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YISHUN TOWN SECONDARY SCHOOL

G3

PRELIMINARY EXAMINATION 2025

SECONDARY 4

G3 PHYSICS

(6091/1)

DATE : 22 Aug 2025

DAY : Friday

DURATION: 1 hr

MARKS: 40 marks

ADDITIONAL MATERIALS

Multiple Choice Answer Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.

There are forty questions. Answer all questions. For each question, there are four possible answers, A, B, C and D. Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet. Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

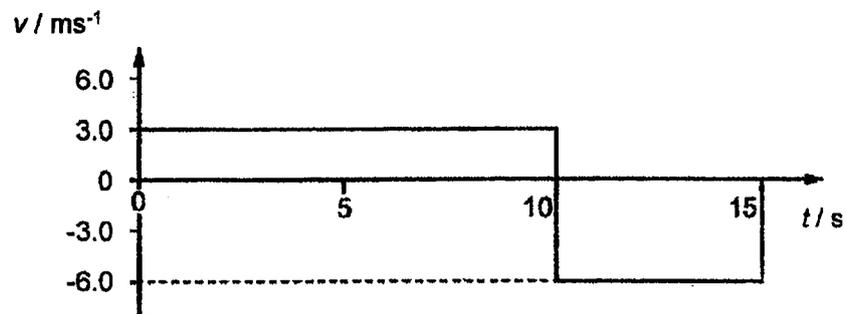
INFORMATION FOR CANDIDATES

Any rough working should be done in this booklet.

You may use an approved calculator.

This question paper consists of 16 printed pages.

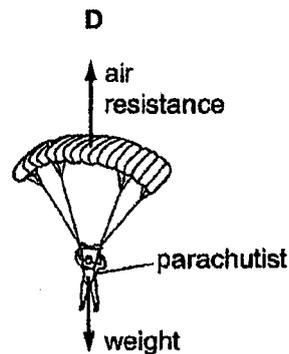
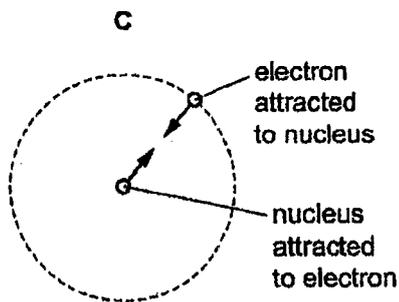
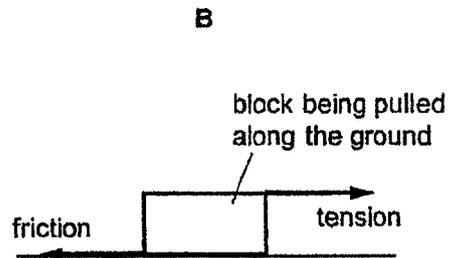
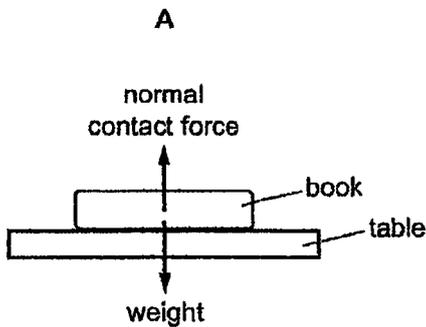
- 1 Which statement is false about a physical vector quantity?
- A It has both magnitude and direction.
 - B It can be represented by an arrow.
 - C It must have a unit.
 - D It can change direction without changing the vector itself.
- 2 Energy is measured in joules. Which unit is also equivalent to the joule?
- A W/s
 - B N/m
 - C $\text{kg m}^2/\text{s}^2$
 - D N m^2
- 3 A radio-controlled toy car travels along a straight line for a time of 15 s. The velocity-time graph is shown below.



What is the average velocity of the toy car for the journey shown by the graph?

- A -1.5 m/s
- B 0.0 m/s
- C 4.0 m/s
- D 4.5 m/s

6 Each diagram shows two forces that are equal in magnitude. Which diagram shows two forces that demonstrates Newton's third law?

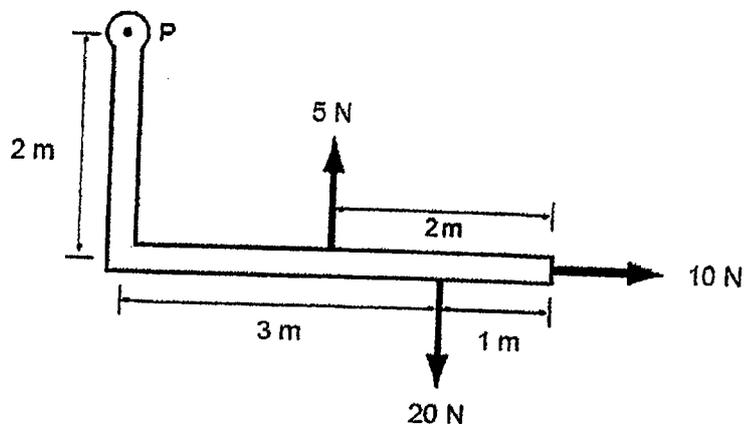


7 The mass of a solid block is measured using a beam balance and is found to be 3.0 kg. Its weight is measured using a weighing scale and is found to be 30 N. The solid block is then brought to the moon together with the same beam balance and weighing scale.

Given that the gravitational field strength of the moon is one-sixth that of Earth, which row correctly shows its mass and weight when measured on the moon?

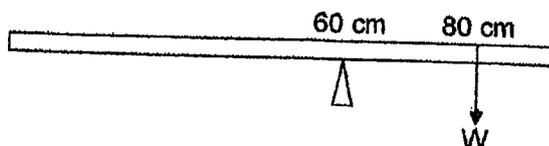
	mass / kg	weight / N
A	0.50	5.0
B	0.50	30
C	3.0	5.0
D	3.0	30

- 8 An L-shaped rigid lever arm is pivoted at point P. Three forces act on the lever arm, as shown in the diagram.



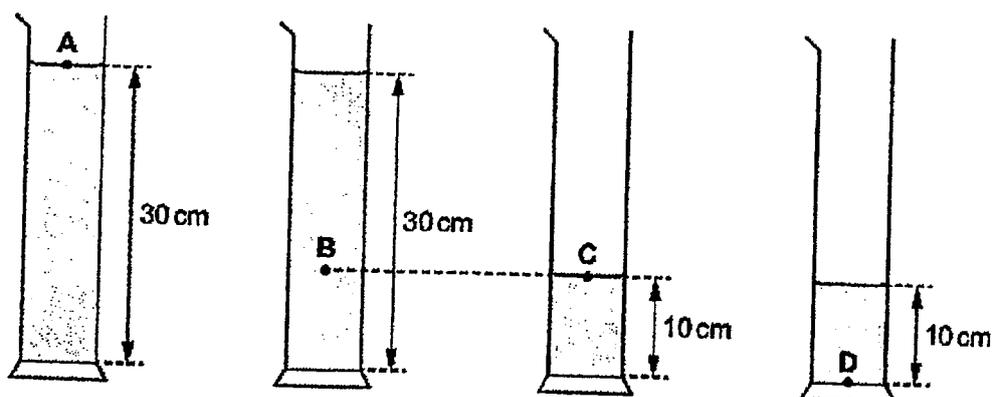
What is the magnitude of the resultant moment of these forces about point P?

- A 30 Nm
 B 35 Nm
 C 50 Nm
 D 90 Nm
- 9 A uniform metre rule of weight 12 N balances at the 60 cm mark, while a weight of W is placed at the 80 cm mark.

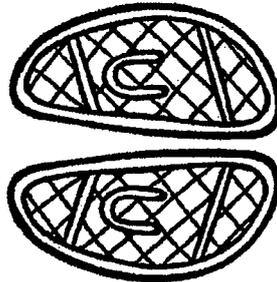


What is the value of W ?

- A 6.0 N
 B 12 N
 C 24 N
 D 36 N
- 10 Four measuring cylinders are filled with the same liquid to the heights shown. At which position is the pressure the greatest?



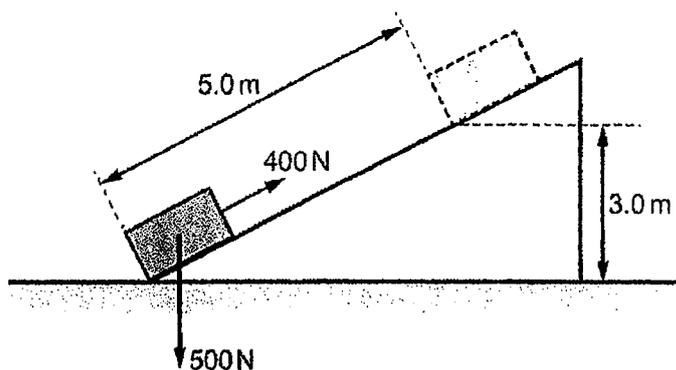
- 11 In the arctic, explorers wear snow shoes such as the ones shown below to travel across the snow.



Which statement best explains why snow shoes have large surface areas when in contact with the snow?

- A To increase the friction between the shoes and the snow.
 B To spread the wear and tear over a larger area.
 C To reduce the depth in which the person sinks when walking on snow.
 D To help melt the snow quickly from the body heat.
- 12 A car is moving initially at a constant speed on level ground. The driver steps on the brake pedal and the car eventually comes to a stop, with the brakes heating up. Which of the following best shows the correct energy conversions?
- A kinetic store of car \rightarrow work done by friction \rightarrow internal store of brakes
 B kinetic store of car \rightarrow work done by friction + internal store of brakes
 C kinetic store of car \rightarrow work done by friction \rightarrow thermal store of brakes
 D kinetic store of car \rightarrow work done by friction + thermal store of brakes
- 13 The input power to a light bulb used in a lighting system is 6.0 W. The bulb emits 2.7 J of heat in 3.0 s. What is the efficiency of this bulb?
- A 15% B 45% C 55% D 85%

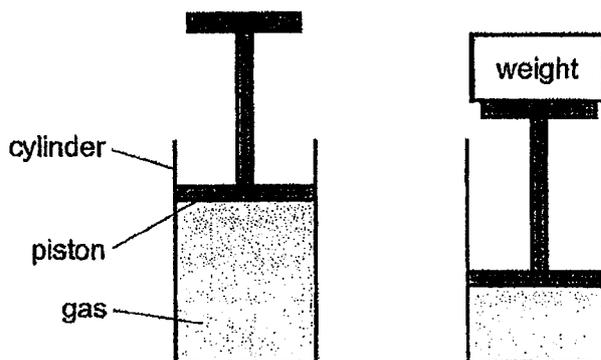
- 14 Work is done when a force of 400 N pulls a crate of weight 500 N at a constant speed along a ramp as shown.



Part of the work done increases the gravitational potential store E of the crate and the rest is work done W against friction. What are the values of E and W ?

	E / J	W / J
A	1500	500
B	1500	2000
C	2000	2500
D	3500	500

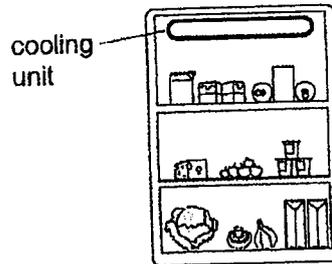
- 15 A piston is supported by gas trapped in a cylinder.



A weight is put on the piston. The volume of gas supporting the piston decreases but the temperature of the gas is unchanged. What happens to the molecules?

- A They hit the piston more frequently.
- B They move more slowly.
- C They have a smaller size.
- D They have more kinetic energy.

16 The diagram shows the inside of a refrigerator.



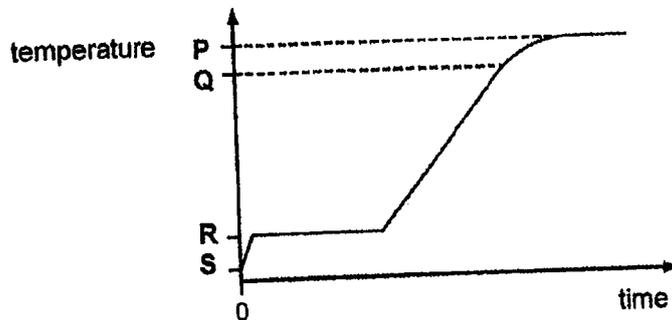
When the refrigerator is first switched on, what happens to the air near the cooling unit?

	particles of this air	density of this air
A	become smaller	decreases
B	become smaller	increases
C	move closer together	decreases
D	move closer together	increases

17 Tom stands barefooted with one foot on a stone floor and the other on a carpet. He observes that the foot on the stone floor feels cooler than the one on the carpet. Which statement explains this observation?

- A Air is unable to circulate through the carpet fibres.
- B More heat flows from the carpet to his foot.
- C More heat flows from his foot to the stone floor.
- D The stone floor is at a lower temperature than the carpet.

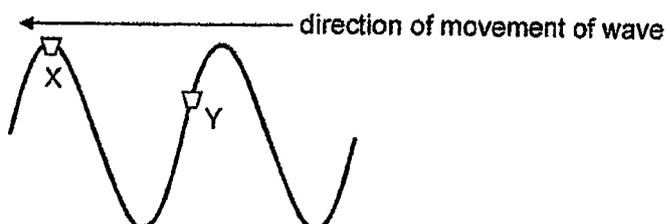
18 A solid substance X, is placed in a metal container. The container is heated at a constant rate and readings of temperature and time are taken. The results are recorded in the graph below.



At which temperatures would evaporation be able to take place?

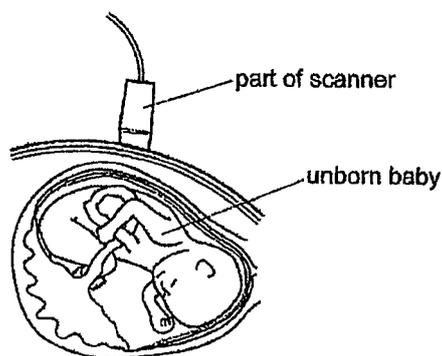
- A Q only
- B S only
- C R & Q only
- D P, Q and R only

- 19 Less heat is needed to raise the temperature of 1.0 kg of copper by 1.0 K than is needed to raise the temperature of 1.0 kg of water by 1.0 K. Which statement explains this?
- A Copper has a higher melting point.
 B Copper has a lower specific heat capacity.
 C Copper has a smaller specific latent heat.
 D Copper is a better conductor of heat.
- 20 The diagram shows two corks, X and Y, floating on water.



What will happen to both corks as the wave passes in the next moment?

- A X will move downwards, Y will move upwards.
 B X will move upwards, Y will move downwards.
 C Both X and Y will move upwards.
 D Both X and Y will move downwards.
- 21 The diagram shows an ultrasound scanner used to produce an image of an unborn baby.



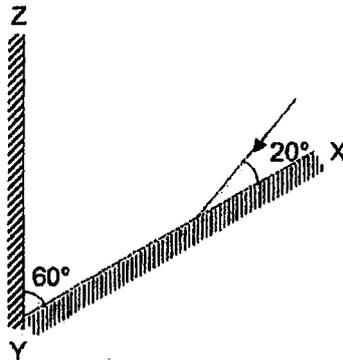
How does the scanner form an image?

- A from ultrasound absorbed by the baby
 B from ultrasound emitted by the baby
 C from ultrasound reflected by the baby
 D from ultrasound refracted by the baby

- 22 Electromagnetic waves are produced by various devices when in operation. Which device produces electromagnetic waves of the lowest frequency?

A sunbed
 B mobile phone
 C television remote
 D toaster

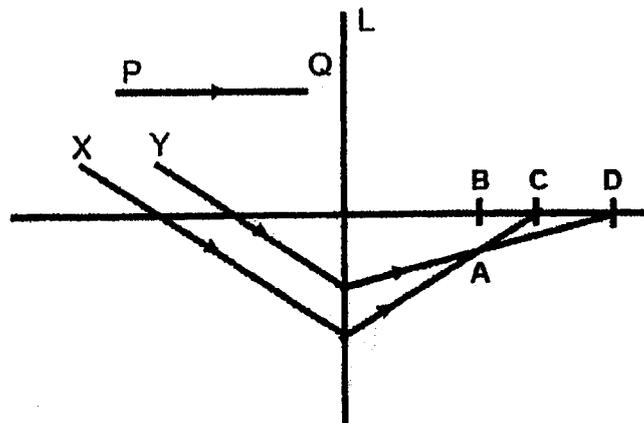
- 23 A ray of light is incident at an angle of 20° to a mirror XY. Another mirror YZ is arranged at an angle of 60° to XY as shown in the diagram below.



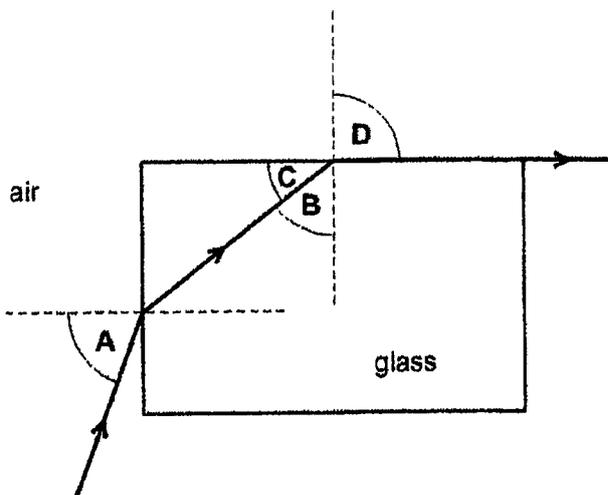
After reflection from XY, the ray is incident on YZ.

What is the angle of incidence of the ray at the mirror YZ?

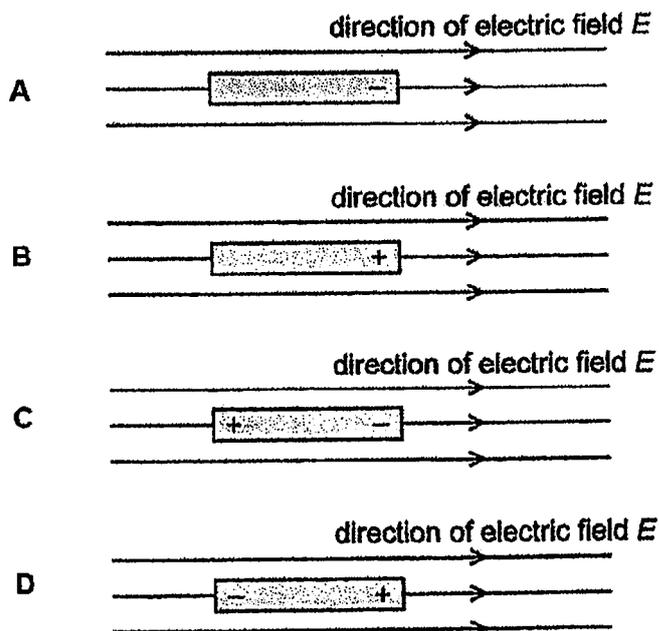
- A 0° B 10° C 20° D 60°
- 24 The diagram shows two incoming parallel rays of light X and Y, which pass through a converging lens, L. Which point will ray PQ pass through after passing through the lens?



- 25 Light travels through a glass block as shown. Which angle is the critical angle for the light in the glass?



- 26 An initially uncharged copper rod is placed in a uniform electric field E . The rod is parallel to the field. Which diagram shows the charges induced on the rod?



27 A polythene rod becomes charged when rubbed with a dry woolen cloth. What causes the polythene rod to be charged?

- A Friction producing a movement of electrons.
- B Friction producing a movement of protons.
- C Magnetism producing a movement of electrons.
- D Magnetism producing a movement of protons.

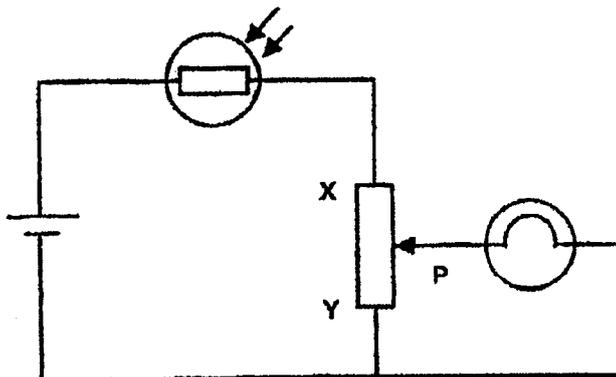
28 An electrical cell uses 1.0 kJ of energy to send 3.0 A of current around a circuit for 2.0 minutes. What is the e.m.f. of the cell?

- A 2.8 V B 6.0 V C 25 V D 360 V

29 Which changes to a wire will double its resistance?

	cross-sectional area	length
A	double	double
B	double	no change
C	halve	no change
D	no change	halve

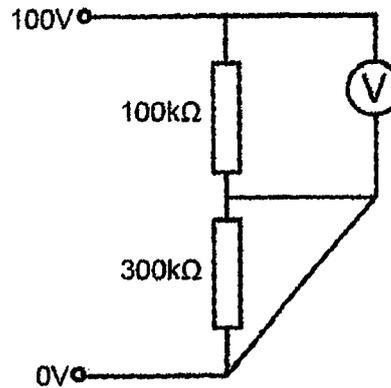
30 A circuit is set up as shown in the diagram below.



Which steps taken would allow the lamp to be at its brightest?

- A Cover the LDR and P is moved to Y.
- B Cover the LDR and P is moved to X.
- C Light falls on the LDR and P is moved to Y.
- D Light falls on the LDR and P is moved to X.

- 31 A circuit is shown below.



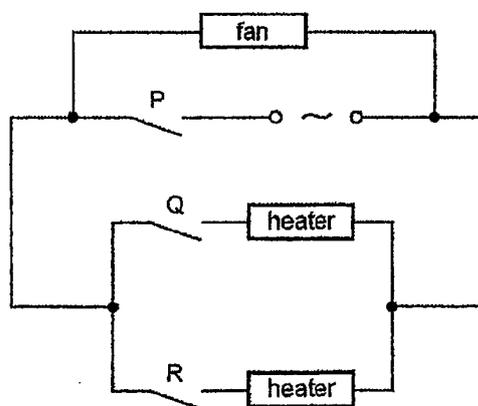
What is the reading on the voltmeter?

- A 25 V B 33 V C 50 V D 100 V
- 32 The current in a filament lamp is 0.25 A when working normally. The lamp is connected to a plug and the mains a.c. supply.

When the lamp is switched on, it does not light. What is a possible cause for this?

- A The earth wire in the plug is not connected.
 B The fuse in the plug is 1 A.
 C The lamp only works on a d.c. power supply.
 D The live wire in the plug is disconnected.

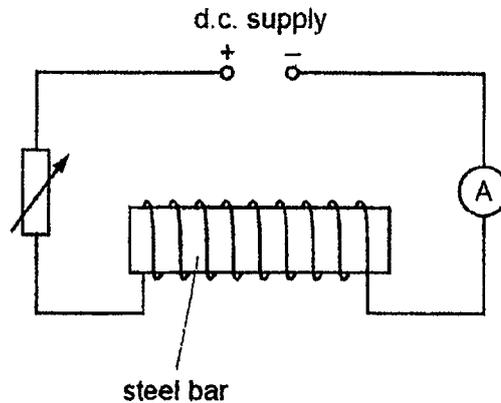
- 33 The diagram shows the circuit for a hair dryer.



The fan has a power rating of 0.10 kW and the heaters each have a rating of 0.40 kW. The cost of electricity is 8 cents / kWh. What is the cost of running the hair dryer for 2 hours with switches P and Q closed only?

- A 1.6 cents B 3.2 cents C 6.4 cents D 8.0 cents

- 34 The diagram shows how a steel bar can be magnetised.

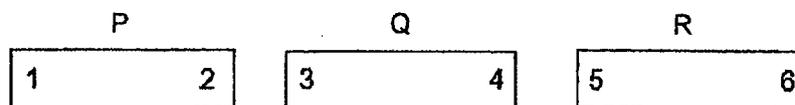


Which statement describes how the steel bar can be demagnetised?

- A Reverse the d.c. supply and gradually decrease the current in the circuit.
 - B Reverse the d.c. supply and gradually increase the current in the circuit.
 - C Use an a.c. supply and gradually decrease the current in the circuit.
 - D Use an a.c. supply and gradually increase the current in the circuit.
- 35 Three metal bars P, Q, and R are identical in size and shape. They are suspected to be magnets.

Tests are carried out and it is found that there is attraction between poles 1 and 6, between poles 2 and 4, and between poles 2 and 6.

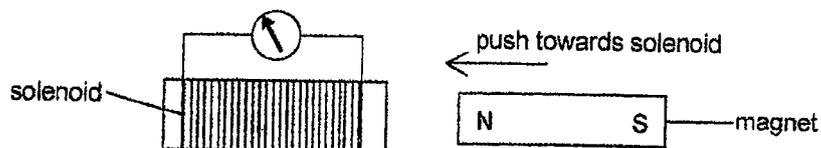
Between poles 2 and 3, there is repulsion.



Without making any further tests, which statement is correct?

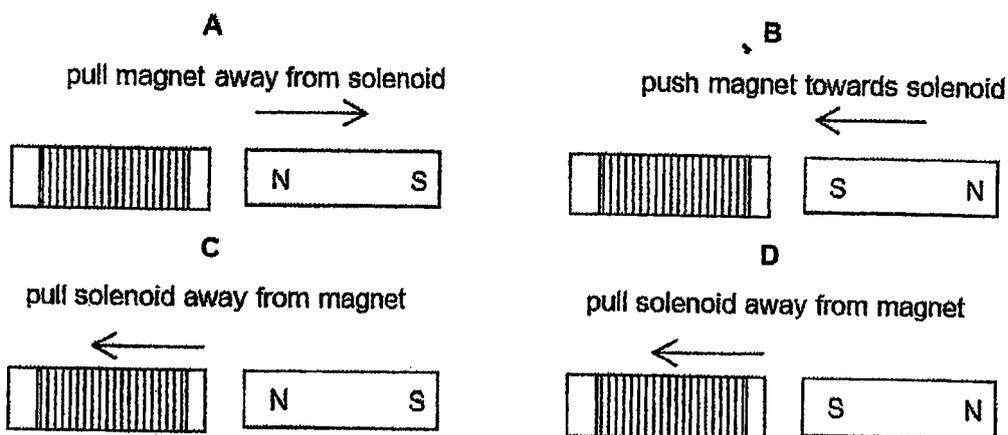
- A P and Q are magnets.
- B P and R are magnets.
- C Poles 2 and 5 would repel each other.
- D All three metal bars are magnets.

36 The diagram shows the North pole of a bar magnet being pushed into a solenoid.

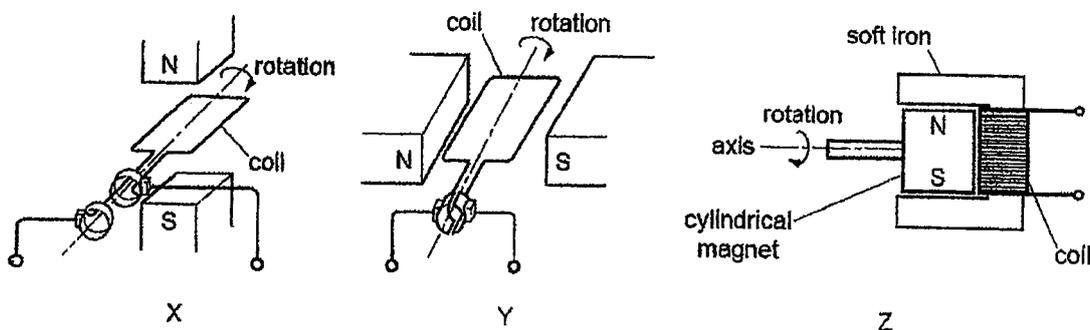


An electromotive force is induced in the solenoid and the galvanometer needle deflects to the left as shown.

Using the same end of the solenoid, which action will cause the galvanometer needle to deflect in the same direction?



37 The diagrams show three electrical devices, X, Y and Z.



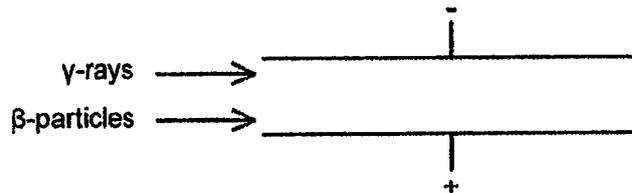
Which devices provide an alternating current (a.c.) output?

- A X only B Y only C X and Y D X and Z

- 38 One nucleus of a uranium isotope contains 92 protons and 146 neutrons. What does the nucleus of another isotope of uranium contain?

	no. of nucleons	no. of neutrons
A	235	143
B	237	147
C	238	144
D	241	146

- 39 Beta and gamma radiation are passed through two charged metal plates as shown in the diagram below.



Which direction, if any, would the β -particles and γ -rays be deflected?

	β -particles	γ -rays
A	into the page	continue straight
B	towards the negative plate	out of the page
C	continue straight	towards the negative plate
D	towards the positive plate	continue straight

- 40 Beta particles are often used in the measurement of the thickness of materials. Which statement explains why beta particles are suitable for this application?
- A They can pass through thin materials but are partially absorbed by thicker ones.
 - B They are completely blocked by all materials, making them ideal for precise measurements.
 - C They have high penetrating power, so they easily pass through all materials.
 - D They can only be detected in a vacuum, which ensures accurate readings.

NAME:		()	CLASS:	
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YISHUN TOWN SECONDARY SCHOOL

G3

PRELIMINARY EXAMINATION 2025

SECONDARY 4

G3 PHYSICS

(6091/2)

DATE : 19 Aug 2025

DAY : Tuesday

DURATION: 1 hr 45 min

MARKS: 80 marks

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.

Section A

Answer **all** the questions. Write your answers in the spaces provided.

Section B

Answer **one** question. Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

Candidates are reminded that all quantitative answers should include appropriate units.

You may use an approved calculator.

Section A	/70
Section B	/10
TOTAL	/80

This question paper consists of **21** printed pages.

Section A

Answer all questions.

1 Fig. 1.1 shows one method of measuring the diameter of a beaker.

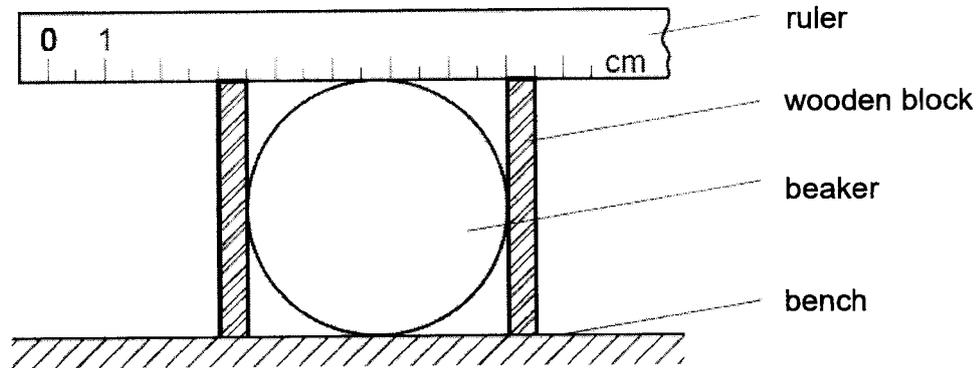


Fig 1.1

(a) State the diameter of the beaker.

..... [1]

(b) Suggest an instrument that could measure the diameter of the beaker more precisely.

..... [1]

(c) Student A makes use of the readings taken in **(a)** to calculate the base area of the beaker.

Student B makes use of the instrument in **(b)** and tells student A that his calculated area is more accurate.

State if you agree with student B and explain your answer.

.....

 [2]

2 Fig. 2.1 shows a ball being released from rest from its initial position above the ground. The ball falls vertically and rebounds.

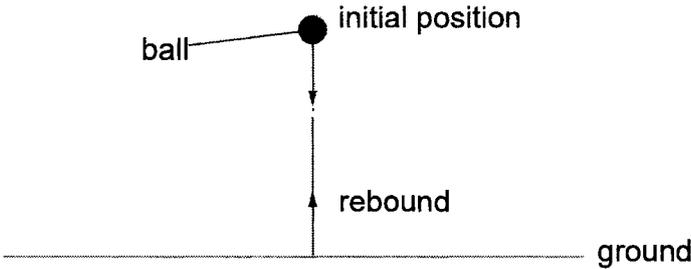


Fig. 2.1

Fig 2.2 shows how the velocity of the ball varies with time.

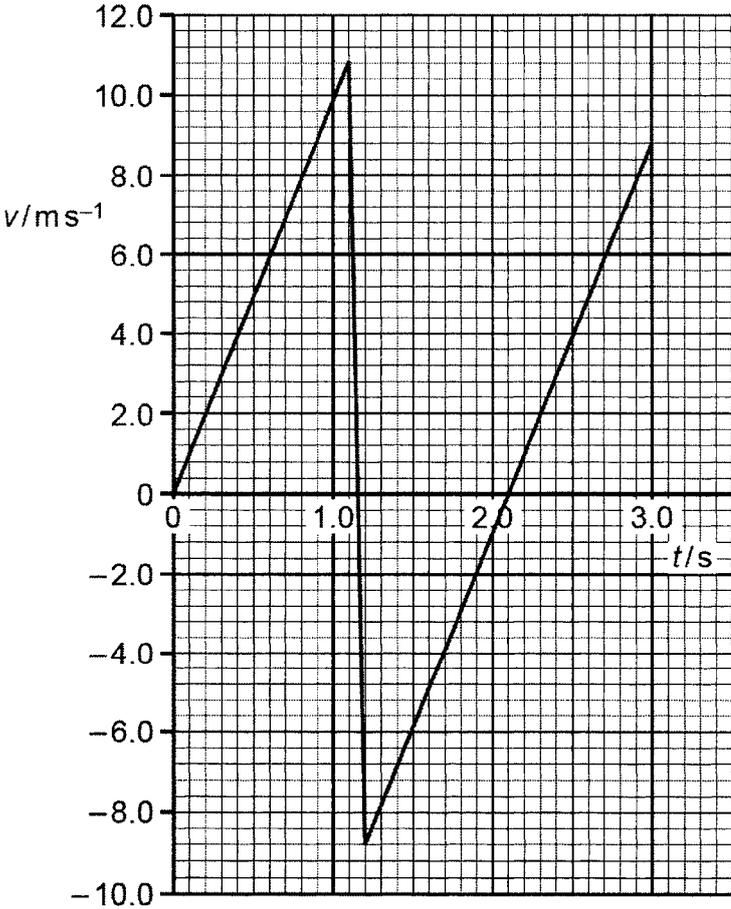


Fig. 2.2

(a) Using the information from the graph, calculate:

(i) the acceleration of the ball after it rebounds.

acceleration =[2]

(ii) the initial height the ball was released.

height =[2]

(iii) the displacement from the initial position after the ball has reached its maximum height after the first rebound.

displacement =[2]

(b) Explain how Fig. 2.2 shows that the effect of air resistance on the ball is negligible.

.....
 [1]

- 3 Fig. 3.1 shows a wheelbarrow and its load, which has a total mass of 15 kg. This is supported by a vertical force F at the end of its handles. The centre of gravity of the wheelbarrow is marked, c.g. on Fig. 3.1.

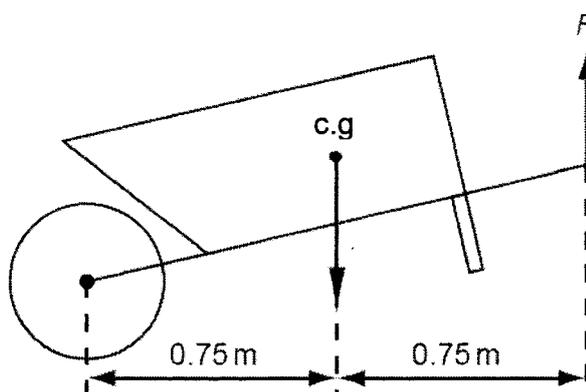


Fig. 3.1

- (a) (i) State the Principle of Moments.

.....

[2]

- (ii) Hence, determine the vertical force, F , to keep the wheelbarrow in equilibrium.

$$F = \text{.....}[2]$$

- (b) The force, F in (a)(ii) is found to have a different value from 150 N. A student says that the wheelbarrow cannot be in equilibrium since the upward forces are not equal to the downward forces.

Explain why the student is incorrect. You may draw on Fig. 3.1 to further substantiate your answer to show how the wheelbarrow is in equilibrium.

.....

 [2]

4 Fig. 4.1 shows a manometer attached to a gas cylinder.

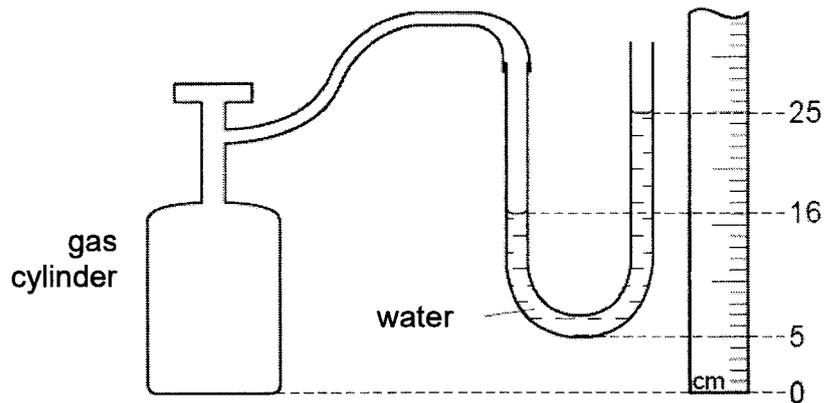


Fig. 4.1

- (a) (i) The density of water is 1000 kg/m^3 and the gravitational field strength is 10 N/kg . Calculate the pressure difference in Pa as shown by the manometer.

pressure difference = Pa [2]

- (ii) The water is replaced with an equal volume of oil with a density of 900 kg/m^3 . Determine the liquid level of the left and right arm of the manometer.

liquid level on right arm =

liquid level on left arm = [2]

(c) Determine the period of the wave.

period =[2]

(d) X is a particle on the wave at $t = 0$ s.

On Fig. 5.1, mark the new position of X at $t = 6.0$ s. Label this position Y. [1]

6 The device shown in Fig. 6.1 uses the reflection of ultrasound to measure distances.

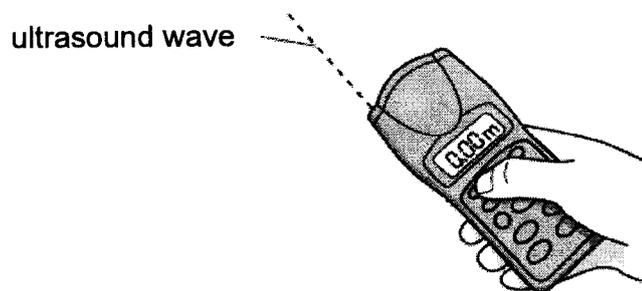


Fig. 6.1

(a) State what is meant by ultrasound.

.....
 [2]

- (b) Fig. 6.2 shows a contractor using the device to measure the width of a room.

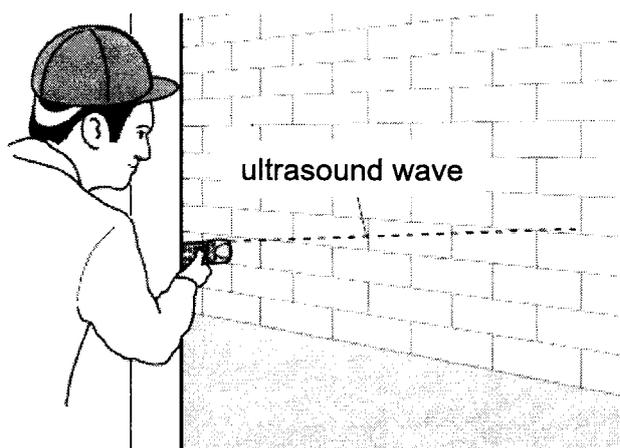


Fig. 6.2

The ultrasound device is placed against one side of the wall and it emits an ultrasound wave that reflects back from the opposite side of the wall. The time between sending out the ultrasound wave and receiving the reflection is 30 ms. The speed of ultrasound in air is 340 m/s.

Calculate the distance between the device and the opposite wall.

distance =[2]

- 7 When light passes from one optical medium to another, one physical quantity changes while the other remains constant.

- (a) State the physical quantity that changes and the one that remains constant. [1]

changes:

remains constant:

- (b) Fig. 7.1 shows the path of a light ray in a glass prism, ABC. The refractive index of the glass prism is 1.80.

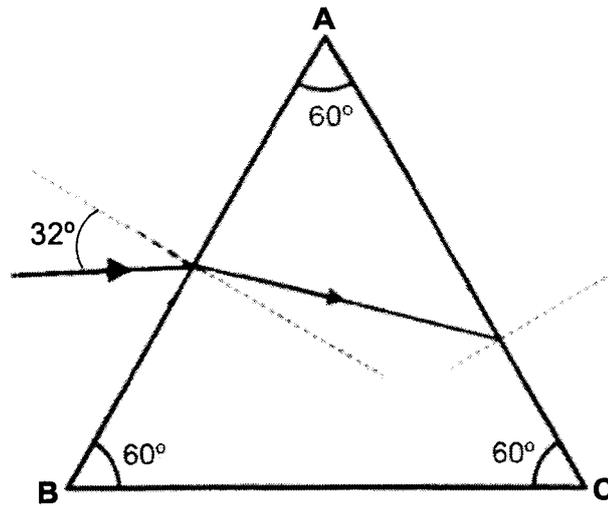


Fig. 7.1

Calculate the angle in which the light ray deviates from its original path on surface AB.

angle of deviation = [3]

- (c) On Fig. 7.2, draw a ray diagram to show how a converging lens is used in a photocopier producing identical copies of the same document. [2]

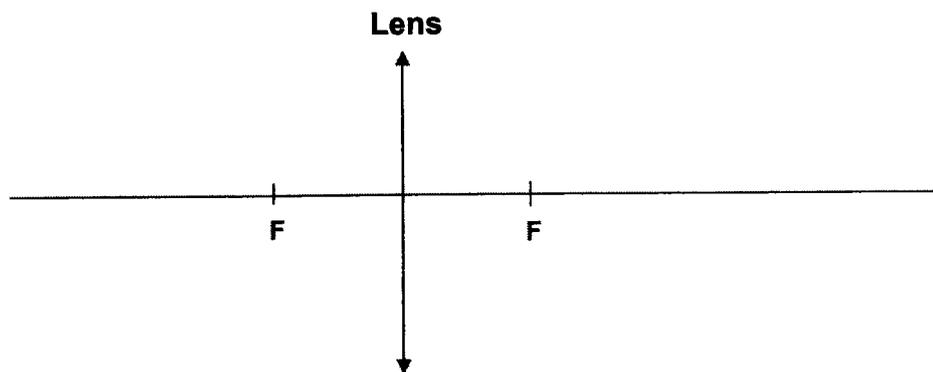


Fig. 7.2

- 8 Fig. 8.1 shows two uncharged conducting spheres, K and L, mounted on two insulating stands. A positively charged insulating rod is held next to K.

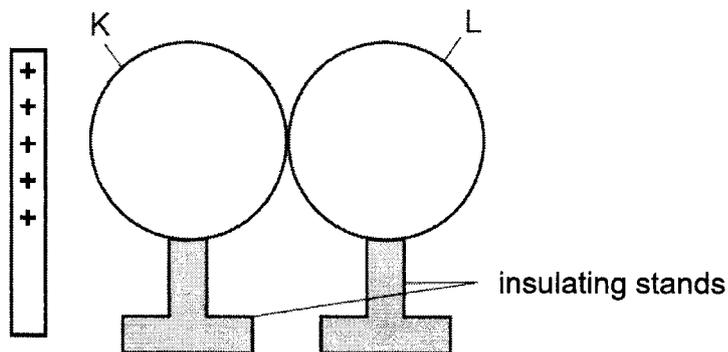


Fig 8.1

- (a) On Fig. 8.1, draw the charges on K and L. [1]

- (b) Sphere L is moved to the right, a long distance from sphere K. The positively charged rod is moved away.

State what happens to the charge on K.

.....
[1]

- (c) An earth wire is then connected to the rod. State and explain what happens to the charge on the rod.

.....

[2]

- (d) State a method to discharge the positively-charged rod.

.....
[1]

9 Sodium-24 and sodium-23 are two isotopes of sodium. Sodium-24 is a radioactive isotope that emits beta-particles and gamma-rays as it decays.

(a) The nuclide notation for the isotope sodium-24 is ${}_{11}^{24}\text{Na}$.

(i) State what is meant by an isotope.

.....
[1]

(ii) State how the composition of a nucleus of sodium-24 differs from the composition of a nucleus of sodium-23.

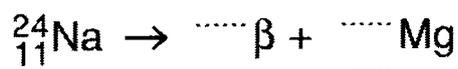
.....
[1]

(b) When a nucleus of sodium-24 emits a beta-particle, it decays to an isotope of magnesium.

(i) State the name of the particle that is identical to a beta-particle.

.....[1]

(ii) Complete the nuclide equation for the emission of a beta particle by sodium-24.
 [2]



(c) Sodium-24 is sometimes used in diagnosing medical conditions. The half-life of sodium-24 is 15 hours.

Explain why a half-life of 15 hours makes the isotope suitable for use in the human body.

.....

[2]

- 10 In an experiment, different sized metal pellets are fired from an air rifle towards an 8.0 kg block of plastic suspended from the top of a ceiling. The initial position of the block is shown in Fig 10.1, and when the pellet hits the plastic block, the block is displaced as shown in Fig 10.2.

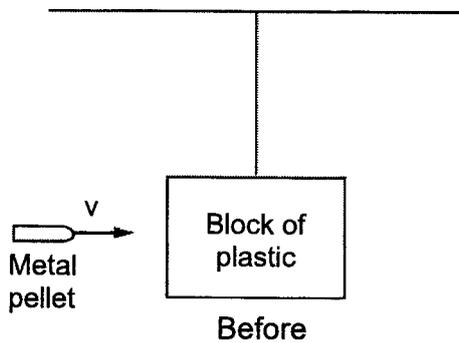


Fig. 10.1

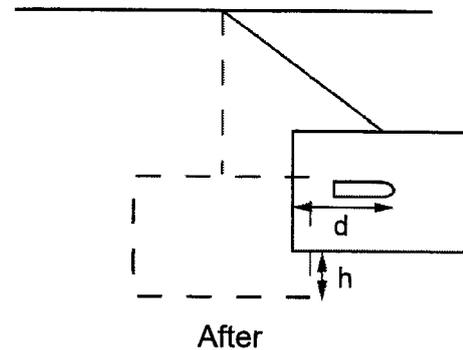


Fig. 10.2

The information obtained from the experiment is shown in the table below.

mass of pellet, m/g	speed of pellet just before it hits plastic block, v / m/s	depth of penetration by pellet, d/m	time taken for pellet to come to a stop, t / ms	maximum increase in height of plastic block, h / m
50	40	0.15	25	0.348
25	56	0.12	20	0.292
20	62	0.11	18	0.274

Take gravitational field strength as 10 N/kg.

- (a) Calculate the kinetic store of the 25 g pellet just before it hits the block of plastic.

kinetic store =[2]

- (b) Calculate the deceleration and hence, the resistive force acting on the 25 g pellet.

deceleration =[2]

resistive force =[1]

- (c) Calculate the work done by the 25 g pellet against friction.

work done =[2]

- (d) Show that there is a discrepancy between the experimental and theoretical values for the increase in height of the plastic block. [3]

11 A potential divider circuit is set up as shown in Fig. 11.1.

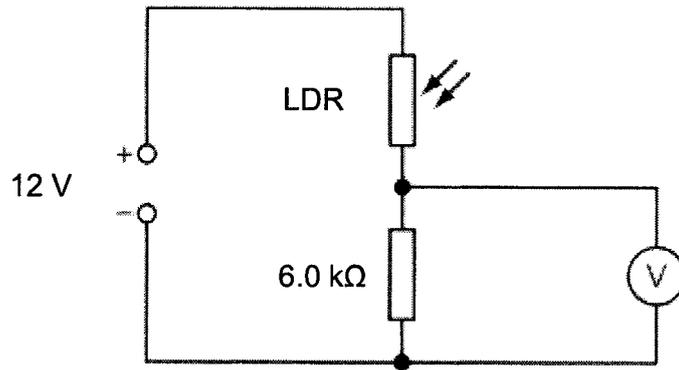


Fig. 11.1

When light shines on the LDR, the resistance of the LDR is 2.0 kΩ

(a) (i) Calculate the reading of the voltmeter when light is shining on the LDR.

voltmeter reading =[2]

(ii) Determine the current in the LDR.

current =[2]

(b) The brightness of the light on the LDR decreases.

State and explain what happens to the reading on the voltmeter.

.....

[2]

- (c) (i) A filament lamp is connected in parallel to the LDR. The brightness of the lamp does not affect the LDR in any manner.

Suggest a use for such a set-up.

.....
..... [1]

- (ii) On Fig. 11.2, sketch a current-voltage graph for the lamp. [1]

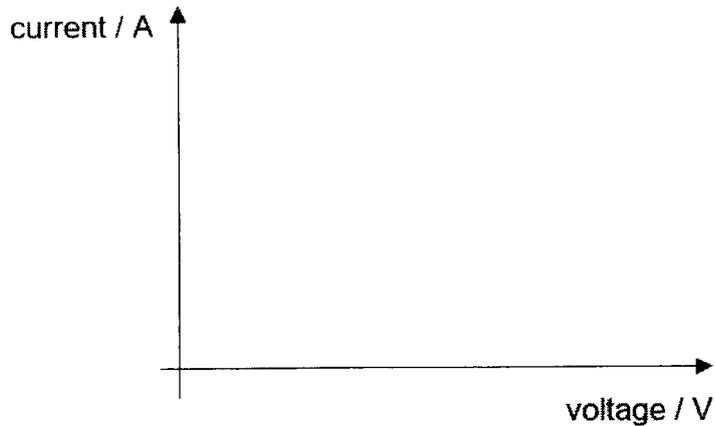


Fig. 11.2

- (iii) State and explain how a current-voltage graph for a fixed resistor is different from the graph for a filament lamp.

.....
.....
.....
..... [2]

Section B

Answer **one** question from this section.

12 Fig 12.1 shows an electric kettle.

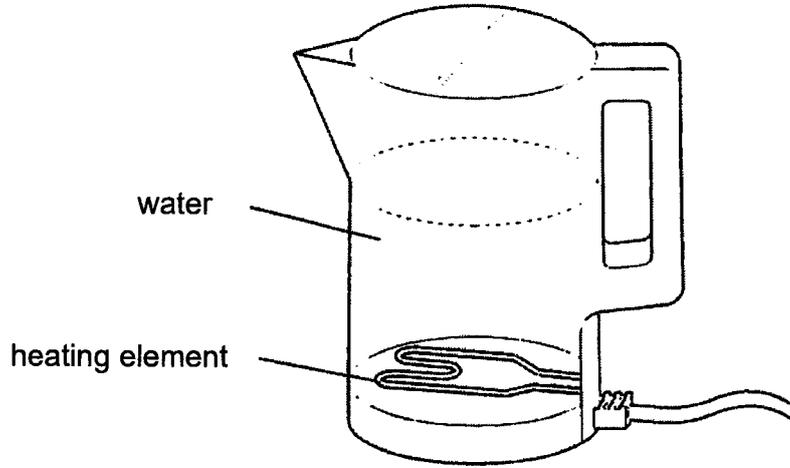


Fig. 12.1

- (a) (i)** State the main process in which thermal energy is transferred from the heating element to the water around it.

.....[1]
- (ii)** Explain how the water in the electric kettle is heated.

.....

.....

.....[2]
- (iii)** Suggest a colour for the outer casing of the kettle, in order for the water to be kept warm for a longer time. Explain your choice.

.....

.....[1]

- (b) 200 g of boiling water from the electric kettle is poured into a ceramic cup.

Ice cubes with a total mass of 100 g were dropped into the cup of hot water. The ice cubes were initially all solid at 0 °C.

The specific heat capacity of water is 4200 J /kg K and specific latent heat of fusion of water is 334 000 J / kg.

Ignore any thermal energy loss to the cup and the surroundings in the calculations.

- (i) Calculate the thermal energy gained by the 100 g of ice to melt completely.

thermal energy =[2]

- (ii) The melted ice and hot water in the cup eventually reached thermal equilibrium. Calculate the final temperature of the water in the cup.

temperature =[2]

- (iii) The electric kettle has an electrical power input of 2000 W. It took 5.0 minutes to heat the 200 g of water to its boiling point. Each kWh of electrical energy costs 26 cents.

Calculate the cost of using the kettle to heat the 200 g of water.

cost =[2]

13 Two coils, A and B, are placed one on top of the other, as shown in Fig. 13.1a.

Coil A is connected in series with a battery and a switch. A millivoltmeter is connected across the terminals of coil B.

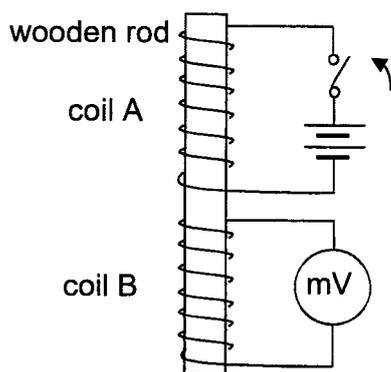


Fig. 13.1a

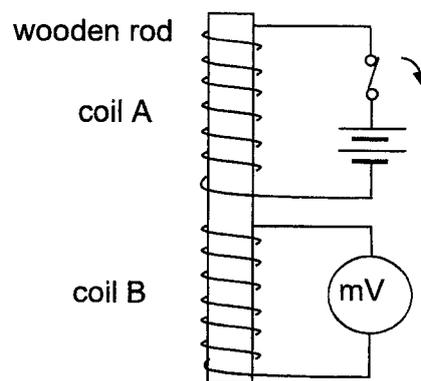


Fig. 13.1b

(a) Describe what happens to the reading in the millivoltmeter when the switch is closed in Fig. 13.1a.

.....

.....

.....[2]

(b) (i) On Fig. 13.1b, draw an arrow on coil B to show the direction of the induced current in coil B when the switch was just opened. [1]

(ii) Explain the direction drawn in (b)(i).

.....

.....

.....

.....

.....

.....

.....

.....

.....[2]

- (c) Fig 13.2 shows two coils of insulated wire wound on an iron core to make a transformer. One coil is connected to a 16 V a.c. supply. The other coil is connected to a lamp, which is rated 12 V, 24 W.

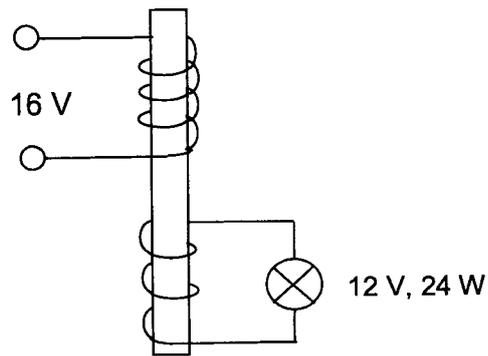


Fig 13.2

Given that the lamp is operating optimally, calculate the minimum current drawn from the 16 V supply.

minimum current =[2]

- (d) It is found that the current drawn from the supply is 1.7 A.

- (i) Calculate the input power to the transformer.

input power =[1]

(ii) Calculate the power loss by the transformer.

power loss =[1]

(iii) State one reason why a transformer is not 100% efficient.

.....
.....[1]

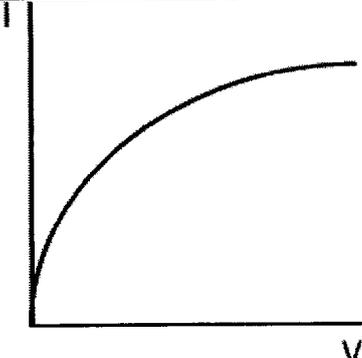
YTSS 4E PHYSICS PRELIM ANS KEY

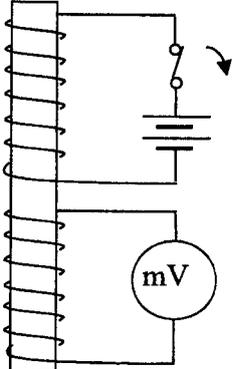
Ques	Ans	Ques	Ans	Ques	Ans	Ques	Ans
1	D	11	C	21	C	31	D
2	C	12	A	22	B	32	D
3	B	13	D	23	B	33	D
4	C	14	A	24	B	34	C
5	A	15	A	25	B	35	A
6	C	16	D	26	D	36	D
7	C	17	C	27	A	37	D
8	A	18	D	28	A	38	A
9	A	19	B	29	C	39	D
10	B	20	A	30	D	40	A

		To award for answers based on intermediate working so long physics concept shown is correct / logical -1 max for sf (per question) -1 max for unit (per question)	
1	(a)	4.5 cm [1]	
	(b)	Digital calipers or vernier calipers [1]	Digital micrometer is not accepted.
	(c)	Do not agree with student B. [1] The instrument could be more precise but not necessarily accurate. [1]	Award zero if agree with student B
2	(ai)	Acceleration = $(8.8 - 0) / (3.0 - 2.1)$ [1] $a = 9.8 \text{ m/s}^2$ [1]	Award 1m for any correct value of time or velocity
	(aii)	Initial height = $0.5 \times 10.8 \times 1.1$ [1] $= 5.9 \text{ m}$ [1]	Award 1m if show idea of area of triangle AND at least time or velocity is correct.
	(aiii)	new max height = $0.5 \times 8.8 \times 0.9 = 4.0 \text{ m}$ [1] displacement = $5.9 - 4.0 = 1.9 \text{ m}$ [1]	If new max height is incorrect, max 1m for showing difference in heights.
	(b)	The gradient of the graph is constant, showing that air resistance does not affect the acceleration. Do not just accept acc is constant	[1] Ans MUST have reference to fig.
3	(ai)	It states that, The sum of CW moments about a pivot is equal to the sum of ACW moments about the same pivot	[1]

		For a system/object to be in equilibrium	[1]
	(aii)	$F \times 1.5 = 150 \times 0.75$ [1] $F = 75 \text{ N}$ [1]	Award max 1m if ans wrong but one side of eqn correct.
	(b)	There is a normal contact force upwards on the pivot. Therefore, weight will balance out with normal contact force AND the force F.	[1] [1]
4	(ai)	$P_{\text{diff}} = 1000 \times 10 \times 0.09 \text{ m}$ [1] $= 900 \text{ Pa}$ [1]	Max 1m if didn't convert cm to m.
	(aii)	New height difference = 0.10 m Hence, right side must rise by 0.05 cm, left side drops by 0.05 cm. Right side, 25.5 cm, left side, 15.5 cm Accept RHS, 26, LHS, 16 ONLY if 25.5 and 15.5 is shown in working	[1] [1]
	(b)	It cannot (give BOD to student even if explanation wrong) The pressure due to water (or oil) is not enough to balance out the pressure due to gas (or manages to explain that most of the pressure balance comes from P_{atm})	[1] [1]
5	(a)	It is a disturbance in which the direction of vibration of particles is perpendicular to the direction of wave travel.	[1] Do not accept move perpendicular
	(b)	The wave travels 1.0 cm in 2 seconds. Hence, speed = 0.50 cm/s	[1]
	(c)	Wavelength = 6.0 cm Speed = 0.50 cm/s Period = $6.0 / 0.50 = 12 \text{ s}$	[1] [1]
	(d)	Y is directly above X, displacement of 2.0 cm	[1]
6	(a)	Sound that cannot be heard by humans. With a frequency above 20kHz	[1] [1]
	(b)	$v = 2d / t$ $340 = 2d / 0.030$ $d = 5.1 \text{ m}$ Max 1m if forgot distance multiply by 2, or forgot to convert ms	[1] [1]
7	(a)	Changes: velocity or speed Remains constant: frequency	[1] for both correct
	(b)	$1.80 = \sin 32 / \sin r$ $r = 17^\circ$ angle of deviation = $90 - 58 - 17 = 15^\circ$	[1] [1] [1]

	(c)		<p>[1] all rays sketched correctly</p> <p>[1] image must be same size as object and object at 2F</p>
8	(a)	<p>-ve charges on left side of K ONLY</p> <p>+ve charges on right side of L ONLY</p>	[1] need to balance at least the spheres, +ve and -ve
	(b)	K becomes negatively charged.	[1]
	(c)	<p>The rod remains positively charged. (BOD even if student explain wrong)</p> <p>Electrons are not able to move freely in an insulator.</p>	<p>[1]</p> <p>[1]</p>
	(d)	<p>By bringing the rod to a humid environment.</p> <p>OR</p> <p>Exposing it to ionized air</p> <p>OR</p> <p>Discharge by friction / rubbing</p>	<p>[1]</p> <p>Do not accept heating as its not practical</p>
9	(ai)	Isotopes are atoms with the same no. of protons but different no. of neutrons	[1]
	(aii)	Sodium 24 will have 1 more neutron than sodium 23.	[1]
	(bi)	Electron	[1]
	(bii)	${}_{11}^{24}\text{Na} \rightarrow {}_{-1}^0\beta + {}_{12}^{24}\text{Mg}$	<p>[1] for beta particle</p> <p>[1] for magnesium</p>
	(c)	<p>A half life of 15 hours is a relatively short time and the isotope will decay quickly. (or doesn't stay radioactive)</p> <p>This limits the amount of time of radiation exposure, or less ionizing over time</p>	<p>[1]</p> <p>[1]</p>
10	(a)	$\text{KE} = \frac{1}{2}mv^2$ $= 0.5 \times 0.025 \times 56^2$ $= 39 \text{ J}$	<p>[1]</p> <p>[1]</p> <p>Max 1m for forgetting conversion, or square of velocity</p>
	(b)	$a = (v-u)/t$ $= (0 - 56)/0.02$ $= -2800 \text{ m/s}^2$ <p>Deceleration = 2800 m/s²</p> $F = ma$ $= 0.025 \times 2800$ $= 70 \text{ N}$	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>Must show understanding of final-initial velocity</p>
	(c)	<p>work done = F x d</p> $= 70 \times 0.12$ $= 8.4 \text{ J}$	<p>[1]</p> <p>[1]</p>

	(d)	By the Principle of Conservation of Energy $KE = WD + GPE$ $39 = 8.4 + GPE$ [1] $GPE = 30.6 \text{ J}$ (Since $GPE = mgh$) $30.6 = mgh$ $h = (30.6) / (0.025 + 8.0)(10)$ $= 0.384 \text{ m}$ (theoretical value) [1]	Max 1m for effort to show difference in experimental and theoretical values (CASE BY CASE)
11	(ai)	$V_{out} = 12 \times 6000 / 8000$ [1] $V_{out} = 9.0 \text{ V}$ [1]	
	(aii)	$I = V / R$ $I = 12 / 8000$ [1] $I = 0.0015 \text{ A}$ [1]	1m max for failure to convert kilo ohm
11	(b)	When the brightness decreases, the resistance of the LDR will increase. Since the LDR and resistor are in series, the ratio of resistance of LDR : fixed resistor will increase, resulting in a smaller reading in the voltmeter. (award 1m for correct understanding of how V is related to R of resistor)	[1] [1] Or similar explanation. If stu just write V is larger, max 1m
	(ci)	An automatic lighting system	[1]
	(cii)		[1]
	(ciii)	The I-V graph for a fixed resistor would be a straight line graph <u>passing through the origin OR mention current is directly proportional to voltage</u> As the fixed resistor would follow Ohm's law	[1] [1]
12	(ai)	Conduction	[1]
	(aii)	Water near the element gains heat, becomes less dense and starts to rise. The cooler water above starts to sink due to density differences. This bulk movement of fluid sets up a <u>convection current</u> , heating the water throughout.	[1] [1]
	(aiii)	It should be white, as white is a poor emitter of heat.	[1]

	(bi)	$L_f = ml_f$ $= 100 \times 334$ $= 33000 \text{ J}$	[1] [1] Can award 1m for conversion if the other parts wrong
	(bii)	heat gained by ice = heat loss by water $33400 + m_{\text{ice}}c_{\text{water}}T = m_{\text{water}}c_{\text{water}}(100 - T)$ $33400 + 100 \times 4.2 \times T = 200 \times 4.2 (100 - T)$ $33400 + 420 T = 84000 - 840T$ $T = 40^\circ \text{ C}$	Max 1m for ans wrong, 1side of eqn correct [1] [1]
	(biii)	$E = 2 \text{ kW} \times 5/60\text{h}$ $E = 0.17 \text{ kWh}$ Cost = $0.17 \times 0.26 = \$0.044$	[1] [1]
13	(a)	The millivoltmeter will first show an emf reading And the reading will then return to zero.	[1] [1]
	(bi)	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>wooden rod</p> <p>coil A</p> <p>coil B</p> </div>  </div>	Arrows on coil B to the right
	(bii)	Coil A initially has a S pole nearest to coil B. When the switch is opened, the change in magnetic field causes the coil B to have a N pole induced at the end closer to coil A to oppose the change. (attract it back) Using right-hand grip rule, we can determine the direction of the induced current drawn in b (i).	[1] [1]
	(c)	Current in lamp = $24 / 12 = 2.0 \text{ A}$ $V_s/V_p = I_p/I_s$ $12/16 = I_p/2$ $I_p = 1.5 \text{ A}$	[1] [1]
	(di)	Input power = $VI = 16 \times 1.7 = 27 \text{ W}$	[1]
	(dii)	Power loss = $27.2 - 24 = 3.2 \text{ W}$	[1]
	(diii)	There will be some energy loss in the form of heat due to resistance.	[1]

