Index Number:_____ SEC24/1L1-2-3.26m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2026 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I – Level 1-2-3
DATE:	16th May 2026
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	$p = \frac{F}{A}$ $\quad p = h \rho g$
Moments	Moment = F × perpendicular distance
Energy and Work	$PE = m g h$ $\quad KE = \frac{1}{2} m v^2$ $\quad W = F s$ $\quad P = \frac{E}{t}$
Force and Motion	resultant force = m a $\quad W = m g$ $\quad p = m v$ $\quad F = \frac{(mv-mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$ $\quad v = u + a t$ $\quad s = (u + v)\frac{t}{2}$
	$v^2 = u^2 + 2 a s$ $\quad s = u t + \frac{1}{2} a t^2$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$ $\quad \eta = \frac{\text{real depth}}{\text{apparent depth}}$
	Magnification = $\frac{\text{image height}}{\text{object height}}$ $\quad$ Magnification = $\frac{\text{image distance}}{\text{object distance}}$
	$v = f\lambda$ $\quad T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $\quad V = I R$ $\quad P = I V$
	$E = Q V$ $\quad E = I V t$
	$R_{total} = R_1 + R_2 + R_3$ $\quad \frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $\quad V_p I_p = V_s I_s$
Heat	$Q = m c \Delta\theta$
Radioactivity	$A = Z + N$
Other equations	Area of a triangle = $\frac{1}{2}$ b h $\quad$ Area of a trapezium = $\frac{1}{2}$ (a + b) h

(For examiners' use only)

Question	1	2	3	4	5	6	7	Total
Marks								

Section A

1. a. Draw arrows on Figure 1 to show **ONE** way of how work can be done on the box, showing both the force applied and the distance moved. (2)

Figure 1

b. Fill in with the correct word: _____ is the ability to do work. (1)

c. Write down the SI units of:

work _____ power _____ (2)

d. Describe an experiment to determine personal power. Your answer should include:

i. a diagram in the space provided below; (1)

ii. a brief experimental procedure including the measurements to be taken and the instruments used;

_____

_____

_____

_____(2)

iii. **ONE** suitable precaution;

_____(1)

iv. the formulae showing how the power is calculated.

_____

_____(2)

e. Fill in the blanks with the relevant forms of energy to show the energy transformations in this experiment.

_____ energy stored in food makes it possible for muscles to move the body and give it _____ energy. As a person is climbing upstairs this energy is converted into _____ energy. _____ energy is also produced which is essential to maintain a constant body temperature. (4)

(Total: 15 marks)

2. a. John uses lenses to create different images.

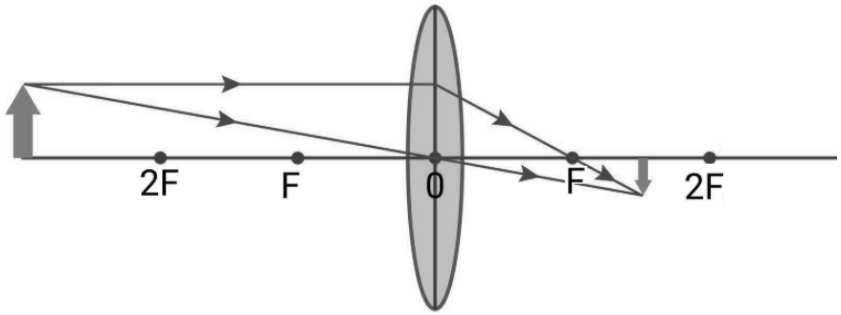


Figure 2

i. Mark on Figure 2 the image distance by means of a line and label it 'v'. (1)

ii. Mark on Figure 2 the object distance by means of a line and label it 'u'. (1)

iii. What is this type of lens called? _____ (1)

iv. Is the image produced in Figure 2 above real or virtual? _____ (1)

v. How can one distinguish between these two types of images?

_____(1)

vi. In one experiment, the object height is 3 cm and the image height is 1.8 cm. Calculate the magnification.

_____

_____(2)

vii. State an application for the above setup.

_____(1)

b. John needs to increase the object distance.

i. Explain how this can be done.

_____(1)

ii. How can he find the new image distance?

_____

_____(2)

c. John wants to show that if the object distance decreases the image distance increases. How can he do this?

_____

_____(1)

d. List **ONE** precaution taken specifically for this experiment.

_____(1)

e. When the object distance is decreased below a certain value, the image disappears from the screen. John concludes that there is no image formed. Is he correct? Explain.

_____

_____(2)

(Total: 15 marks)

3. Maria received a gold ring for her birthday. She calculated its density to verify that it was really made of gold.

a. Define density.

_____(1)

b. Describe how she can find the density of the ring, with the aid of a diagram.

_____

_____

_____

_____

_____(4)

c. Identify the SI unit of the following physical quantities:

Mass _____; Volume _____; Density _____ (3)

d. The ring has a mass of 5 g and a volume of 0.259 cm^3. Calculate its density in SI units.

_____

_____

_____

_____(3)

e. Table 1 shows a list of densities for different materials.

Table 1

Material	Density (g/cm^3)
Steel	7.85
Oak wood	0.59
Copper	8.91
Water	1.00
Oil	0.80

i. List **ONE** material that will float on water. _____(1)

ii. Explain your answer.

_____ (1)

iii. List **ONE** material that will sink in oil. _____ (1)

iv. Explain your answer.

_____ (1)

(Total: 15 marks)

Please turn the page.

4. a. Complete table 2 using the following: (3)

Ω **Ampere** **V** **A** **Ohm** **Volt**

Table 2

Quantity	SI Unit	Symbol of SI Unit
Current		
Voltage		
Resistance		

b. State whether the following statements are True (T) or False (F).

- A wire of diameter 2 mm has a higher resistance than one of the same material and length with a 6 mm diameter. _____ (1)
- The resistance of a wire increases when its temperature decreases. _____ (1)

c. Two students were investigating the relationship between the resistance of a conductor and its length.

i. Draw a labelled diagram of the circuit used to carry out this investigation. (4)

ii. Explain **ONE** precaution the students should take.

_____

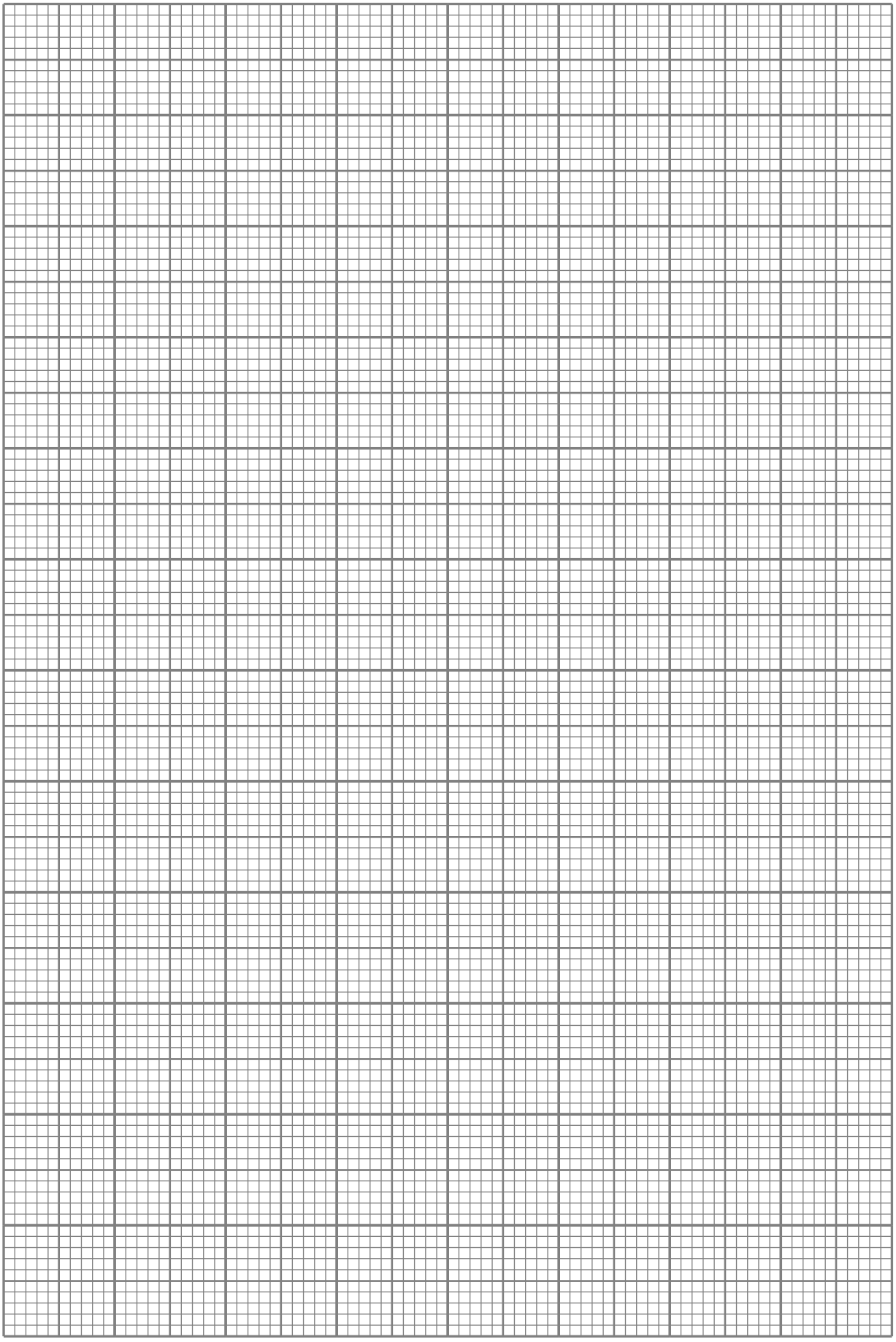
_____(2)

d. Table 3 shows the results obtained during the experiment. Plot a graph of Resistance on the y-axis against Length on the x-axis. (4)

Table 3

Length / m	0.1	0.2	0.3	0.4	0.5	0.6
Resistance / Ω	0.3	0.7	0.9	1.1	1.4	1.8

(Total: 15 marks)



5. Figure 3 shows a cordless speaker which Carla and Sean bought so that they can listen to music. It makes use of an electromagnet.

a. Draw a labelled diagram of an electromagnet. (2)

Figure 3

(Adapted from www.freepik.com)

During their Physics lesson, Carla and Sean were investigating how the strength of an electromagnet is attracting metal pins depends on:

- the current (Part A);
- the number of turns in the coil (Part B).

b. Draw **TWO** labelled diagrams of the setups required to carry out both parts of this investigation. (3)

c. List **TWO** precautions that they should take.

_____

_____ (2)

Tables 4 and 5 show the results obtained.

Table 4

Part A						
Current / A	0	0.4	0.8	1.2	1.6	2.0
Number of metal pins attracted	0	3	7	13	16	22

Table 5

Part B					
Number of turns in the coil	0	50	100	200	400
Number of metal pins attracted	0	9	22	38	56

d. From the above tables, draw **ONE** conclusion related to the number of pins attracted for **each** part of the investigation.

_____

_____(2)

e. Explain the conclusions mentioned in part (d) in relation to the strength of the electromagnet for **each** part of the investigation.

_____

_____(2)

f. List **TWO** other applications where electromagnets are used.

_____

_____(2)

g. Compare **TWO** properties of permanent magnets and electromagnets.

_____

_____(2)

(Total: 15 marks)

Please turn the page.

Section B

6. a. State the SI unit of pressure _____ (1)

b. Describe an experiment to determine the pressure a person exerts on the ground when standing on both feet. Assume the person is wearing flat footwear and that graph paper is available.
Your answer should include the experimental procedure, the measurements taken and instruments used, and how the pressure is calculated. A diagram is **not** necessary.

_____

_____

_____

_____

_____

_____(5)

c. Football shoes normally have several studs (also known as spikes or cleats) at the bottom of the shoe as shown in Figure 4.

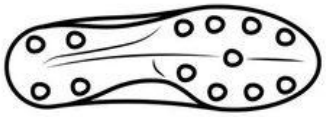


Figure 4

Underline the correct word from **each** bracket in the following statement:

These studs help to (decrease / increase) the area of the shoe in contact with the ground and because of this the pressure exerted on the ground (decreases / increases). This helps to (decrease / increase) the friction with the ground and ensures a better grip when the footballer is running.

(3)

d. Figure 5 shows a hydraulic system showing a piston in a cylinder at both ends and a pipe connecting both cylinders together.

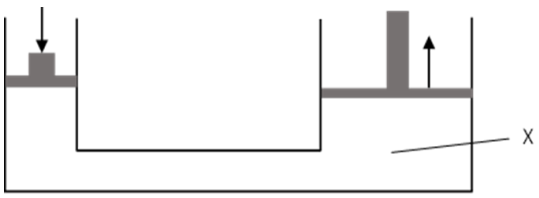


Figure 5

i. What is the space labelled X filled with?

_____ (1)

ii. Fill in the blanks to complete the following statement:

Hydraulic systems work because _____ is transmitted _____ in all directions. (1)

iii. Give **TWO** practical applications where a hydraulic system is used in a machine.

_____

_____ (2)

(Total: 13 marks)

7. The students of Year 10 were participating in a science fair. They charged a balloon, which is an insulator, and then placed it close to someone's hair to demonstrate static electricity.

a. Explain how charging the balloon by friction involves the movement of negative charges.

_____

_____(2)

b. Polythene and acetate can also be charged by friction. State the charge they acquire.

Polythene - _____ Acetate - _____ (2)

c. State the conditions for electrical attraction and repulsion between charges.

_____

_____(2)

d. State what happens when the balloon is placed close to human hair. Explain the observation.

_____

_____(2)

e. List **TWO** uses of static electricity.

_____

_____

_____(2)

f. A metal sphere resting on an insulated stand is charged negatively. Describe how the sphere can be made neutral through earthing.

_____

_____ (2)

(Total: 12 marks)

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SECONDARY EDUCATION CERTIFICATE LEVEL
2026 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	II – Level 1-2
DATE:	16th May 2026
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		

(For examiners' use only)

Question	1	2	3	4	5	6	7	8	9	10	11	12	Total
Marks													

Section A

1. The diagram shows a car travelling in the forward direction. Point C represents the center of mass of the car.

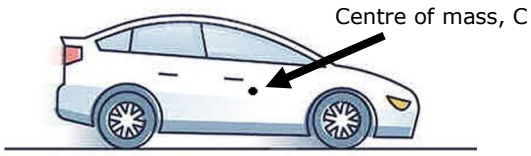


Figure 1

a. Define center of mass.

_____(1)

b. On Figure 1, draw an arrow to show the:
   i. weight of the car labelled W;
   ii. air resistance on the car labelled R. (2)

c. At one point the forward force exerted by the engine is 4000 N while the air resistance is 2500 N.
   i. Calculate the resultant force acting on the car.

_____(1)

   ii. State the type of motion of the car at this point.

_____(1)

(Total: 5 marks)

2. Figure 2 shows a section of a rollercoaster in an amusement park. One cart on this rollercoaster having a total mass of 400 kg starts from rest at A and moves towards B. As it reaches D brakes are applied and the cart comes to a complete stop at E.

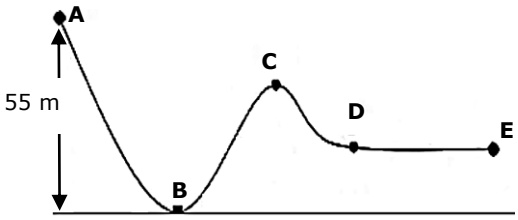


Figure 2

a. State the type or types of energy possessed by the cart at:

   B _____ and C _____ (2)

b. Calculate the gravitational potential energy of the cart at A which is 55 m above ground level.

_____

_____(2)

c. In which direction, D to E or E to D, is the frictional force on the cart acting as it comes to rest?

_____(1)

(Total: 5 marks)

3. Figure 3 shows a right-angled isosceles prism.

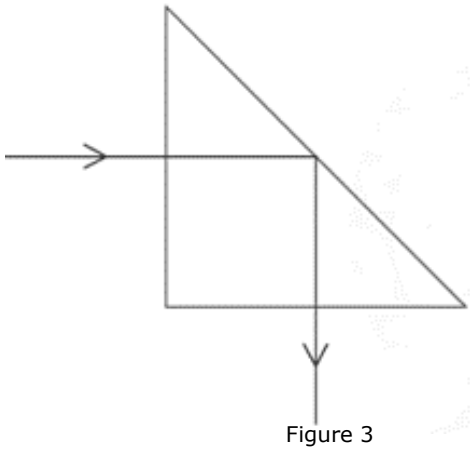


Figure 3

totally internally reflected	smaller	fibre optics	larger	light	sound	normal	critical	incident	refraction

Fill in the blanks using any of the above to complete the following paragraph describing the situation in Figure 3.

The light ray meets the first boundary and keeps going through undeviated because it enters along the _____. At the second boundary, the light ray is _____ because the angle of incidence is _____ than the _____ angle. The same phenomenon occurs in _____ and is used to carry energy with minimal energy loss. (5)

(Total: 5 marks)

4. In Xwejni, Gozo, salt is produced by trapping sea water in large, shallow ponds and letting the water evaporate. The leftover salt is then collected.

Figure 4
(Adapted from Flickr.com)

Please turn the page.

a. Underline the correct answer in the brackets:

One main factor that affects the rate of evaporation from the surface of the sea water is (mass, density, temperature). (1)

b. What happens to the energy of the water molecules remaining in the salt pans after surface molecules evaporate? _____ (1)

c. State why the ponds used in this process have large surface areas.

_____ (1)

d. State the effect of air humidity on the rate of evaporation. _____ (1)

e. Name the appropriate state of matter from solid, liquid and gas in the following situations.

i. A _____ has a fixed volume but no fixed shape. (1)

ii. A _____ has very loosely packed particles. (1)

(Total: 6 marks)

5. a. Fill in the blanks with the correct word to complete the following statements.

Heating can be described as an _____ transfer due to a temperature difference.

It flows from a _____ temperature to a _____ temperature. (2)

b. Boiling water was poured into a drinking glass to make some tea and the glass cracked. Identify whether the glass expanded or contracted in this case.

_____(1)

c. Boiling water is poured into a similar drinking glass containing a metal spoon. The spoon absorbs some of the thermal energy. State whether metal is a conductor or an insulator of heat.

_____(1)

(Total: 4 marks)

6. a. Figure 5 shows a simple circuit. Redraw the circuit using the appropriate circuit symbols in the space provided next to Figure 5. (2)

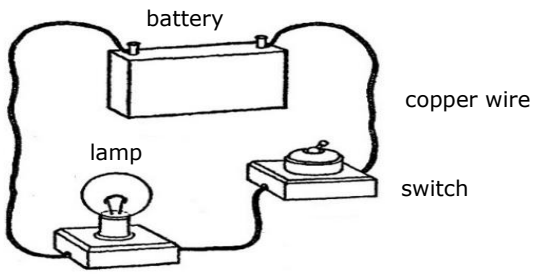


Figure 5 (*Adapted from pinterest.com)*

b. Describe current.

_____(1)

c. On the circuit drawn in part (a), draw the direction of the conventional flow of current. (1)

d. Underline the correct word in the following statement:

If a battery of half the voltage is used, the current in the above circuit will (remain the same, approximately double, approximately decrease by half). (1)

(Total: 5 marks)

7. The human body contains a small amount of $^{40}_{19}K$ which is a radioactive isotope of potassium. This isotope decays by emitting a β particle and has a half life of 1.2×10^9 years.

a. What does a β particle consist of? _____ (1)

b. What charge does a β particle have? _____ (1)

c. Explain what is meant by the term half-life of a radioactive substance.

_____(1)

d. Name the apparatus used to detect ionizing radiation.

_____(1)

e. Radiation from $^{40}_{19}K$ is one source of background radiation. State another source of background radiation. _____ (1)

(Total: 5 marks)

8. a. Describe **ONE** feature of our earth which distinguishes it from other planets in our solar system.

_____ (1)

b. Distinguish between a natural and an artificial satellite.

_____

_____(1)

c. Name the instruments used to observe the universe. _____ (1)

d. An astronomer was explaining to his audience that when one observes the night sky one is looking at events which happened ages ago. Explain why this is so.

_____(1)

e. Underline the correct word: A light-year is a measure of (speed / distance / time). (1)

(Total: 5 marks)

Section B

9. a. A force applied to a body can have different effects on the body. State **TWO** of these effects.

_____ (2)

b. Name the instrument used to measure each of these two quantities.

mass: _____ weight: _____ (2)

c. Students in a Physics lab are asked to investigate the stretching of a spring. They use the apparatus shown in Figure 6.

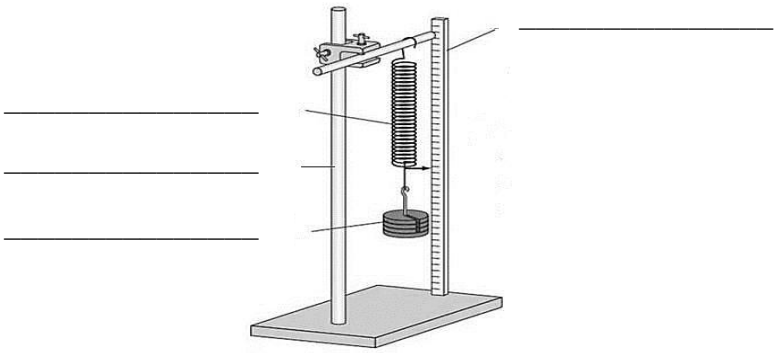


Figure 6
(http://digestiblenotes.com)

i. Label the **FOUR** items indicated in the setup. (2)

ii. State Hooke's Law.

_____

_____(1)

iii. State **ONE** main precaution to be taken to ensure accurate results.

_____(1)

d. The results obtained were tabulated as shown below.

Table 1

stretching force (N)	1.7	3.5	5.3	7.0	8.8	10.5
extension (mm)	12	25	38	50	63	75

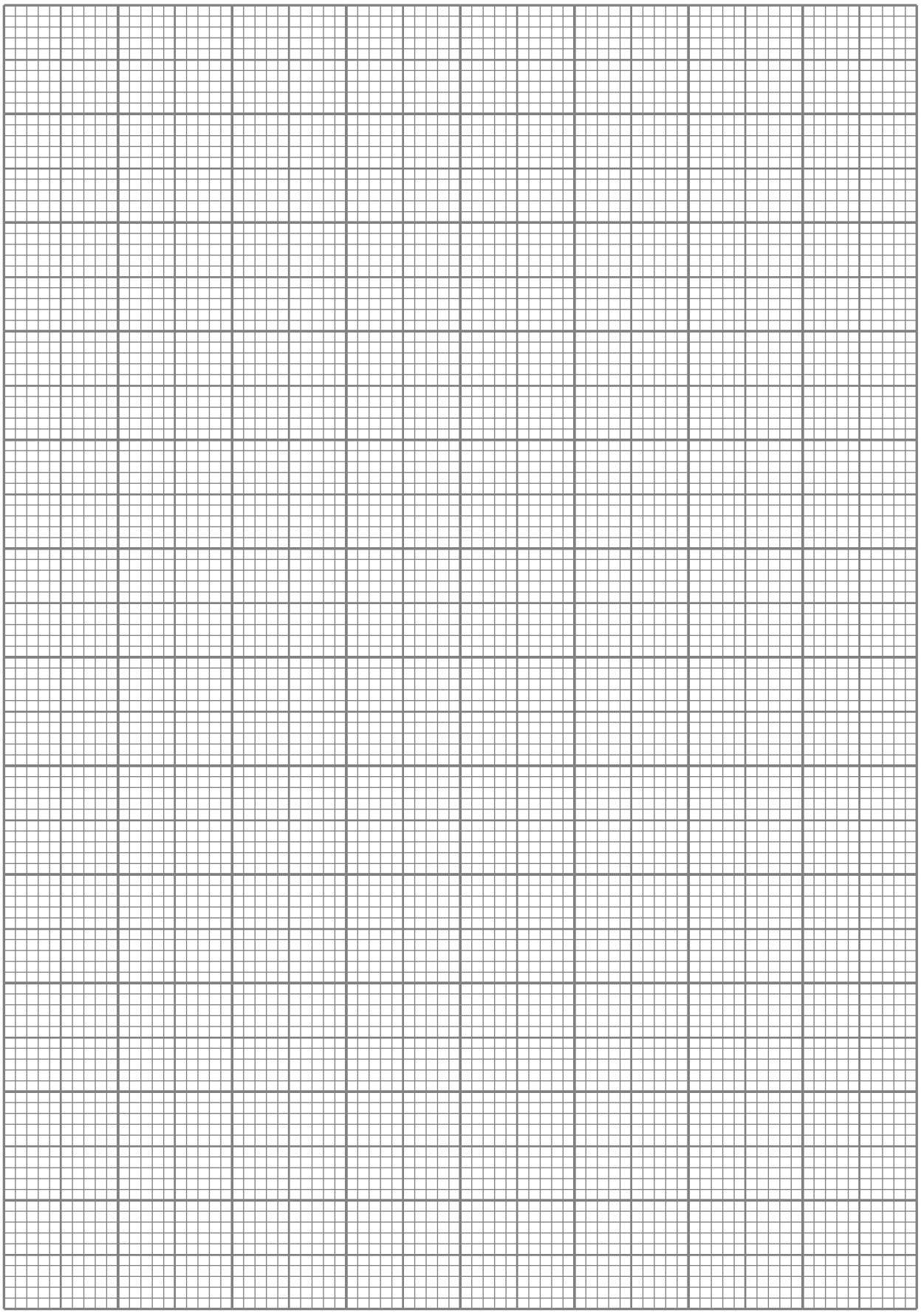
Plot a graph of stretching force (y-axis) against extension (x-axis). (5)

e. Define the term elastic limit.

_____(1)

f. Based on Hooke's Law stated above, identify whether the elastic limit was exceeded in this experiment. _____ (1)

(Total: 15 marks)



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Section C

10. An incident ray reaches a plane mirror as shown in Figure 7.

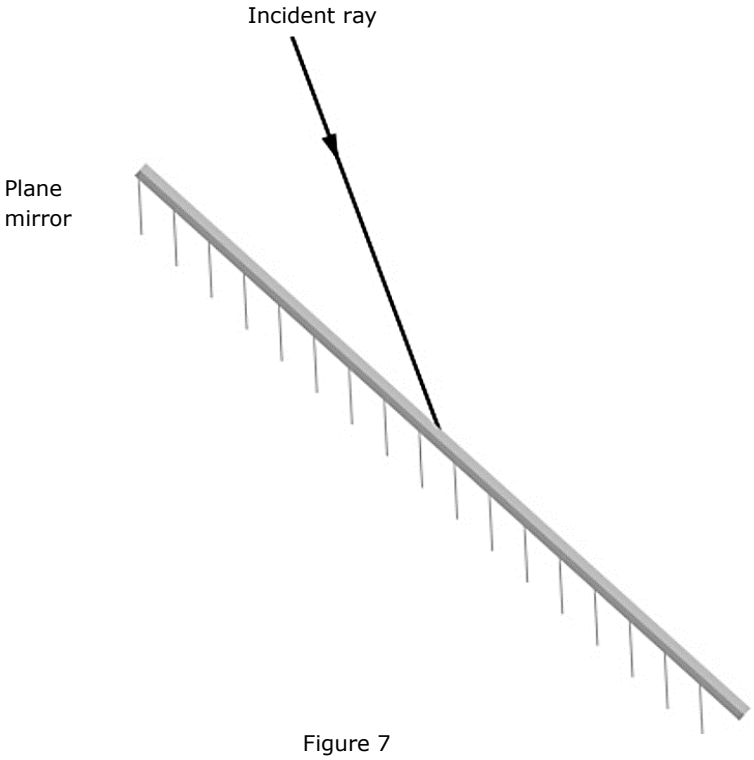

Figure 7

a. i. Draw the normal on the mirror. (1)
ii. Continue the path of the ray of light in Figure 7 after it reaches the mirror. (1)
iii. Label the angle of incidence with an 'i'. (1)
iv. Label the angle of reflection with an 'r'. (1)

b. List the **THREE** properties of images formed by plane mirrors.

_____

_____

_____(3)

c. State whether the following statements refer to a sound wave or a light wave.

i. Travels through a vacuum. _____ (1)

ii. An echo is a reflection of this wave. _____ (1)

iii. This wave is longitudinal. _____ (1)

iv. Forms part of the electromagnetic spectrum. _____ (1)

d. Pico laser treatment uses ultra-short pulses of laser energy to break down pigment in the skin, treating issues like sunspots, acne scars, tattoos, and fine lines with minimal heat damage to surrounding tissue. This technology uses light beams with a wavelength of 5.32×10^{-7} m and has a frequency of 5.4×10^{14} Hz.

i. Calculate the speed of these waves.

_____

_____(2)

ii. Calculate the period of the wave.

_____

_____(2)

(Total: 15 marks)

11. Christa bought a new home appliance with a metal body. The appliance did not have a three-pin plug installed.

a. Explain the function of these three wires.

Live: _____ (1)

Neutral: _____(1)

Earth: _____ (1)

b. Christa was going to install the three-pin plug herself. She found the following two diagrams which show how the wires should be connected in the plug. In the figure below circle the three-pin plug which is wired correctly. (1)

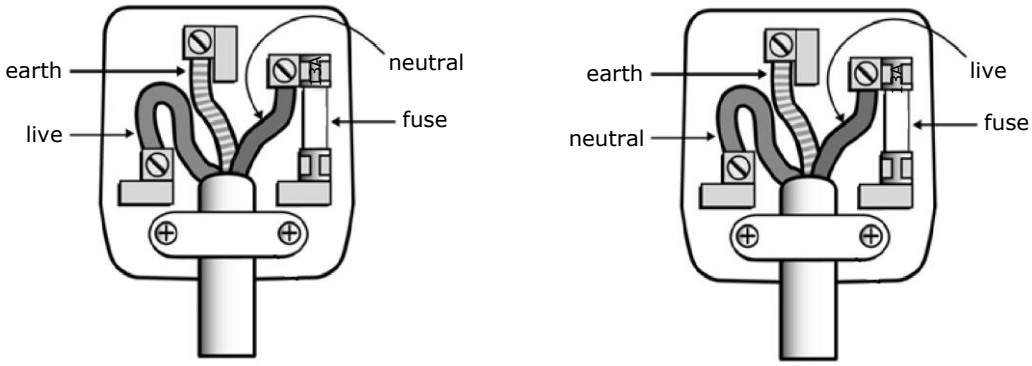

Figure 8
(adapted from futurehousestore.co.uk)

This question continues on next page.

c. The plug includes a fuse with a rating of 13 A. Explain why fuses have different ratings.

_____

_____(2)

The following values were written on Christa's appliance.

Current – 10 A

Resistance – 24 Ω

d. Describe resistance.

_____(1)

e. Christa wanted to know the power rating of the appliance she bought. Define electrical power.

_____(1)

f. Calculate the voltage of the appliance.

_____

_____(2)

g. Find the electrical power of the appliance.

_____

_____(2)

Christa bought also a small appliance having a plastic body. She noticed that there was no earth wire.

h. Explain why the small plastic appliance does not need an earth wire.

_____

_____(2)

i. Complete Figure 9 to show how the wall plug in a ring circuit is wired. One of them is already completed. (1)

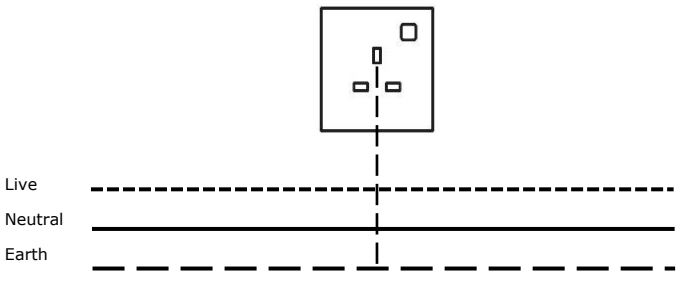

Figure 9

(Total: 15 marks)

12. Bank cards have a magnetic stripe which is used to store information.

a. Distinguish between magnetic and non-magnetic materials.

_____

_____(2)

b. Describe **ONE** method which can be used to create a permanent magnet.

_____

_____(2)

c. Describe the property of permanent magnets.

_____

_____(1)

d. Describe a magnetic field.

_____

_____(2)

e. Describe a simple experiment which can be made to demonstrate the magnetic field around a bar magnet.

_____

_____

_____ (3)

f. Draw a diagram of the magnetic field which results from the experiment in part (e). (1)

g. Describe **TWO** simple day practices that can cause a magnet to demagnetise.

_____

_____ (2)

This question continues on next page.

h. Draw the magnetic field lines around the following two bar magnets. (2)

(Total: 15 marks)

Index Number:_____ SEC24/2L2-3.26m

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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2026 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	II – Level 2-3
DATE:	16th May 2026
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		

(For examiners' use only)

Question	1	2	3	4	5	6	7	8	9	10	11	12	Total
Marks													

Section A

1. Figure 1 shows a long ruler that can be used to determine the value of human reaction time. S represents the zero mark on the ruler.

a. Describe the method used and the measurement taken.

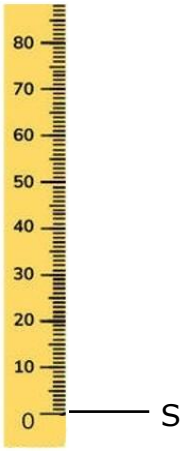


Figure 1

_____

_____

_____ (3)

b. State **ONE** main precaution to be taken.

_____ (1)

c. State the formula used to determine the reaction time. Note that there is no need to make the reaction time the subject of the formula.

_____ (1)

(Total: 5 marks)

2. Figure 2 shows a section of a rollercoaster in an amusement park. A cart on this rollercoaster of mass 400 kg starts from rest at A and moves towards B. As it reaches D, brakes are applied and the cart comes to a complete stop at E.

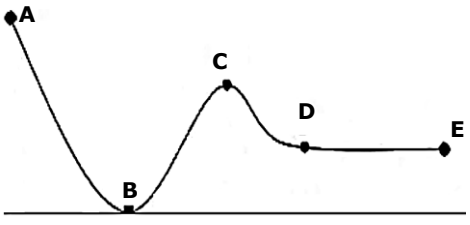


Figure 2

a. The gravitational potential energy of the cart at A is 400 kJ. Ignoring energy losses, calculate the speed of the cart at B.

_____

_____

_____(3)

b. The kinetic energy of the cart at D is 300 kJ and the distance DE is 40 m. Calculate the value of the total frictional forces on the cart between D and E as it comes to rest.

_____

_____

_____(2)

(Total: 5 marks)

3. Pico laser treatment uses ultra-short pulses of laser energy to break down pigment in the skin, treating issues like acne scars and tattoos. This technology uses light beams with a wavelength of 5.32×10^{-7} m which travel at 3×10^{8} m/s.

a. Calculate the frequency of the waves.

_____

_____(2)

b. Find the periodic time of the waves.

_____

_____(2)

c. Describe with the aid of a diagram how to generate a transverse wave on a slinky spring.

_____(1)

(Total: 5 marks)

Please turn the page.

4. In Xwejni, Gozo, salt is produced by trapping sea water in large, shallow ponds and letting the water evaporate. The leftover salt is then collected from the saltpans shown in Figure 3.

Figure 3 *(Adapted from Flickr.com)*

a. Underline the correct answer in the brackets:

Evaporation occurs from the (bottom, surface, middle) of the water at (0 °C, any temperature, 100 °C). (2)

b. Describe, in terms of molecules, what happens as the water evaporates.

_____ (1)

c. Sea breezes often occur in such places. Explain how these are formed.

_____

_____ (2)

(Total: 5 marks)

5. a. Describe the term heating.

_____

_____ (2)

b. Describe how changes in thermal energy result in expansion.

_____

_____ (2)

c. Identify **ONE** practical situation where expansion occurs due to changes in thermal energy.

_____

_____ (1)

(Total: 5 marks)

6. a. Define the kilowatt hour.

_____(1)

b. A washing machine uses 3.24 MJ per cycle. Calculate the energy used by the machine in 4 cycles in kWh.

_____

_____ (2)

c. If the cost of 1 kWh is 15 c, calculate the cost for using the machine to make 4 cycles.

_____

_____(2)

(Total: 5 marks)

7. a. $^{40}_{19}K$ is one isotope of potassium. Underline which of the following options represents another isotope of potassium: $^{39}_{19}X$ $^{40}_{20}Y$ $^{41}_{21}Z$ (1)

b. Medical tracers use radioactive isotopes that emit ionising radiation, which can harm the body. Underline the type of radiation emitter that would be safest to use.

α emitter β emitter γ emitter (1)

c. Describe an experiment to determine the corrected count rate of a radioactive source.

_____

_____

_____ (3)

(Total: 5 marks)

8. a. Distinguish between natural and artificial satellites.

_____

_____(1)

b. Polar orbit satellites and geostationary satellites orbit the Earth. Complete Table 1 to distinguish between these two types. Numerical values are **not** required. (2)

Table 1

Type of satellite	Distance from Earth	Duration of orbit
Polar orbit		
Geostationary		

c. Space observation telescopes like the Hubble and James Webb telescopes have been put in orbit around earth to observe the universe. State **ONE** advantage and **ONE** disadvantage that such telescopes have as opposed to terrestrial telescopes.

Advantage: _____ (1)

Disadvantage: _____(1)

(Total: 5 marks)

Please turn the page.

Section B

9. a. Describe the difference between mass and weight.

_____

_____(1)

b. Students in a Physics lab are asked to investigate the stretching of a spring. They hang a spring from a support and load it with various weights. For each weight they measure the extension produced with the help of a ruler placed vertically beside the spring.

i. State Hooke's Law.

_____

_____(1)

ii. State **ONE** main precaution to be taken to ensure accurate results.

_____(1)

c. The results obtained were tabulated in Table 2.

Table 2

Force (N)	0	2	4	6	8	10
Extension (mm)	0	10	33	61	100	160

Plot a graph of stretching force (y-axis) against extension (x-axis). (5)

d. Was Hooke's law obeyed in this experiment? Explain how you arrived at your conclusion.

_____

_____ (2)

e. Describe what happens if the spring is loaded beyond its elastic limit.

_____ (1)

f. How would the extension produced by a given force differ if a stiffer spring was used? Hence state how the gradient of the graph for a stiffer spring plotted on the same axes would differ.

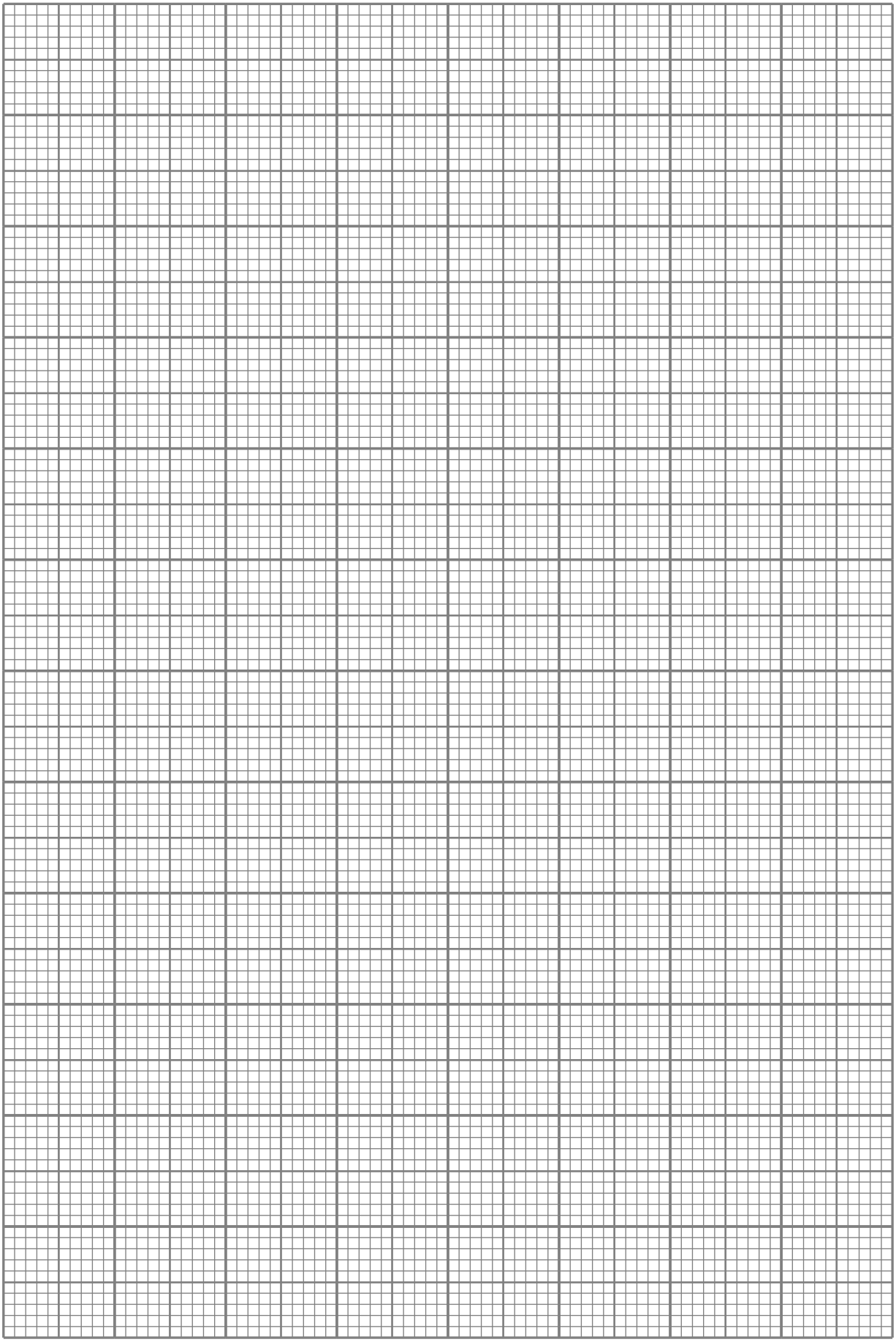
_____

_____ (2)

g. Draw and label the **TWO** main forces acting on the diagram shown in Figure 4. (2)

(Total: 15 marks)

Figure 4



Section C

10. Physicists at the University of Rochester were able to invent an invisibility shield using four mirrors strategically placed in such a way as to produce an area which becomes invisible. Anyone standing behind mirror D cannot see an object placed in the invisibility area, in front of mirror D.

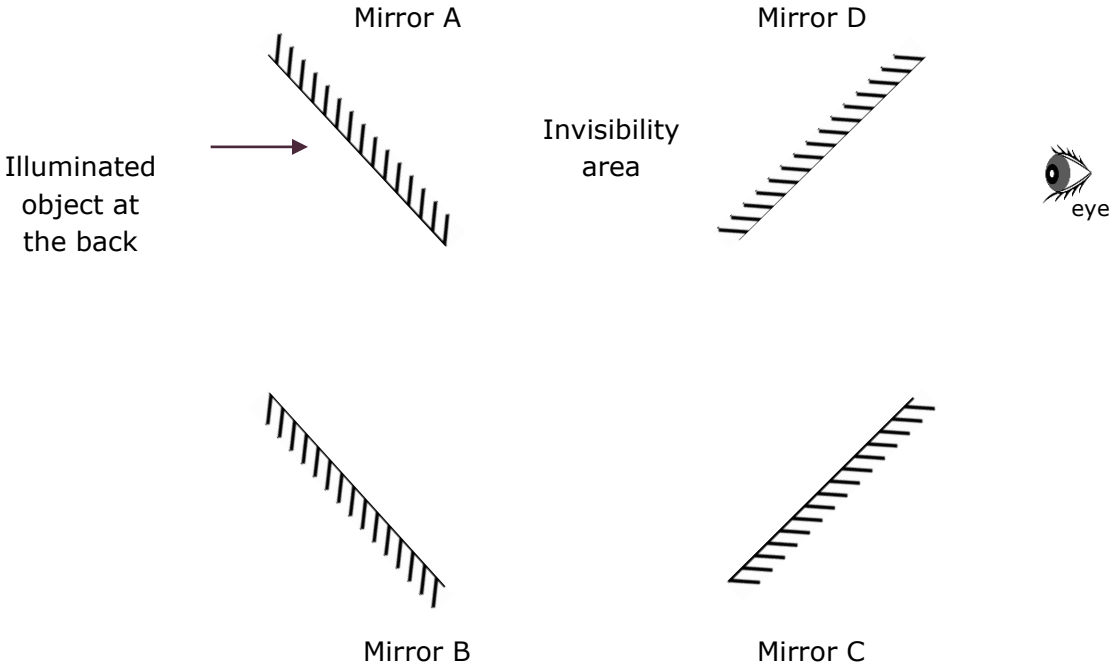


Figure 5

a. Continue the path of the ray of light in Figure 5 after it reaches mirror A. Include the normal. (2)

b. Continue the ray of light until it enters the eye. (2)

c. Discuss how an isosceles right-angle prism as the one in Figure 6 can deflect light by 180°. State **ONE** example of its use in everyday life.

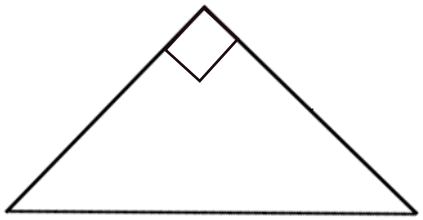


Figure 6

_____

_____

_____(2)

d. Explain the **TWO** conditions for the phenomenon present in part (c) to occur.

_____

_____ (2)

e. John conducts an experiment to find the critical angle of the semi-circular glass block shown in Figure 7.

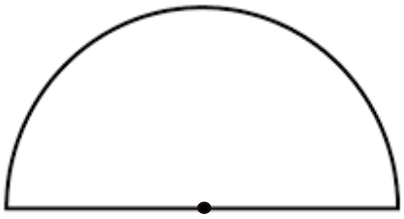


Figure 7

i. Draw and label any additional apparatus in Figure 7. (1)

ii. Explain how he can find the critical angle for the block in Figure 7.

_____

_____

_____

_____ (3)

iii. Write down **ONE** main source of error in this experiment.

_____

_____ (1)

f. Gamma waves and infrared waves, same as light, form part of the electromagnetic spectrum. Describe the source of these two regions of the electromagnetic spectrum.

- Gamma waves _____ (1)
- Infrared waves _____ (1)

(Total: 15 marks)

Please turn the page.

11. Christa bought a new home appliance with a metal body. The appliance did not have a three-pin plug installed.

a. Explain the function of these three wires.

Live: _____ (1)

Neutral: _____(1)

Earth: _____ (1)

b. Christa was going to install the three-pin plug herself. She found the following two diagrams which show how the wires should be connected in the plug. In the figure below circle the three-pin plug which is wired correctly. (1)

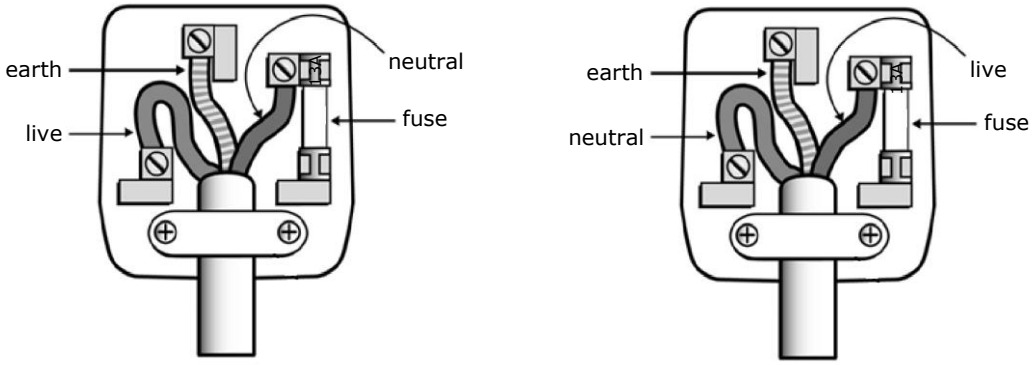


Figure 8
(adapted from futurehousestore.co.uk)

c. The plug includes a fuse with a rating of 13 A. Explain why fuses have different ratings.

_____

_____(2)

The following values were written on Christa's appliance.

Current – 10 A

Resistance – 24 Ω

d. Describe resistance.

_____(1)

e. Christa wanted to know the power rating of the appliance she bought. Define electrical power.

_____(1)

f. Calculate the voltage of the appliance.

_____

_____(2)

g. Find the electrical power of the appliance.

_____

_____(2)

Christa bought also a small appliance having a plastic body. She noticed that there was no earth wire.

h. Explain why the small plastic appliance does **not** need an earth wire.

_____

_____(2)

i. Complete Figure 9 to show how the wall plug in a ring circuit is wired. One of them is already completed. (1)

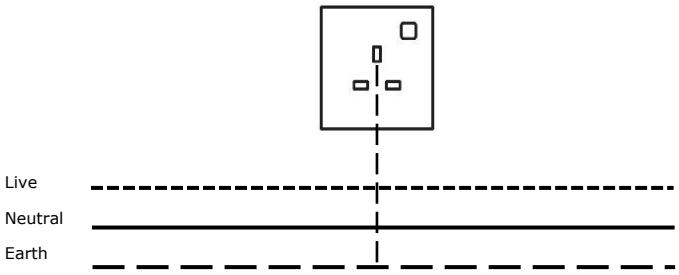


Figure 9

(Total: 15 marks)

12. The mobile phone charger, the laptop power supply, and even electrical energy distribution across the country all rely on transformers.

a. Draw a labelled diagram of the construction of a basic iron core step-up transformer. (3)

This question continues on next page.

b. Explain the following statement:
Transformers should be supplied with alternating current to function properly.

_____

_____ (2)

c. Explain how an emf is induced in the secondary coil of a transformer.

_____

_____ (2)

An ideal transformer steps 12 V up to 48 V and its secondary coil has 200 turns.

d. Distinguish between an ideal and a practical transformer.

_____

_____ (2)

e. Calculate the number of turns in the primary coil of the transformer.

_____

_____ (2)

f. If the current in the primary coil is 2.2 A, calculate the current in the secondary coil.

_____

_____ (2)

g. Explain the role of transformers when electrical energy is being transferred from the power station, through the grid, to the houses of the consumers.

_____

_____ (2)

(Total: 15 marks)