh is disconnected from the negative charge.

_____(1)

(Total: 5 marks)

7. This question is about radioactivity.

The following graph represents the radioactive decay of Iodine 131 ($^{131}_{53}\mathrm{I}$). During decay, a beta particle is emitted and Xenon (Xe) is produced.



(Adapted from: https://www.nagwa.com)

a. Define the term radioactive decay.

_____

_____(1)

b. Calculate the percentage of Iodine 131 left after 32 days.

_____

_____(2)

c. Write down the nuclear equation to represent the radioactive decay of Iodine 131.

_____(2)

(Total: 5 marks)

8. This question is about space physics.

a. Describe the solar system.

_____

_____(1)

b. Is the earth considered to be a rocky or gaseous planet? _____ (1)

c. What type of movement causes day and night on earth?

_____ (1)

d. What causes the formation of seasons on earth?

_____ (1)

e. Name the galaxy in which our solar system is located.

_____ (1)

(Total: 5 marks)

Please turn the page.

Section B

9. This question is about waves.

a. Figure 5 shows the setup for an experiment carried out to find the speed of sound at different temperatures.
A speaker is used to emit a sound wave, which reaches a microphone. The sound wave is then inputted into an oscilloscope. The speed of sound is then calculated by dividing the distance between the speaker and the microphone, by the time taken by the wave to travel that distance.

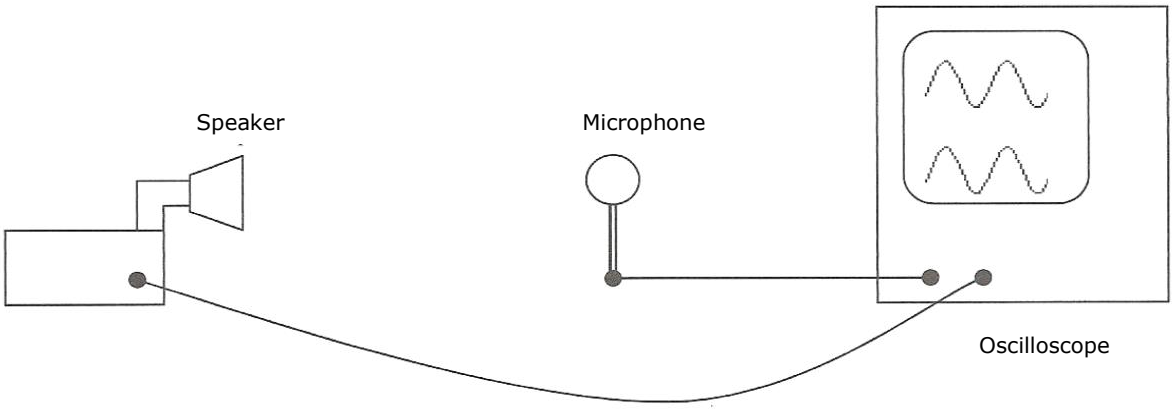


Figure 5

The microphone and speaker are then placed in a polystyrene cooler which acts as an insulated environment to control the temperature of the air inside. The temperature inside the cooler is changed and the experiment is repeated.

The following results were obtained:

Temperature (°C)	Speed of sound (m/s)
0	331
10	337
20	343
25	346
30	349
40	355

i. Plot a graph of speed of sound (m/s) on the y-axis against temperature (°C) on the x-axis. (5)

ii. State what can be concluded from the graph.

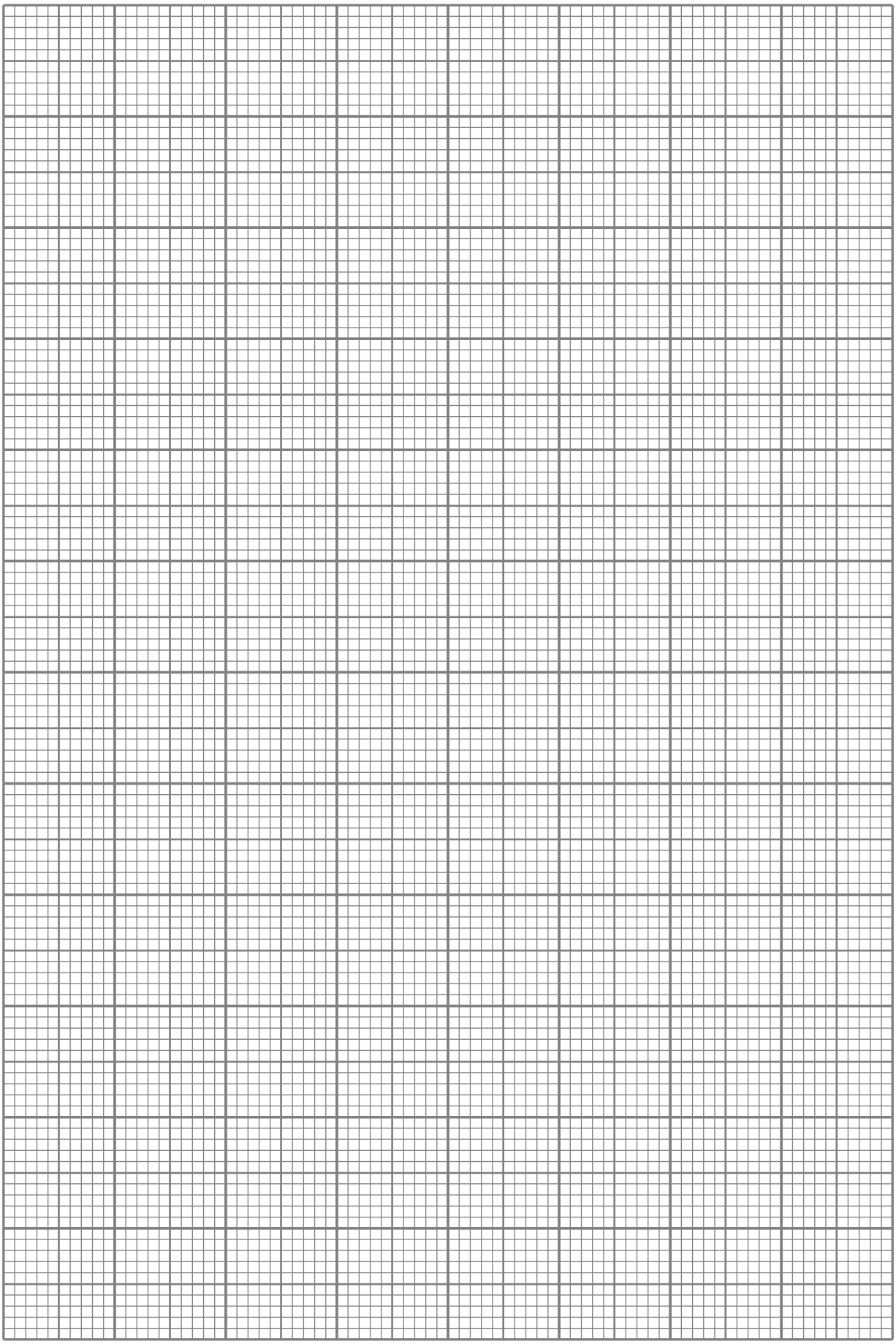
_____

_____ (1)

iii. Explain the conclusion in terms of the movement of air molecules.

_____

_____ (1)



b. Water waves are transverse waves. Sound waves are longitudinal waves.

i. Explain the difference between a transverse wave and a longitudinal wave. Include labelled diagrams in your answer in the space provided.

_____

_____

_____

_____(4)

ii. Explain what is meant by a mechanical wave.

_____(1)

c. Figure 6 shows a tennis coach using a speed gun to measure how fast the player serves the ball.

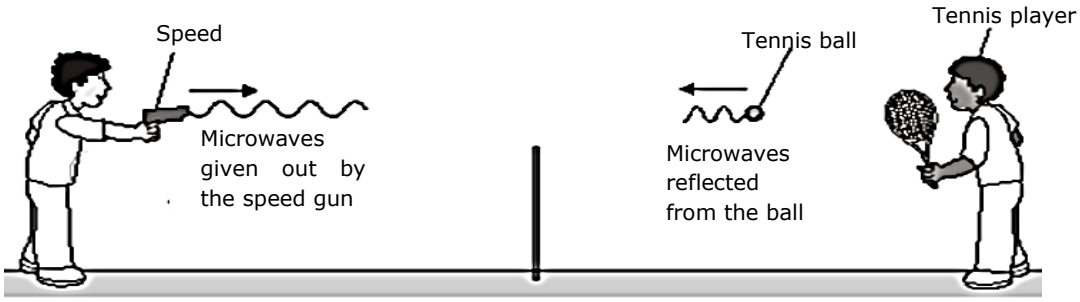


Figure 6

i. The microwaves transmitted by the speed gun have a frequency of 2.4 x 10^{10} Hz and a wavelength of 0.0125 m. Calculate the speed of the microwaves emitted from the speed gun.

_____

_____ (2)

ii. Underline the correct word in each bracket to complete the following statement.

Some of the microwaves transmitted by the speed gun are absorbed by the ball and its temperature (increases/decreases). This causes the average speed of the particles in the ball to (increase/decrease). (1)

(Total: 15 marks)

Section C

10. This question is about moments.

a. Complete the following statement.

The Law of Moments states that for a body in equilibrium,_____

_____ (1)

b. Describe an experiment to prove the law of moments.
Your answer should include:

- a labelled diagram of the set-up used; (2)
- a brief account of the method followed; (3)
- **ONE** precaution taken; (1)
- the measurements taken and how these were used in the calculations. (2)

_____

_____

_____

_____

_____

_____

_____

_____

c. State the **ONE** condition for a body to be in equilibrium, apart from the law stated in part (a).

_____

_____ (1)

This question continues on the next page.

d. A uniform beam of length 2.8 m is supported at its centre and has a 150 N weight placed 1.1 m from the left end of the beam. An unknown weight W is placed 1.2 m from the right end. Calculate the value of W, given that the beam is in equilibrium.

_____

_____

_____

_____ (5)

(Total: 15 marks)

11. This question is about thermal energy.

a. Figure 7 shows a fridge with a freezer compartment. The temperature of the air inside the freezer compartment is –18 °C. Underline the correct word in the brackets for (i) to (iii).

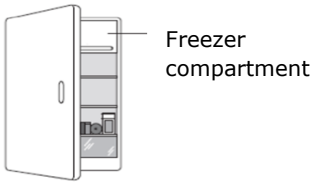


Figure 7

When the air near the freezing compartment is cooled, the:

i. energy of the air particles is (unchanged, decreased, increased); (1)

ii. spaces between the air particles are (unchanged, decreased, increased); (1)

iii. density of the air is (unchanged, decreased, increased). (1)

b. Describe how the air inside the freezer compartment exerts pressure when the freezer is closed.

_____

_____(2)

c. Figure 8 shows a moving metal grid. Uncooked biscuits are placed on the grid, and they are cooked as they pass between two hot electrical heating elements inside an oven.

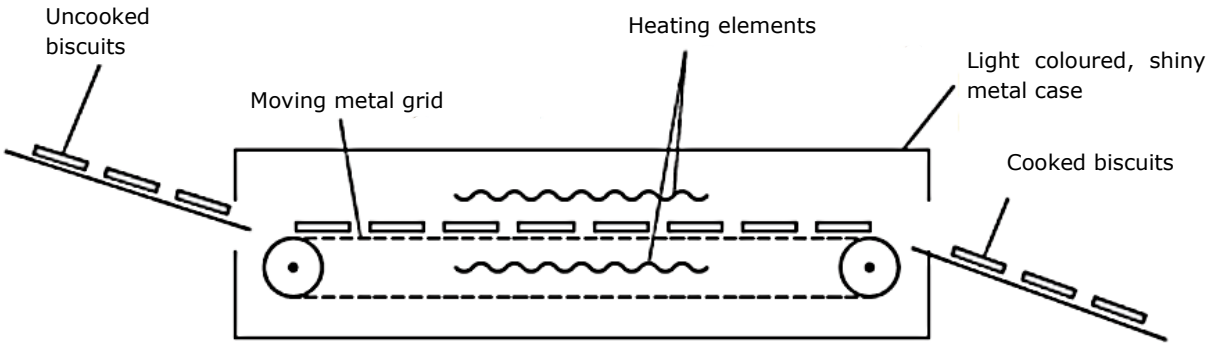


Figure 8

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

This question continues on the next page.

i. Thermal radiation is one type of heat transfer. Define radiation.

_____(1)

ii. The biscuits absorb the infra-red radiation emitted by the heating elements and are cooked, hence turning brown. State another use of infra-red radiation.

_____(1)

iii. The inside surfaces of the oven are light-coloured and shiny. If a dark, matt surface is used instead of a shiny, light-coloured surface, describe the changes, if any, in the rates of emission and absorption of heat.

_____

_____

_____(2)

iv. Convection currents are also created inside the oven. Define convection.

_____(2)

d. Figure 9 shows the direction of heat transfer through a single-glazed window.

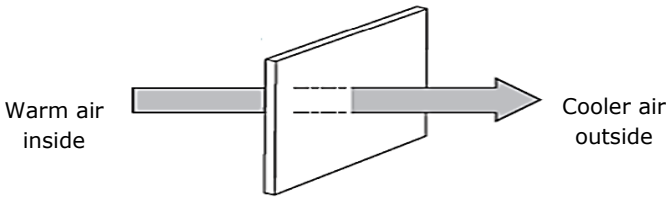


Figure 9

i. Heat is transferred as shown by conduction. Define conduction.

_____(2)

ii. A homeowner plans to replace the single-glazed windows in his home with double-glazed windows. These are made with two panes of glass separated by a gap filled with air or argon gas as shown in Figure 10.
Explain why these gases are used to fill the gap.

_____

_____

_____ (2)

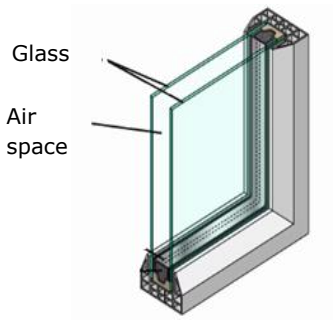


Figure 10

(Total: 15 marks)

Please turn the page.

12. This question is about electricity and magnetism.

a. The circuit in Figure 11 shows three resistors connected to a 12 V battery. A current of 2 A flows through the circuit as shown.

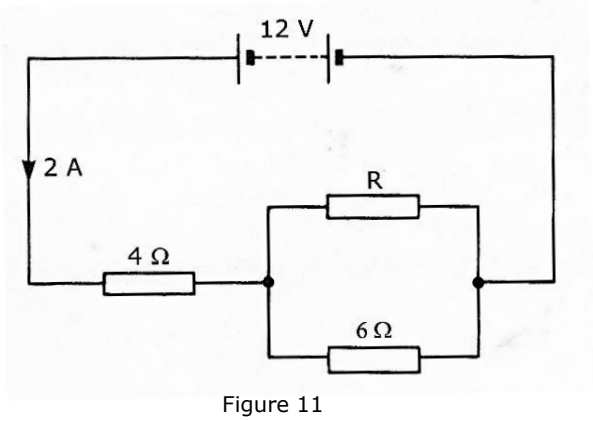


Figure 11

i. Calculate the potential difference across the 4 Ω resistor.

_____

_____(2)

ii. Determine the p.d. across the 2 resistors in parallel combination.

_____ (1)

iii. Calculate the current passing through the 6 Ω resistor.

_____(2)

iv. Calculate the resistance of resistor R.

_____

_____ (2)

b. A socket like the one shown in Figure 12 is connected in a room's ring main circuit and is protected by a circuit breaker. An appliance rated at 1500 W, 230 V, is connected to the socket.

i. State why a circuit breaker is necessary in this situation.

_____ (1)

Figure 12

ii. Determine the current passing through the appliance when switched on.

_____

_____ (2)

iii. A fuse is to be connected in the plug of this appliance. Identify the appropriate fuse rating based on the calculation in part (ii). _____ (1)

c. Figure 13 shows a permanent magnet with its poles labelled and placed on a spring. Between its poles as shown is a fixed horizontal wire whose ends are connected to a sensitive galvanometer. When the magnet is pushed down a little and released, the spring causes it to oscillate upwards and downwards.

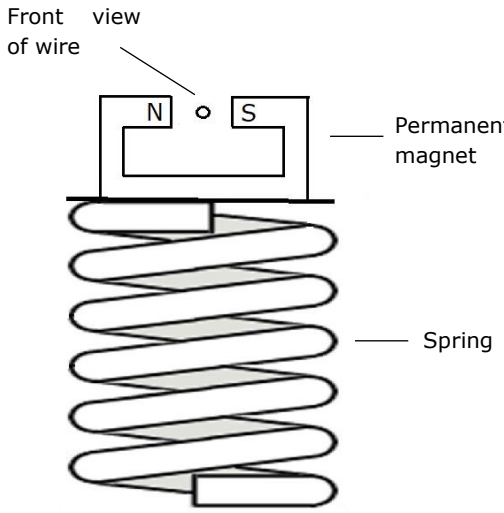


Figure 13

i. State Faraday's law.

_____

_____ (2)

ii. Explain what is observed on the galvanometer as the magnet moves upwards and downwards.

_____

_____ (2)

(Total: 15 marks)

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