

L-Università
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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
2026 SUPPLEMENTARY SESSION**

SUBJECT:	Physics
PAPER NUMBER:	I – Level 1-2-3
DATE:	28 th August 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 = $\frac{\text{image height}}{\text{object height}}$ $\text{Magnification} = \frac{\text{image distance}}{\text{object distance}}$
	$v = f \lambda$ $T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
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	Total
Marks								

Section A

1. a. Distinguish between vectors and scalars.

_____ (2)

b. i. Identify **ONE** situation where friction is:

• an advantage: _____ (1)

• a disadvantage: _____ (1)

ii. Name **ONE** factor which affects the amount of friction between two surfaces and state **ONE** way to reduce it.

_____ (2)

c. State the **TWO** quantities which affect moment of a force.

_____ (2)

d. i. Describe briefly how the center of mass of a flat rectangular lamina can be determined using only a pencil and ruler.

_____ (2)

ii. Describe a simple experiment to find the center of mass of an irregularly shaped lamina that is swinging freely on a nail clamped to a stand. Include a diagram in the space provided.

 _____ (3)

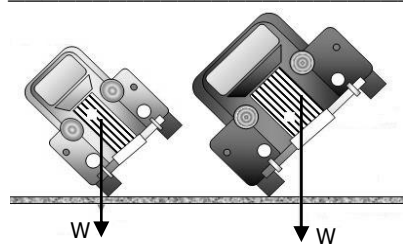


Figure 1
 (<http://schoolphysics.co.uk>)

e. By referring to Figure 1, state **TWO** factors affecting the stability of these cars.

 _____ (2)

(Total: 15 marks)

2. Zirconia is an affordable, man-made stone created in laboratories which is like diamonds with its brilliance, clear, and flawless appearance. Figure 2 shows a ray of light from a ray box incident on a semicircular zirconia block.

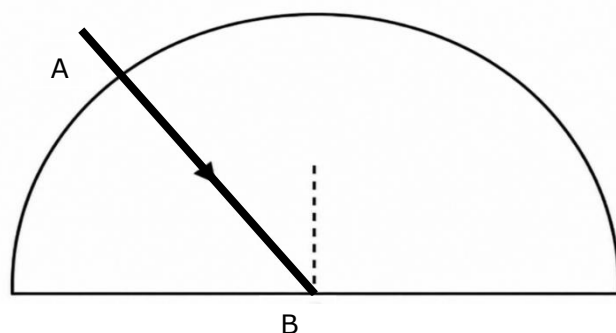


Figure 2

- a. i. Identify the angle of incidence at point B by labelling it with an 'i' on Figure 2. (1)
- ii. Continue the path of the ray of light on Figure 2, if the angle of incidence at B is smaller than the critical angle. (2)
- iii. Identify the angle of refraction at point B by labelling it with an 'r' on Figure 2. (1)
- iv. Identify **ONE** everyday situation where refraction of a light ray occurs. (1)

_____ (1)

- v. Describe how a ray box can be used to measure the critical angle at point B.

 _____ (2)

- vi. Continue the path of the ray of light in Figure 3, if it is incident at B at the critical angle. (1)

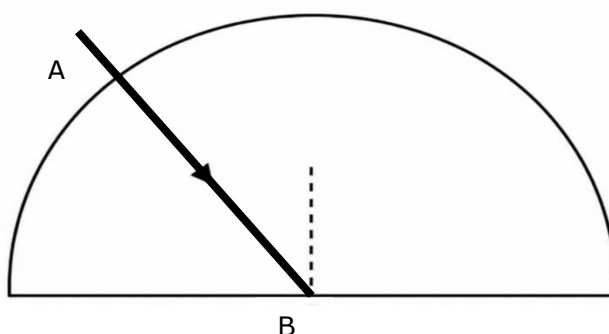


Figure 3

- vii. As the ray of light travels from zirconia into air, state the main condition for total internal reflection to occur.

_____ (1)

- viii. Explain how the ray box and the semicircular block can be used to demonstrate total internal reflection.

(1)

- ix. Continue the path of the incident ray on Figure 4, to demonstrate what happens when the ray reaches B and total internal reflection occurs.

(1)

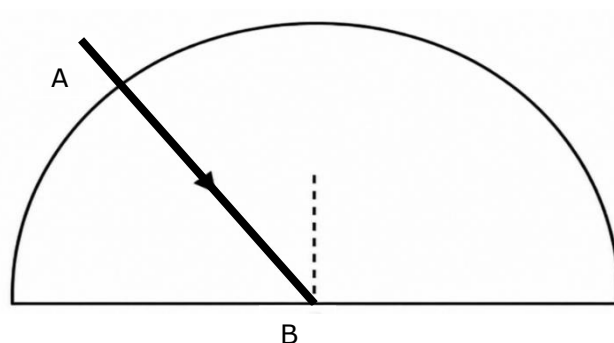


Figure 4

- x. Identify **ONE** everyday situation where total internal reflection occurs.

(1)

- b. The refractive index of zirconia is 2.18. Find the speed of light in zirconia if the speed of light in air is 3×10^8 m/s.

(3)

(Total: 15 marks)

3. Radiator heaters, such as the one shown in Figure 5, use hot water or steam for heating. They are connected to a central boiler and used in colder climates where heating is required for long periods. A manufacturer of these radiator heaters is considering different colours for the radiators, namely black, white, or silver.

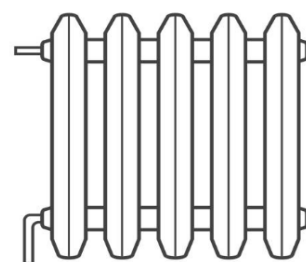


Figure 5
(istockphoto.com)

- a. The radiator transfers energy to the surroundings by emitting radiant heat. Identify the type of wave by which radiant heat is transferred.

(1)

- b. State why radiators are made of metal.

(1)

c. The manufacturer wants to verify, through an experiment, how the heaters' surface colour affects the emission of heat. He has three identical glass beakers containing the same amount of cold water. He also has three radiator heaters: one black, one silver, and one white.

i. List **TWO** additional pieces of apparatus required.

_____ (2)

ii. Describe the method to show how the colour of the radiator heater affects the emission of heat.

_____ (3)

iii. On the same axes shown in Figure 6, sketch **TWO** graphs showing the expected rates of heat emission for the black and white heaters. Clearly label both axes and each graph. (3)



Figure 6

d. i. Figure 7 shows a radiator heater placed in one corner of a room. Describe how convection ensures that the whole room is heated.

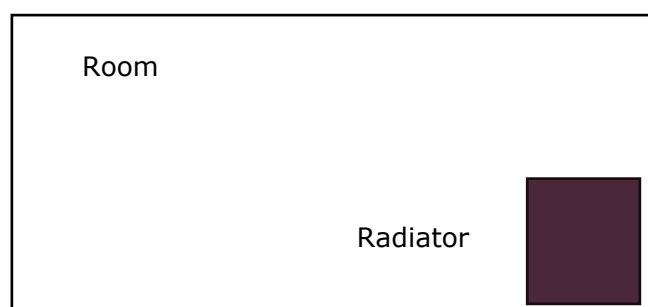


Figure 7

_____ (1)

ii. On Figure 7, draw arrows to show how convection of heat takes place in the room. (2)

- e. List **TWO** ways of limiting energy costs at home or other buildings.

 _____ (2)

(Total: 15 marks)

4. Ms Apap's physics class is investigating whether a metallic conductor obeys Ohm's Law. They were given the following apparatus: a wire, a battery, a switch, a fixed resistor, a variable resistor, a voltmeter and an ammeter.

- a. Ohm's Law states that current and voltage across a _____ are _____, provided that the _____ remains constant. (3)
- b. Draw the circuit diagram the students should use to carry out this investigation. (3)

- c. List **TWO** precautions that should be taken during the investigation.

 _____ (2)

Table 1 below shows the values obtained by one of the students.

Table 1

Voltage, V / V	0.0	1.5	3.0	4.5	6.0	7.5	9.0
Current, I / A	0.00	0.28	0.60	0.88	1.12	1.40	1.68

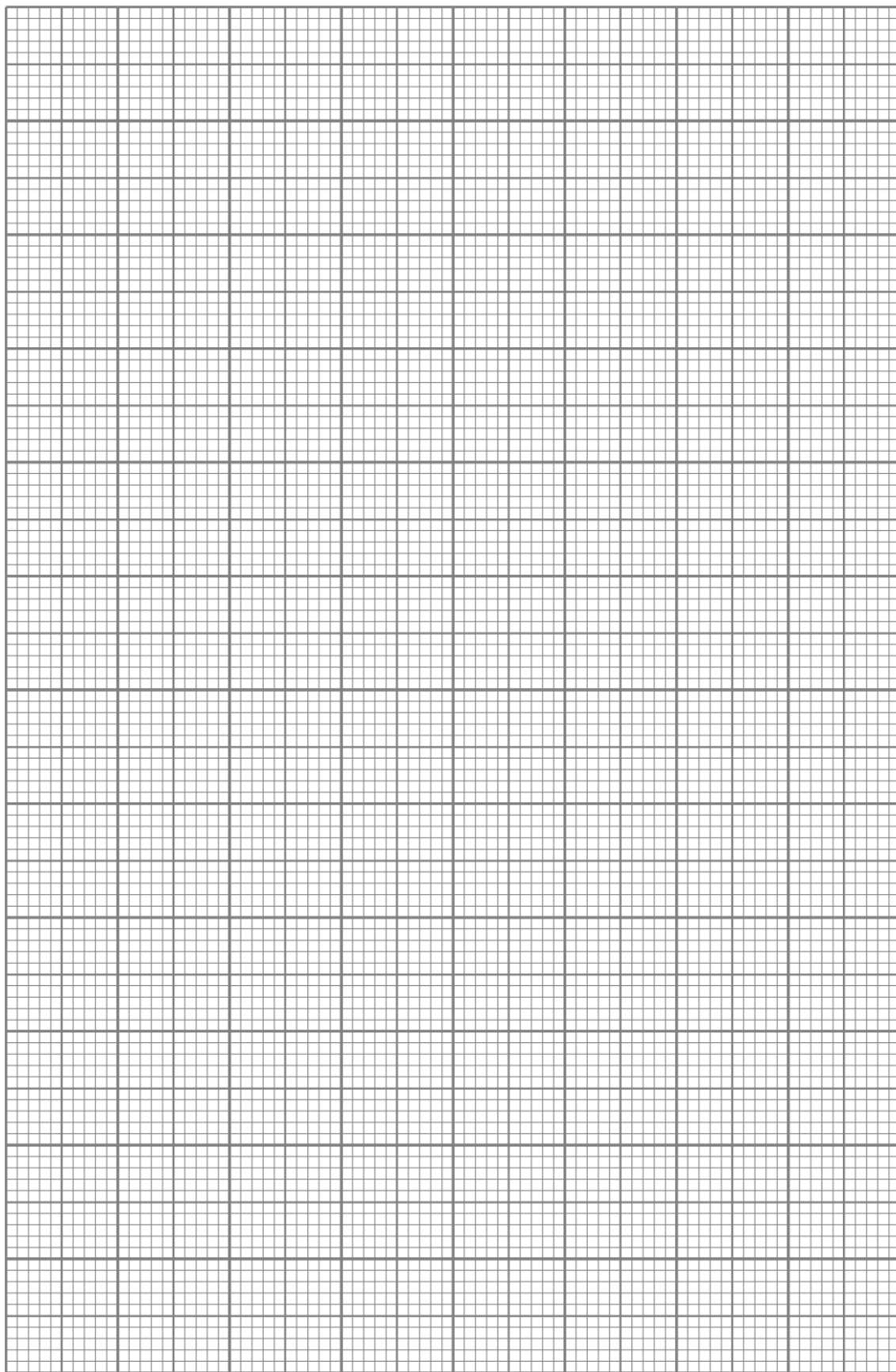
- d. Plot a graph of Voltage/V on the y-axis against Current/A on the x-axis. (4)
- e. Explain how the graph obtained shows whether the metallic conductor obeys Ohm's law.

_____ (1)

- f. Ms Apap asked the students to carry out a similar investigation for a filament lamp. Would the students get the same graph as the one plotted in part (d)? Discuss.

 _____ (2)

(Total: 15 marks)



5. Magnetic fields are invisible areas formed around magnets or electric currents.

a. Draw the magnetic field present in the following **TWO** scenarios in Figures 8 and 9.

i. Two bar magnets with like poles facing each other. Mark the neutral point with an X. (3)



Figure 8

ii. A straight current-carrying wire. (2)

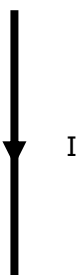


Figure 9

b. Describe how one can demonstrate the direction of the field around a straight current-carrying conductor.

_____ (2)

When current flows through a solenoid a magnetic field is formed as shown in Figure 10. This is called an electromagnet.

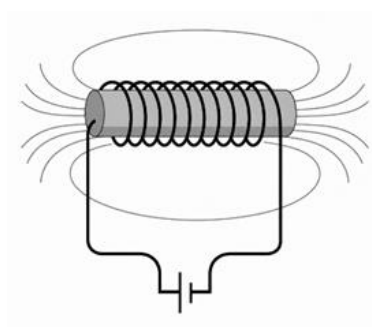


Figure 10

c. On Figure 10, mark the polarities of the solenoid and the direction of the magnetic field lines. (2)

d. State **TWO** characteristics of the field shown in Figure 10.

 _____ (2)

e. Describe **ONE** application where an electromagnet is used.

 _____ (2)

A magnet is brought close to a coil and moved back and forth as shown below in Figure 11.

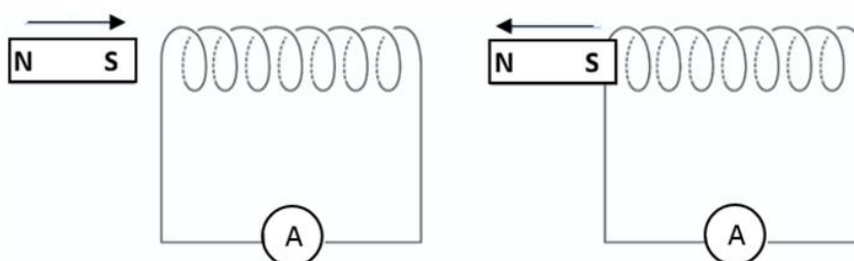


Figure 11

f. State what happens when the magnet moves in and out of the coil.

 _____ (2)

(Total: 15 marks)

Section B

6. a. i. Define momentum.

 _____ (2)

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

b. A moving supermarket trolley A hits an identical trolley B initially at rest. The two trolleys continue moving together after collision.

i. Explain why the velocity of the two trolleys moving together after the collision was lower than the velocity of trolley A before the collision.

 _____ (2)

ii. Explain why the two trolleys stop moving after some time.

 _____ (1)

c. Sarah is with her friends in a playground. She jumps from a platform which is high above the ground. That area of the playground is covered with a soft rubber surface.

i. State the meaning of time of impact.

_____ (1)

ii. Explain the usefulness of the soft rubber surface in terms of time of impact, force and momentum.

_____ (2)

iii. State an example of a safety feature used in cars for a purpose similar to a soft rubber surface in a playground.

_____ (1)

d. i. State Newton's 3rd Law of Motion.

_____ (1)

ii. State the reaction forces for **each** of the following forces:

• a person pushing against a wall _____ (1)

• the force of gravity of a person _____ (1)

(Total: 13 marks)

7. Consider the following circuits in Figure 12.

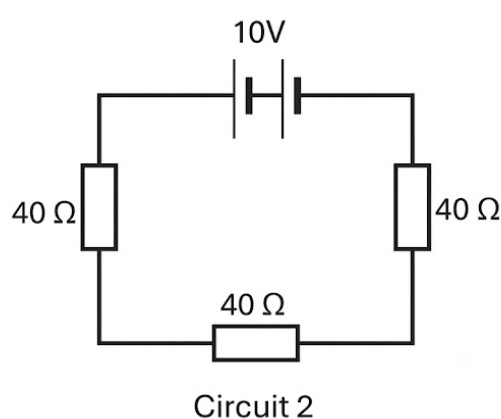
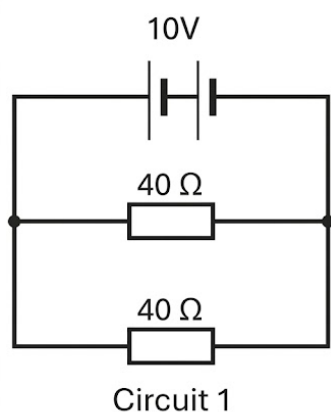


Figure 12

a. State which circuit shows resistors that are connected:

In series: _____ (1)

In parallel: _____ (1)

b. Calculate the total resistance in:

i. Circuit 1

(2)

ii. Circuit 2

(2)

c. On Figure 12, draw an ammeter in **each** circuit which can be used to measure the total current flowing in the circuit. (2)

d. Calculate the current flowing through **each** resistor in Circuit 1.

(3)

e. On Figure 12, draw a voltmeter in Circuit 2 which can be used to measure the voltage across **ONE** chosen resistor. (1)

(Total: 12 marks)

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**SECONDARY EDUCATION CERTIFICATE LEVEL
2026 SUPPLEMENTARY SESSION**

SUBJECT: **Physics**
PAPER NUMBER: II – Level 2-3
DATE: 28th August 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 = $F \times$ 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	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
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. A car is being driven on a long runway. It starts from rest and reaches a velocity of 25 m/s in 4.0 s.
- a. Calculate the acceleration of the car.

_____ (2)

- b. Calculate the distance travelled during this time.

_____ (2)

- c. When the car reaches its maximum constant speed, identify **ONE** force opposing its motion.

_____ (1)

(Total: 5 marks)

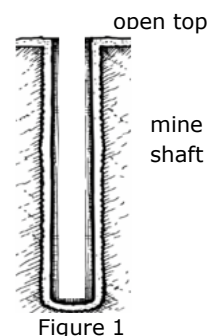
2. a. Fill in the blanks to complete the following statement:

Atmospheric pressure is due to the _____ per unit area exerted on a surface by the _____ of the column of air extending above the surface. (2)

- b. i. Explain why atmospheric pressure varies with height above the Earth's surface.

_____ (2)

- ii. The bottom of a vertical mine shaft lies at a considerable depth below the surface of the ground. Figure 1 shows that the top of the shaft is open. State whether the atmospheric pressure at the bottom of the shaft is greater than, smaller than or equal to that at the surface.



_____ (1)

(Total: 5 marks)

3. A Physics teacher sets up the ripple tank to demonstrate diffraction in water waves.

- a. A stroboscope is positioned on top of the water tank and is switched on. Explain why this is needed.

_____ (1)

- b. Describe briefly how the ripple tank can be used to demonstrate diffraction of water waves as they pass through a gap.

(2)

- c. Another experiment was carried out to investigate the refraction of water waves in a ripple tank. Figure 2 shows plane waves in a ripple tank approaching a shallow section. Complete the figure to show refraction of the waves in the shallow section. (2)

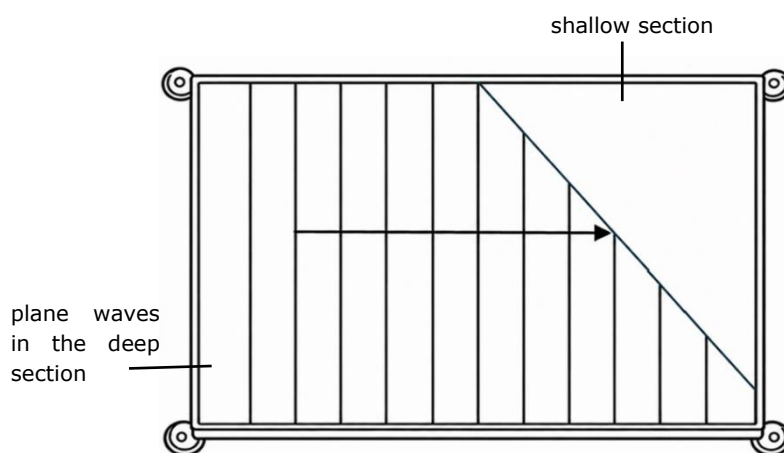
(Source: <https://chatgpt.com/>)

Figure 2

(Total: 5 marks)

4. A hot water tank is used to heat up water in a household. The water close to the heating element is heated by conduction.
- a. Describe conduction.

(2)

- b. State a material ideal for the pipes connecting the hot water tank to the water tap. Give **ONE** reason for your answer.

(2)

- c. Most water tanks are painted white. Give **ONE** reason for this choice of colour.

(1)

(Total: 5 marks)***Please turn the page.***

5. a. Matthew pours equal masses of two different liquids into identical beakers. The liquids have the same initial temperature. He wants to demonstrate that the liquids reach different final temperatures when they each receive the same amount of heat energy. Describe what he must do to demonstrate this.

(2)

- b. In a heating experiment, a mass of water at $23\text{ }^{\circ}\text{C}$ is heated by a heater of power 2000 W for 90 s . The final temperature of water reaches $65\text{ }^{\circ}\text{C}$. Given that the specific heat capacity of water is $4200\text{ J/kg}^{\circ}\text{C}$, calculate the mass of water used.

(3)

(Total: 5 marks)

6. Consider the following scenario in Figure 3.

A school storeroom is being used as a temporary workspace. A kettle, a fan, and several other plugs are plugged into an extension lead lying on the floor, while water from a leaking mop bucket spreads toward it. Nearby, a damaged cable with exposed wires risks a short circuit if switched on. A student with wet hands enters and reaches for the light switch.



(Source: <https://chatgpt.com/>)

Figure 3

- a. Describe a short circuit.

(1)

- b. Recognize and explain **TWO** dangerous practices related to the use of mains electricity.

(4)

(Total: 5 marks)

7. a. The radioactive isotope of radium $^{226}_{88}\text{Ra}$ decays by emitting an alpha particle to form an isotope of the gas radon (Rn). Write down a nuclear equation representing this decay.

(2)

- b. A radioactive source emits either alpha or beta radiation. A Geiger Muller tube and a ratemeter were used to measure the count rate. Readings were taken with no absorber, then with a sheet of paper placed between the source and the tube, and then with a sheet of aluminium placed between the source and the tube. Finally, the source was removed to measure the background count rate. The readings obtained were as shown in Table 1.

Table 1

	ratemeter reading (counts/minute)
source with no absorber	185
source and sheet of paper	185
source and sheet of aluminium	15
no source	15

State which radiation was emitted and justify your reasoning.

(3)

(Total: 5 marks)

8. a. Name the force which keeps a planet in orbit round the sun. _____

(1)

- b. Underline the correct word in brackets in **each** of the following statements about the force identified in (a).

- i. The force (decreases / increases) if the mass of the planet is bigger. (1)
- ii. The force (decreases / increases) if the distance of the planet from the sun increases. (1)
- c. In the late 1920s, astronomers discovered that the universe is expanding. Explain how this observation led to the Big Bang theory.

(2)

(Total: 5 marks)***Please turn the page.***

Section B

9. a. In an experiment to verify Newton's second law of motion, a group of students applied various forces to an object and measured the acceleration produced. The values of the force applied, and the corresponding acceleration were tabulated in Table 2.

Table 2

Force applied / N	0	0.2	0.5	0.8	1.1	1.4
Acceleration / m/s^2	0	0.32	0.82	1.24	1.72	2.22

- i. Plot a graph of acceleration on the y-axis against the force applied on the x-axis. (5)
- ii. Use the graph plotted to state the relationship between the acceleration experienced by the object and the force applied on it. Explain.

_____ (2)

- iii. Hence, state whether Newton's 2nd Law was verified as a result. _____ (1)

- iv. Use the graph to find the mass of the object.

_____ (2)

- v. State what effect would there be on the gradient of a second graph plotted on the same axes if the object used had a heavier mass.

_____ (1)

- b. A hammer is used to drive a nail into a piece of wood. The head of the hammer has a mass of 1.0 kg. The hammer head travelling at 2 m/s is brought to rest in 0.1 s when it hits the nail. Calculate:

- i. the momentum of the hammer before it makes contact with the nail;

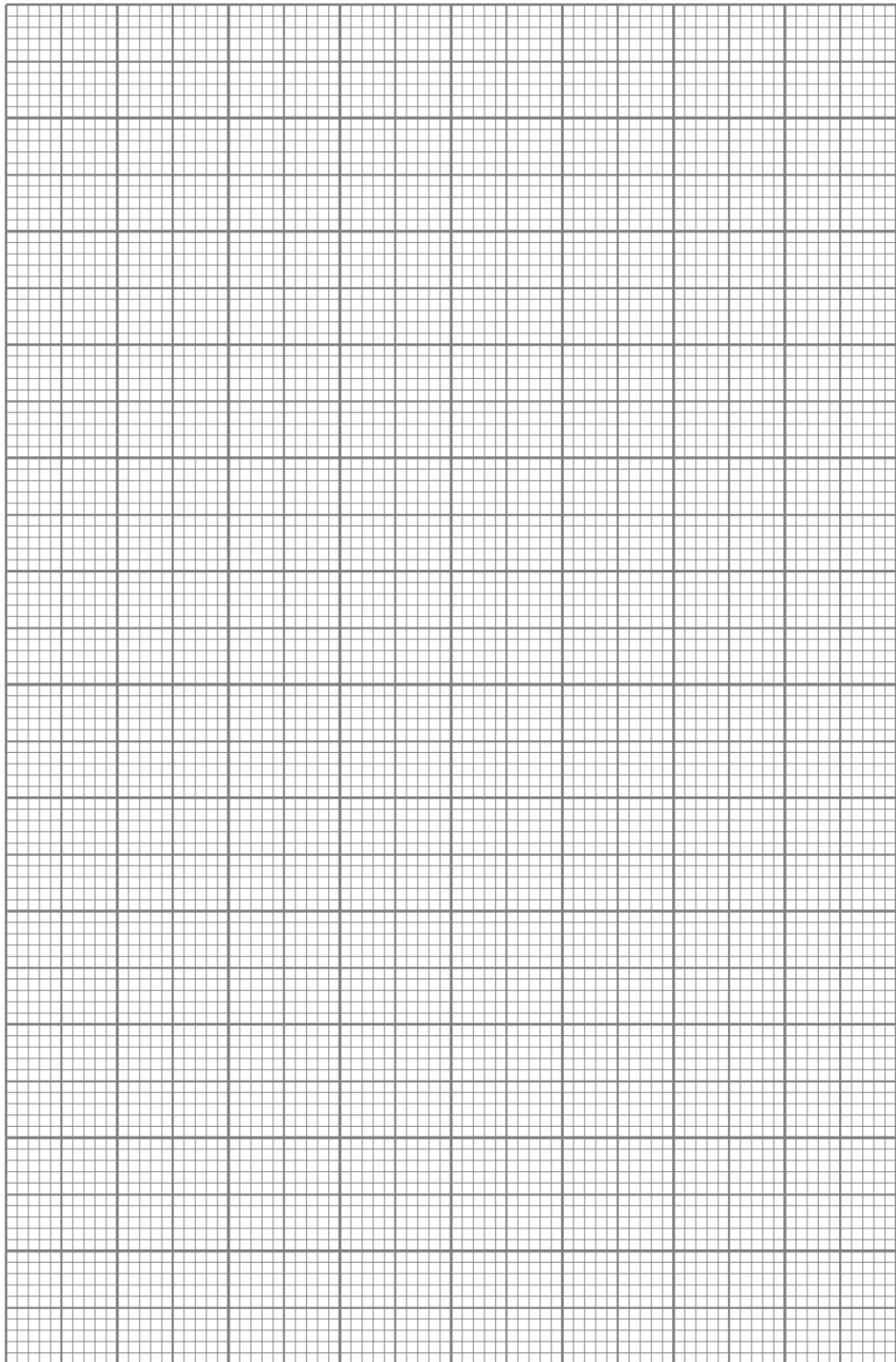
_____ (2)

- ii. the force of impact on the hammer.

_____ (2)

(Total: 15 marks)

DO NOT WRITE ABOVE THIS LINE



Section C

10. Parking sensors use ultrasound waves to detect obstacles around a car, alerting the driver with increasingly fast beeps as you get closer. Figure 4 shows a car with rear sensors. The frequency used is 40 KHz. The speed of sound of waves is 330 m/s.



Figure 4
(vecteezy.com)

- a. Define frequency.

 _____ (1)

- b. i. Describe ultrasound waves.

 _____ (1)

- ii. Describe **ONE** other use to this type of waves.

 _____ (2)

- c. Calculate the wavelength of these waves.

 _____ (3)

- d. If the car is 40 cm away from a wall, how long does the wave take to travel from and to the car?

 _____ (3)

- e. John wants to investigate how the frequency of the beeping sound produced by the car varies as the distance from the wall changes.

Table 3

Distance from wall / cm	Time for 1 beep / s	Frequency / Hz
110	10	
80	6	
50	3	
20	1	

- i. Complete Table 3 by calculating the frequency of the beeps in Hz. (2)
- ii. Fill in the blank to complete the statement:

Vibrating objects produce sound by causing _____ and
 _____ of the particles in the carrying medium. (1)

- iii. An oscilloscope is used to show different sound waves as shown in Figure 5.

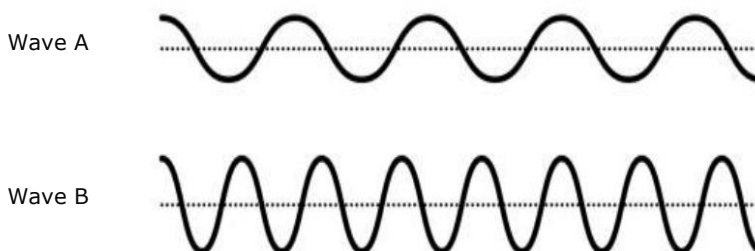


Figure 5

(istock.com)

State which wave, A or B, shows a higher pitch. _____ (1)

- iv. The oscilloscope now displays the waveform shown in Figure 6. Tick with an **X** the correct answer from Table 4 describing how the wave changes with time. (1)

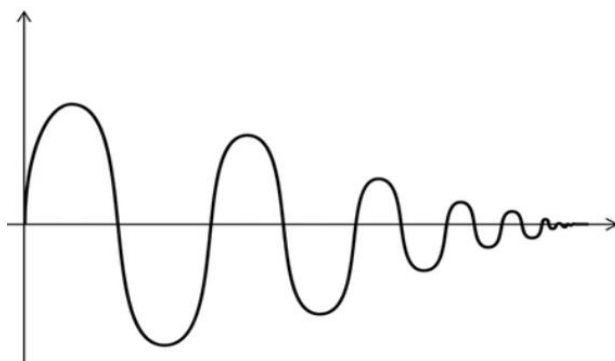


Figure 6

(istock.com)

Table 4

Conclusion	Tick with an X the correct answer.
The sound is becoming louder.	
The sound is becoming weaker.	
There are too many sound waves coming from the car.	

(Total: 15 marks)***Please turn the page.***

11. Static electricity is a phenomenon which happens when charges move from one surface of an insulator to another, leaving charges unbalanced and causing objects to stick, cling, or give small shocks.

a. Distinguish between electrical conductors and insulators in terms of conductivity.

(1)

b. Figure 7 shows the structure of an atom. Complete Table 5 with the name of the labelled particles and their charges, if any.

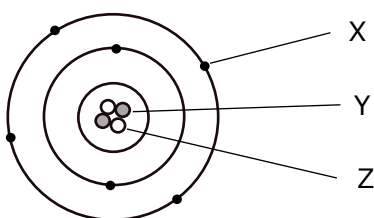


Figure 7

Table 5

Particle	Name	Charge
X		
Y		
Z		

(3)

c. Material A was negatively charged by friction using material B. Describe how charging by friction is done.

(1)

d. After charging, material B was left positively charged. Explain.

(2)

e. State whether the following statements are completely correct or **not** and explain why.

i. Material A was brought close to material C and there was attraction. Material C is definitely positively charged.

Completely correct: Yes / No

(1)

Explanation:

(2)

- ii. Material A was brought close to material D and there was repulsion. Charge of material D may either be negative or neutral.

Completely correct: Yes / No (1)

Explanation: _____

_____ (2)

- f. Describe how static electricity is used when paint spraying objects.

 _____ (2)

(Total: 15 marks)

12. Figure 8 shows a setup with wire PQ lying between the poles of a magnet.

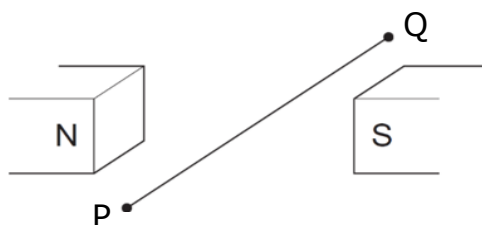


Figure 8

- a. Explain how wire PQ experiences a force when current flows through it. Your explanation should include the direction in which the force acts on wire PQ when current flows in the direction PQ.

 _____ (2)

- b. Describe **TWO** factors which will affect the magnitude of the force experienced by wire PQ.

 _____ (2)

The setup was changed as shown in Figure 9.

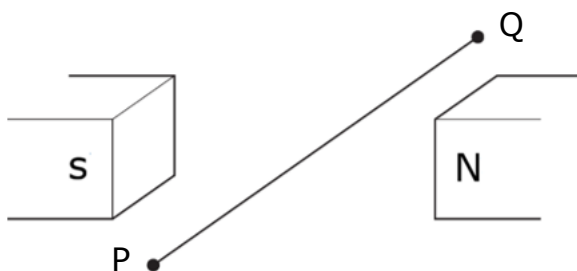


Figure 9

- c. Explain how the force experienced by current carrying wire PQ is affected.

(2)

- d. Figure 10 shows a rectangular coil, carrying a current in the direction ABCD. When placed in a magnetic field, the coil experiences a turning effect. Explain.

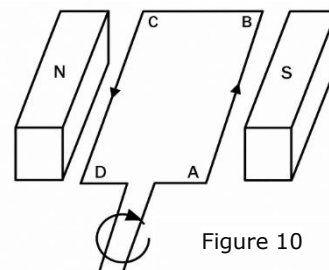


Figure 10

(2)

- e. Fill in the blanks to complete the following statement.

When the number of turns of a current-carrying coil placed between the poles of a magnet

_____ the coil rotates faster and when the strength of the magnetic field is

_____ the speed of rotation of the coil will decrease. (2)

Wire PQ is connected to a sensitive ammeter as shown in Figure 11. When wire PQ is moved in the directions of arrow R the sensitive ammeter shows a reading indicating that a current was induced. This is the basic concept behind the generation of electricity.

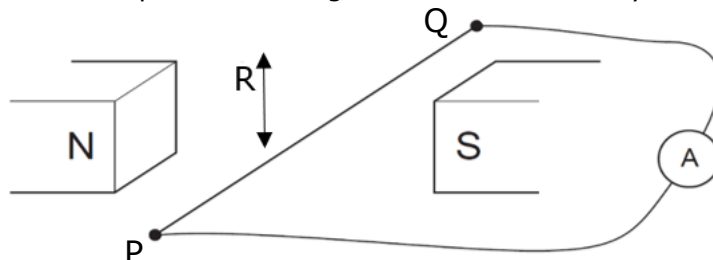


Figure 11

- f. List **TWO** factors which affect the size of the current induced in wire PQ.

(2)

- g. Relate this concept to the way electricity is generated in power stations.

(3)

(Total: 15 marks)