Anglican High School
Secondary Four
Preliminary Examination
2025

S4

CANDIDATE NAME

CLASS 4 | INDEX NUMBER

PHYSICS
Paper 1 Multiple Choice

6091/01
29 August 2025
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction tape.
Write your name, index number and class on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. 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.

Read the instructions on the Answer Sheet very carefully

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this question paper.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **18** printed pages.

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1 Which pair of units measure the same quantity?

A A and C / s

B W and J s

C N and kg m / s

D N m^2 and Pa

2 Which instrument can be directly used to measure the circumference of a cup?

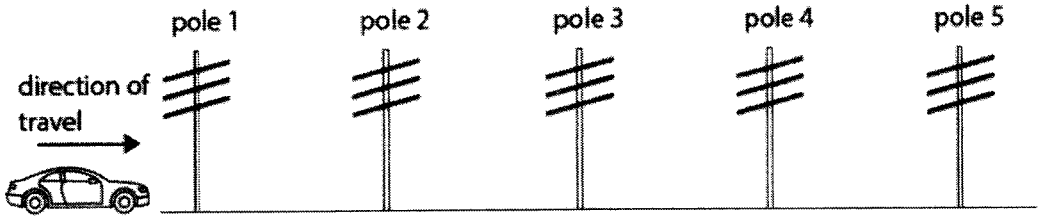
A digital calipers

B measuring tape

C digital micrometer screw gauge

D metre rule

3 Five poles are positioned equally apart along a straight road. A car starts from rest and accelerates at an increasing rate from pole 1 to pole 2 till it reaches maximum acceleration. It then continues with this maximum acceleration from pole 2 to pole 3. The car then travels along the road with zero acceleration until it reaches pole 4. Between pole 4 and 5, it starts to decelerate at a decreasing rate.



(no to scale)

The time intervals for the car to travel between the poles are measured.
Which time interval is the shortest?

A pole 1 to pole 2

B pole 2 to pole 3

C pole 3 to pole 4

D pole 4 to pole 5

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4 A small jet plane is at rest on a runway, ready for take-off. The average acceleration during take-off is 2.2 m / s^2 and the minimum speed required for take-off is 66 m / s. What is the minimum length of runway required for the jet plane to take off?

A 150 m

B 990 m

C 1500 m

D 1900 m

5 A man of mass 50 kg stands on an electronic balance in a lift. The balance reads 600 N. The gravitational field strength, g is 10 N / kg.
Which of the following describes the motion of the lift?

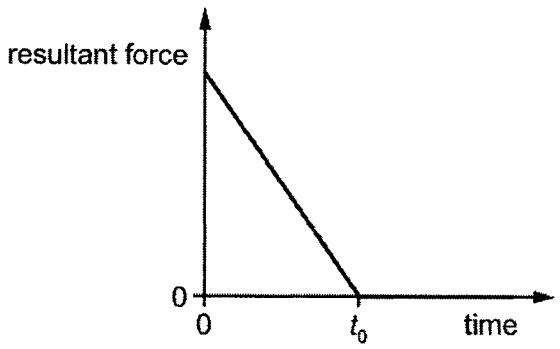
A accelerating upwards

B accelerating downwards

C moving upwards with constant speed

D moving downwards with constant speed

6 A resultant force acts on an object and causes it to move in a straight line. The graph shows how the resultant force on the object varies with time.



Which of the following is true about the motion of the object?

A The object accelerates at a constant rate until it reaches a constant velocity.

B The object accelerates at a decreasing rate until it reaches a constant velocity.

C The object decelerates at a constant rate and finally come to rest.

D The object decelerates at a decreasing rate and finally come to rest.

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7 35 g of liquid Z is poured into a measuring cylinder containing 56 g of paraffin oil. Liquid Z is insoluble in the oil and the total volume of the substances in the cylinder is 90 cm^3. Given that the density of paraffin oil is 0.80 g / cm^3, what is the density of liquid Z?

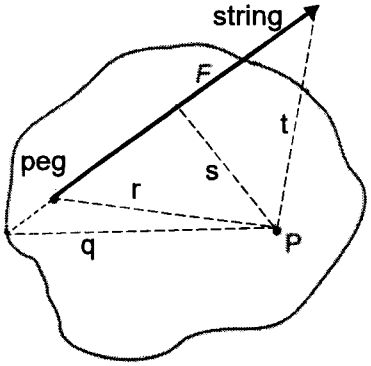
A 0.50 g / cm^3

B 0.78 g / cm^3

C 1.0 g / cm^3

D 1.8 g / cm^3

8 An object is pivoted at point P. A student ties a length of string to a peg on the object. He pulls the string with a force F in the direction shown.



What is the moment of the force F about the point P?

A F x q

B F x r

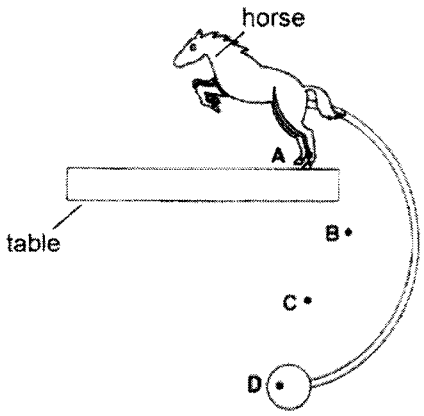
C F x s

D F x t

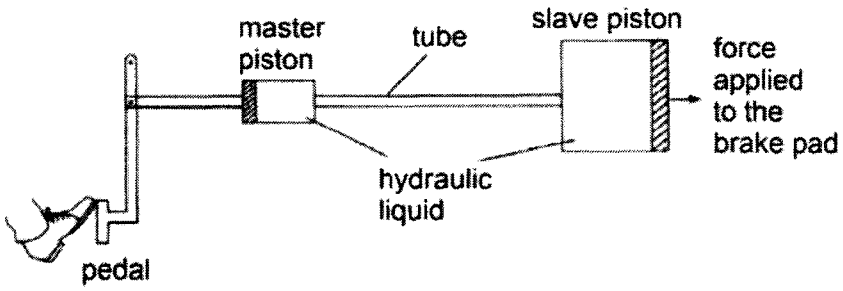
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9 The diagram shows the rest position of a balancing toy near the edge of a table.

Which position is most likely to be the centre of gravity of the toy?



10 The diagram shows a hydraulic brake system used in vehicles.



A tube links the master piston to the slave piston. Both pistons are cylindrical and the area of the slave piston is four times that of the master piston. The driver presses down on the pedal and a force of 450 N is applied on the master piston.

What is the force applied by the slave piston to the brake pad?

A 113 N

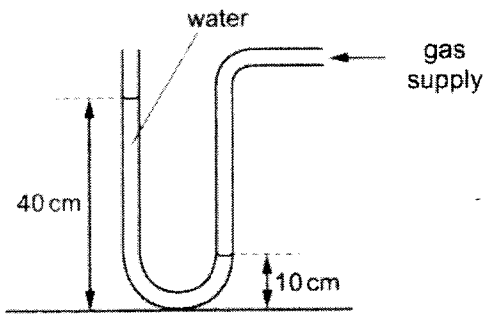
B 225 N

C 900 N

D 1 800 N

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11 A manometer containing water is used to measure the pressure of a gas supply, as shown. The gravitational field strength, g is 10 N / kg.



The atmospheric pressure is 76 cm Hg.

The density of mercury is 13 600 kg / m^3 and density of water is 1000 kg / m^3.

What is the pressure of the gas supply?

A 100 000 Pa

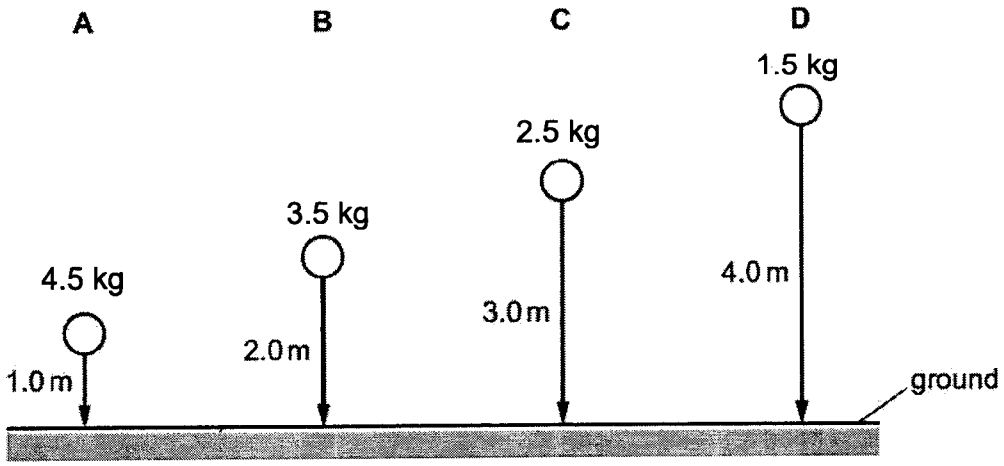
B 104 000 Pa

C 106 000 Pa

D 144 000 Pa

12 Four balls with different masses are dropped from the heights shown. Air resistance may be ignored. The acceleration due to gravity g, is 10 m / s^2.

Which ball has the largest energy in its kinetic store just before it hits the ground?

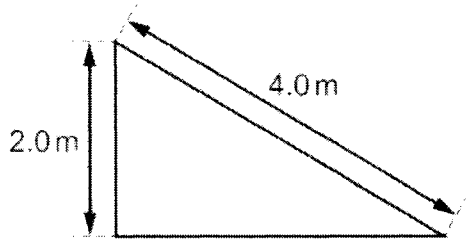


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13 A box is initially at rest at the top of a rough slope. The box slides down the slope.

The mass of the box is 2.0 kg and gravitational field strength, g is 10 N / kg.

The slope is 4.0 m long and 2.0 m high.



The frictional force acting on the box is 2.6 N.

What is the speed of the box as it reaches the bottom of the slope?

A 5.4 m / s

B 6.3 m / s

C 7.1 m / s

D 9.5 m / s

14 Electromagnetic waves from the Sun are absorbed by solar panels with a total area of 12 m^2. Every 1.0 m^2 of the solar panels absorbs 0.85 kJ of energy from the Sun each second.

If the efficiency of the panels is 16 %, what is the power output of the panels?

A 1.6 kW

B 2.2 kW

C 64 kW

D 160 kW

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15 Brownian motion can be observed in small magnetic particles suspended in a fluid.

What causes the motion of the small magnetic particles?

A The collisions of the small magnetic particles with each other.

B The gravitational forces acting on the small magnetic particles in the fluid.

C The presence of magnetic fields within the fluid.

D The fluid particles bombarding the small magnetic particles.

16 A bicycle tyre contains air. When the bicycle is in motion, the air in the tyre becomes warmer and the air pressure inside the tyre increases. The volume of the tyre remains unchanged.

Which description about the air particles in the tyre when the bicycle is in motion is correct?

	force exerted on the inner walls of tyre by air particles	frequency of collisions between air particles and inner walls of tyre
A	increase	increase
B	increase	unchanged
C	unchanged	increase
D	unchanged	unchanged

17 Energy in the internal store of the following objects is dissipated to the surroundings.

Which object transferred its energy by radiation only?

A a concrete block with white surfaces at 100 °C in air

B a metal block with black surfaces at 40 °C in air

C a shiny metal satellite at 30 °C in outer space

D the heating element of a kettle at 150 °C in water

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18 Two objects, A and B, are placed in physical contact with one another. They have the same temperature. Assume there is no energy transfer to the surrounding media.

Which statement is correct?

A There is energy transfer from all molecules in A to all molecules in B.

B There is energy transfer from some molecules in A to some molecules in B, as well as from some molecules in B to some molecules in A.

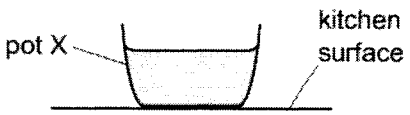
C There is energy transfer from some molecules in A to some molecules in B, but no energy transfer from some molecules in B to some molecules in A.

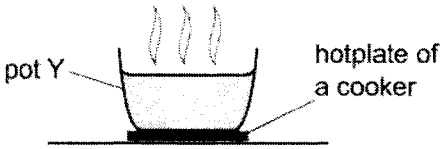
D There is no energy transfer between any molecule in A to any molecule in B.

19 Pot X and pot Y are both in a cool room.

Pot X contains hot water below its boiling point.

Pot Y is identical to pot X but contains water that is kept boiling by a hotplate underneath it.





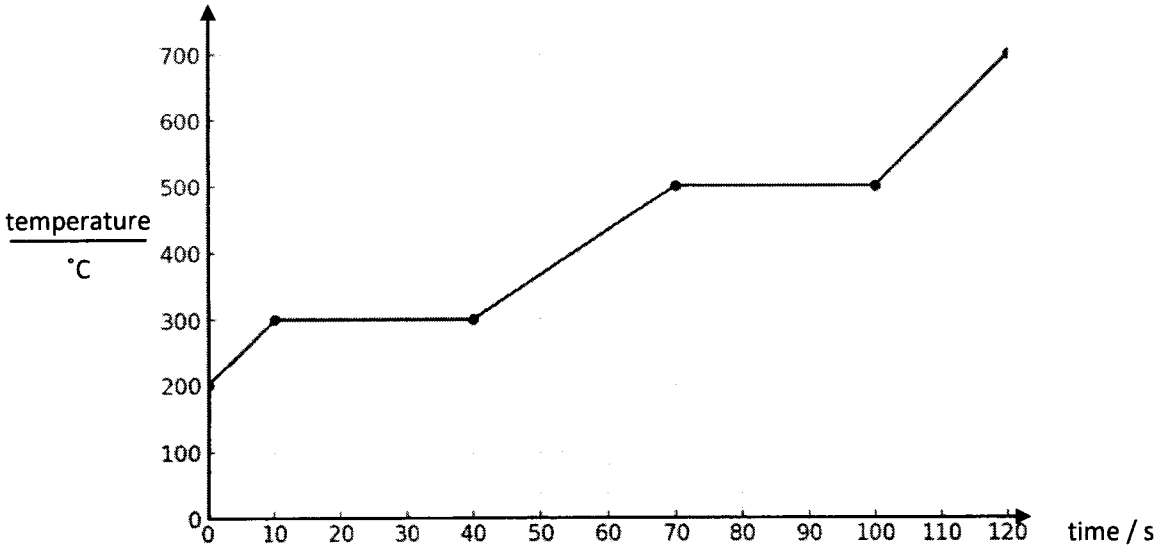
What happens to the average kinetic energy of the water particles in pot X and pot Y?

	kinetic energy of liquid particles in pot X	kinetic energy of liquid particles in pot Y
A	decreases	increases
B	decreases	stays the same
C	stays the same	increases
D	stays the same	stays the same

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20 A solid substance is heated at a constant rate by an electric heater.

The graph shows how the temperature of the substance changes as it is heated by a 1000 W heater.



Which statement about the substance is correct?

A The melting point of the substance is 500 °C.

B The specific latent heat of fusion is greater than the specific latent heat of vaporisation.

C The specific heat capacity of the substance in liquid state is larger than the specific heat capacity of the substance in solid state.

D The specific heat capacity of the substance in gaseous state is larger than the specific heat capacity of the substance in solid state.

21 What is meant by the term *wavefront*?

A the distance between successive crests of a wave

B the distance between the trough and the crest of a wave

C a line joining points along the crest of a wave

D a line joining the trough and a the crest of a wave

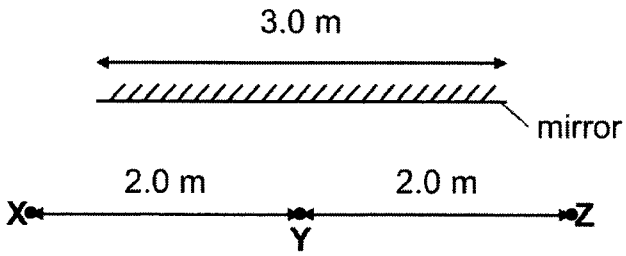
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22 Which of the following correctly shows examples of a transverse and longitudinal waves?

	longitudinal	transverse
A	Sound	gamma-rays
B	water waves	infrared
C	Light	radio
D	X-rays	sound

23 Three student stand 2.0 m apart in front of a plane mirror that is 3.0 m long.

Student Y is standing opposite the mid-point of the mirror.



How many students can see the images of the other 2?

A 0

B 1

C 2

D 3

24 Radio waves, visible light, and X-rays are part of the electromagnetic spectrum.

Which of the following show them in ascending order of wavelength?

A radio waves, visible light, X-rays

B radio waves, X-rays, visible light

C X-rays, radio waves, visible light

D X-rays, visible light, radio waves

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25 Below are four statements about the uses of electromagnetic radiation.

i. Gamma rays are used in medical treatment.

ii. Ultraviolet waves are used in sunbeds.

iii. Microwaves are used in mobile phones.

iv. X-rays are used in intruder alarms.

How many of the statements are correct?

A 0

B 1

C 2

D 3

26 Which of the following will **not** attract small pieces of aluminum when placed near it?

A an earthed metal rod rubbed with a feather duster

B a plastic comb pulled through dry hair

C a plastic rod rubbed with a piece of cloth

D a rubber balloon rubbed against a shirt

27 A neutral conductor is brought into contact with a positively charged conductor.

What happens to the neutral conductor?

A It remains neutral as no electrons are transferred.

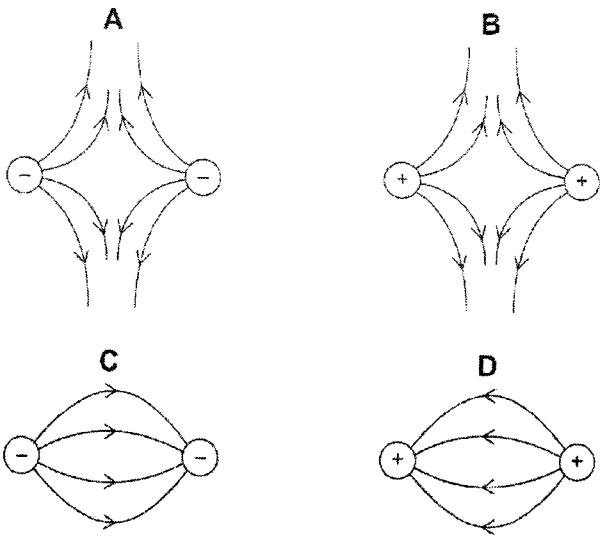
B It becomes negatively charged due to the transfer of electrons.

C It becomes positively charged due to the transfer of protons.

D It becomes positively charged due to the transfer of electrons.

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28 Which diagram correctly shows the electric field pattern in between two isolated point charges?



29 The potential difference across a conductor is 12 V.

How much energy is transferred when 100 C of charge flows through it?

A 0.12 J

B 8.3 J

C 88 J

D 1200 J

30 Why can birds stand on an overhead transmission line without getting an electric shock?

A Their bodies have very high resistance.

B Their feet are very good electrical insulators.

C There is no potential difference between their feet.

D The air trapped in their feathers is an insulator.

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31 Which of the following changes causes a wire to double its resistance?

	diameter	length
A	halve	double
B	halve	halve
C	double	double
D	double	halve

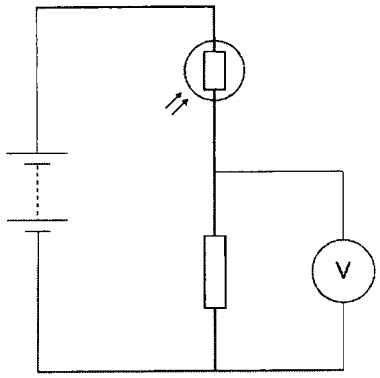
32 A circuit with a light dependent resistor (LDR) is used to detect changes in light levels.

In sunlight, the LDR has a resistance of 200 kΩ.

In moonlight, the LDR has a resistance of 2.0 MΩ.

The fixed resistor has a resistance of 1.0 MΩ

What are the voltmeter readings in sunlight and in moonlight?



	in sunlight / V	in moonlight / V
A	2.0	8.0
B	8.0	4.0
C	4.0	10
D	10	4.0

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33 For all devices, the switch is always connected to the live wire.

Which of the following best explains why?

A No current flows in the neutral wire of the device.

B The device can be made to be at zero potential.

C The device can never be switched off if the switch is connected to the neutral wire.

D The earth wire is not always necessary.

34 A house owner replaces a blown fuse for the lights in the house. When the lights are switched on, the second fuse also blows. The owner then decides to use a third fuse with a higher rating than the previous two.

Why is this **not** the correct thing to do?

A The fuse rating must be exactly equal to the operating current.

B The third fuse will melt because its rating is too high.

C If the fuse rating is too high, it can cause electric shocks.

D The lights may work but the fault is not corrected.

35 Which of the following will prove that a metal bar is a permanent magnet?

A it attracts another magnet

B it repels another magnet

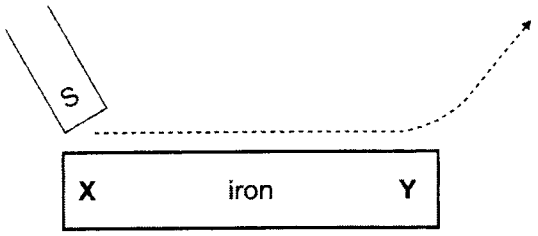
C it can be given an electric charge

D it attracts both ends of a compass needle

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36 A piece of iron can be magnetised by stroking it with a magnet.

When the magnet is moved in the direction shown, which poles are produced at X and Y?



	X	Y
A	north	north
B	north	south
C	south	north
D	south	south

37 Which of the following has **no** effect on the size of the turning effect acting on the coil of an electric motor?

A the size of the current in the coil

B the direction of the current in the coil

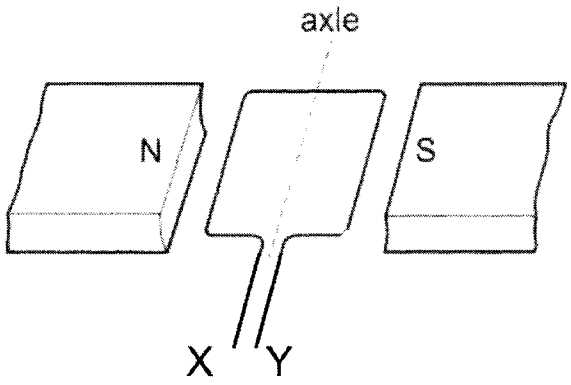
C the number of turns in the coil

D the strength of the magnetic field

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38 The diagram shows a coil in a magnetic field. The coil is to be used in a d.c. motor.

What must be connected directly to X and Y?



What must be directly connected to X and Y?

A split rings

B slip rings

C direct current supply

D carbon brushes

39 Why is the core of most transformers made of iron?

A iron is a good electrical conductor

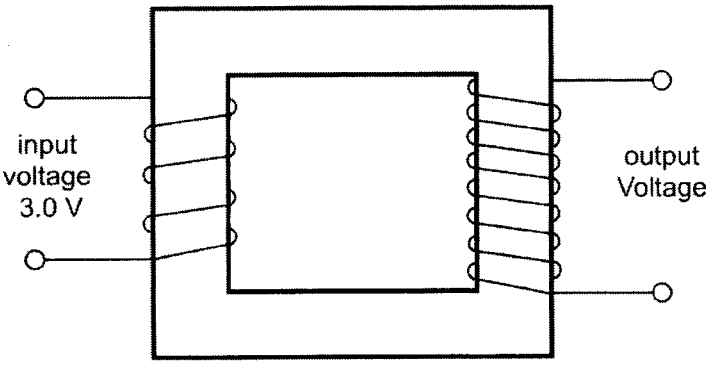
B iron is cheaper than copper

C iron is easily magnetised and demagnetised

D iron can be made into a permanent magnet

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40 An ideal step-up transformer has an input voltage of 3.0 V and an input current of 2.0 A



Under these conditions, what output voltage and output current can be obtained?

	output voltage / V	output current / A
A	1.0	6.0
B	2.0	3.0
C	4.0	1.0
D	6.0	1.0

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Anglican High School
Secondary Four
Preliminary Examination
2025

S4

CANDIDATE NAME

CLASS 4

INDEX NUMBER

PHYSICS
Paper 2 Theory

6091/02
26 Aug 2025
1 hour 45 min

	Marks
Section A	
Section B	
s.f. error	
Total (80)	

Candidates answer on the Question Paper.

No additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all your work.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction tape.

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

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

Assessment noted by :

_____

Name of Parent/Guardian

_____

Signature of Parent/Guardian

Date : _____

Candidates are reminded that **all** quantitative answers should be given to appropriate units and rounded off to the appropriate number of significant figures.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

This Question Paper consists of **22** printed pages including this cover page.

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Section A

Answer **all** questions in this section.

1 **(a)** The second, metre and kilogram are all SI units of base quantities.

Name **two** other base quantities whose SI units are not stated above.

1 .....

2 ..... [2]

(b) **(i)** Circle the value for the prefix *deci*.

10^{-9} 10^{-6} 10^{-3} 10^{-2} 10^{-1} 10^{3} 10^{6} 10^{9} 10^{12}

[1]

(ii) Rearrange the following prefixes in order from the largest value to the smallest value.

n μ G m k

..... [1]

[Total: 4]

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2 A car is travelling at 30 m / s towards the East from start point A. Fig. 2.1 represents the velocity-time graph of the car for a duration of 90 s.

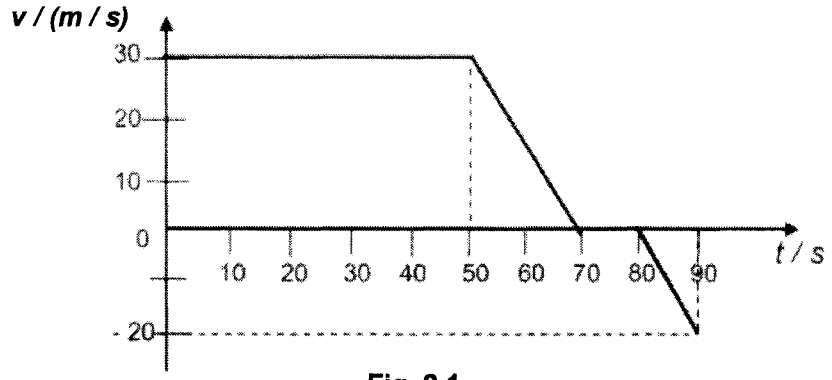


Fig. 2.1

(a) Calculate the displacement of the car from point A at t = 90 s.

displacement from point A = ... [2]

(b) Describe the motion of the car from t = 80 s to t = 90 s.

.....

.....

..... [2]

[Total: 4]

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3 Fig. 3.1 shows a load of mass 8.0 kg hanging from two strings.

When the load is stationary, the tension in the string on the left is 40 N. Using a labelled vector diagram, determine the tension in the other string, T_1.

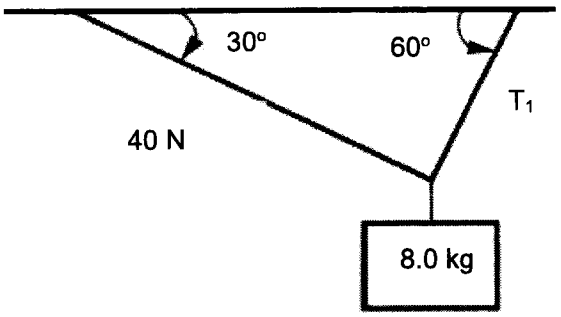


Fig. 3.1

Tension T_1 = ... [3]

[Total: 3]

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4 Fig. 4.1 shows a worker carrying a ladder on his shoulder. There is a bucket of weight 20 N hanging at one end of the ladder, 1.3 m away from the worker's shoulder. The ladder has a mass of 1.6 kg, and its centre of mass is 0.85 m from the worker's shoulder. The gravitational field strength, *g* is taken to be 10 N / kg.

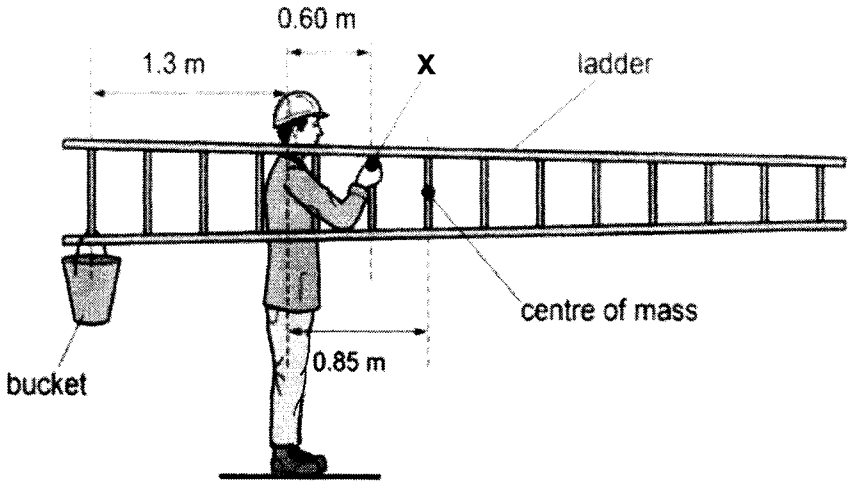


Fig. 4.1

The worker uses his hand to apply a vertical force at point X, on the ladder to keep the ladder horizontal. The horizontal distance of this force from his shoulder is 0.60 m.

(a) State the *principle of moments*.

.....

.....

..... [2]

(b) Determine the force exerted by the worker at point X.

force = ... [2]

[Total: 4]

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5 In Fig. 5.1, two liquid-in-glass barometers are set up side by side at sea level using identical glass tubes. One is filled with liquid A and the other filled with liquid B. There is vacuum in the space above the liquid columns in both set-ups.

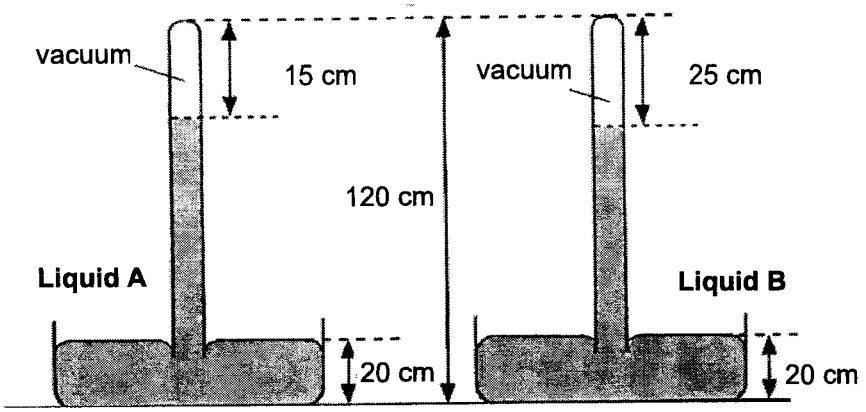


Fig. 5.1

(a) Liquid B is mercury, which has a density of 13 600 kg / m^3. The gravitational field strength g is taken to be 10 N / kg.

Determine the density of liquid A.

density of liquid A = ... [2]

(b) Without using any additional apparatus, suggest how you can check that there is no air that is trapped at the top of any one of the inverted glass tubes, while it is at the same place.

.....

.....

.....

..... [2]

[Total: 4]

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6 Fig. 6.1 shows a skier of mass 75 kg skiing down a very steep smooth slope.

The gravitational field strength, g is 10 N / kg.

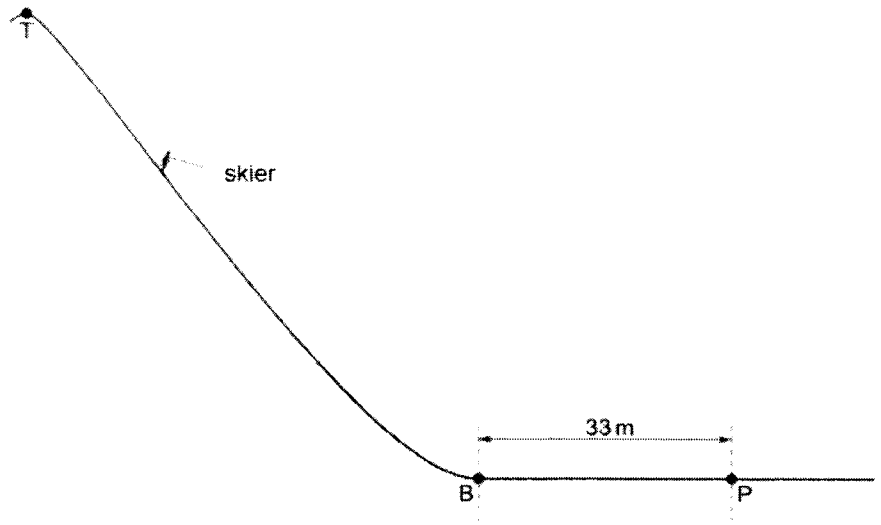


Fig. 6.1 (not to scale)

The skier starts moving from the top of the slope at point T with an initial speed of 2.0 m / s. He accelerates down the slope and reaches point B at the bottom of the slope with a speed of 30 m / s.

(a) (i) Calculate the change in energy in the kinetic store of the skier as he travelled from point T to point B.

change in energy in kinetic store = ... [2]

(ii) Hence, determine the height of point T from point B.

height = ... [1]

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(b) Upon reaching point B, the skier digs his skis into the snow and comes to a stop at point P after moving horizontally for 33 m.

Calculate the average braking force that acts on the skier between points B and P.

average braking force = ... [1]

(c) Describe, using ideas about energy stores and transfer pathways, how energy was transferred as the skier moves from point B to point P.

.....

.....

.....

..... [2]

[Total: 6]

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7 **(a)** Define the *focal length* of a converging lens.

.....[1]

(b) Describe briefly an experiment to determine the focal length of such a lens. You may include a diagram in your description.

.....

.....

.....

.....[2]

(c) A small object of height 4.0 cm is placed 5.0 cm away from a thin converging lens of focal length 10.0 cm. Using a suitable scale, draw a ray diagram to determine the size of the image.

size = ... [3]

(d) Other than the location and the magnification of the image, state two other characteristics of the image formed.

.....[2]

[Total: 8]

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8 Fig. 8.1 shows an electrical circuit containing two resistors.

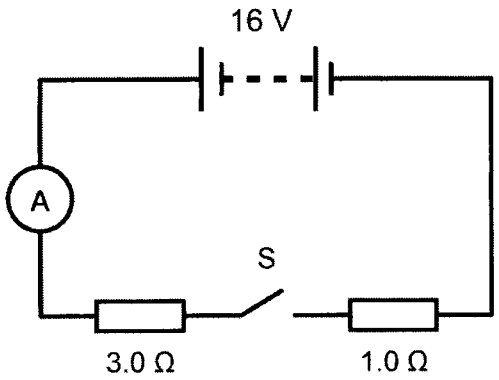


Fig. 8.1

(a) When switch S is open, the ammeter reading is zero.

State the value of the potential difference across switch S.

p.d.= .....[1]

(b) Switch S is now closed.

(i) Calculate the current in the ammeter.

current = ...[2]

(ii) Calculate the potential difference across the 3.0 Ω resistor.

p.d.= .....[1]

(iii) The 1.0 Ω resistor is replaced with a different resistor. The potential difference across the 3.0 Ω resistor is now 1.5 V.

Calculate the resistance of the new resistor.

resistance = ...[2]
[Total: 6]

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9 The owner of a house records the details of the electricity usage for one day. The details are shown in Fig. 9.1.

appliance	power rating / W	time switched on / hours	energy used / kWh
TV and computer	1000	2.0	
kettle	2000	0.20	
lights	800	3.0	
water heater	3500	0.20	
air conditioner	1500	6.0	

Fig. 9.1

(a) Complete Fig. 9.1 by calculating the amount of energy used by each appliance. [1]

(b) The cost of electricity is 31 cents per unit. Calculate the cost of the electricity usage for one day.

cost = ...[2]

(c) The wires supplying electric current to the water heater are thicker than those supplying current to the lights.

Explain why this is necessary.

.....

.....

.....

.....[2]

[Total: 5]

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10 Fig. 10.1 shows four magnets fixed to a turntable spinning in the direction shown. An alternating e.m.f. is induced in a coil placed near it.

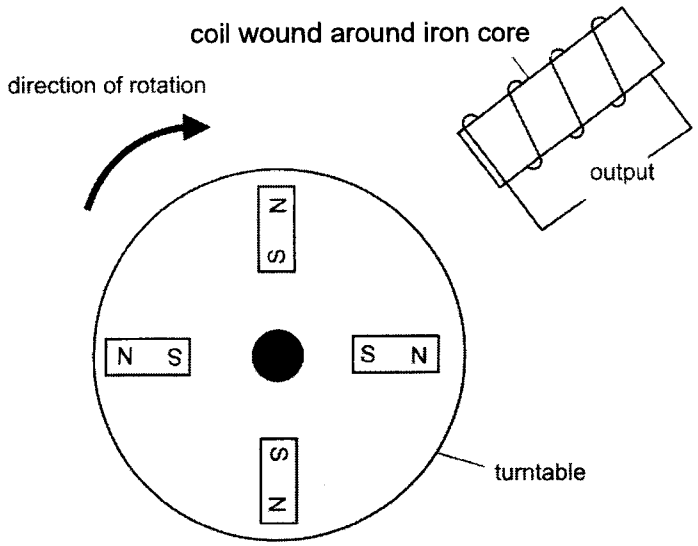


Fig. 10.1

(a) Explain why an e.m.f. is induced in the coil as the turntable rotates.

.....

.....

.....[2]

(b) As one of the magnets approaches the coil, the magnet experiences an opposing force. Explain why.

.....

.....

.....

.....[2]

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(c) The graph below shows how the e.m.f. varies with time when the turntable rotates at a constant speed. On Fig. 10.2, draw the graph for 0 to 30 ms to show how the e.m.f varies with time if the turntable rotates at twice the speed. [2]

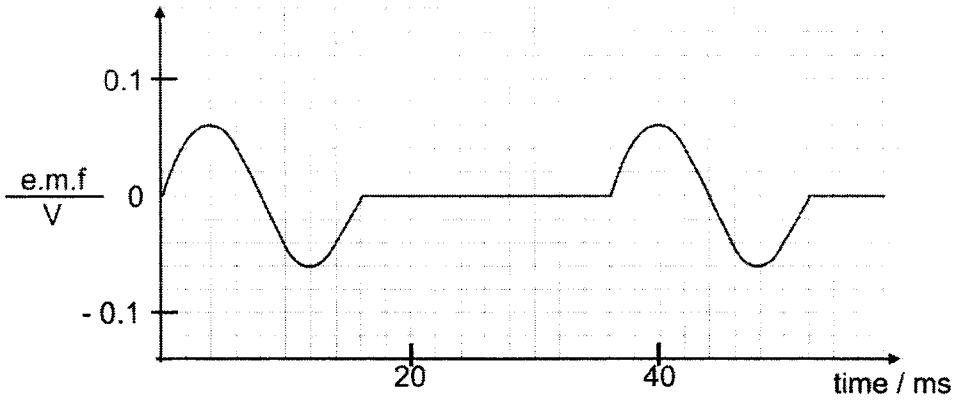


Fig. 10.2

[Total: 6]

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11 A company makes insulating bowls to keep food cold. It carries out an experiment to determine the better material for making the bowl and whether it is worth supplying a lid. Bowls made of polystyrene and waterproof paper cardboard are filled with 200 g of ice at 0°C at the start. The mass of water (melted ice) is recorded at 5 minute intervals and the results are shown in Table 11.1 below.

Table 11.1

	bowl made from polystyrene		**bowl made from paper cardboard**	
	without lid	with lid	without lid	with lid
time / min	mass / g	mass / g	mass / g	mass / g
0	0	0	0	0
5	2	0	12	5
10	9	5	25	14
15	13	9	44	30
20	20	14	58	45
25	30	23	79	63

(a) State one other variable that should be kept constant to ensure a fair test.

..... [1]

(b) Using the information from Table 11.1, suggest which material is better for insulation and explain your choice.

.....

.....

.....

..... [1]

(c) Using ideas about thermal processes, suggest one reason for the difference in the mass of water collected with and without lid for both materials.

.....

.....

..... [1]

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(d) State and explain whether the bowl should be light-coloured or dark-coloured.

.....

..... [1]

(e) An ice maker is used to produce the ice for the above experiment. Water at a temperature of 25.0 °C is fed into the machine and ice cubes at a temperature of – 3.0 °C emerge from it. The following information is given:

specific heat capacity of water	=	4.2 J / (g °C)
specific latent heat of fusion of water	=	340 J / g
specific heat capacity of ice	=	2.1 J / (g °C)

(i) State what is meant by *specific latent heat of fusion of water is 340 J / g.*

.....

.....

..... [2]

(ii) Explain why the internal energy of water decreases even though the temperature of water remains constant as it solidifies into ice.

.....

.....

..... [1]

(iii) Calculate the total amount of energy transferred as 500 g of water at 25.0 °C is cooled to form ice at – 3.0 °C.

energy transferred = ... [3]

[Total: 10]

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12 A doctor uses a radioactive isotope, iodine-131, to determine the volume of blood in a patient's body. Iodine-131 decays by emitting beta particles and gamma rays.

(a) State two differences between beta particles and gamma rays.

.....

.....

.....

.....[2]

(b) Some iodine-131 is injected into the patient and spreads evenly throughout the patient's blood after twelve minutes. Nine samples of blood, each of volume 2.0 cm^3 are taken from the other arm at two minute intervals.

Fig. 12.1 shows the count rates from the nine samples after subtracting background radiation.

Sample number	1	2	3	4	5	6	7	8	9
Time after injection / min	2	4	6	8	10	12	14	16	18
Count rate / per second	0	4	12	18	28	40	38	36	40

Fig 12.1

(i) State the reason why the count rates of samples 6 to 9 are not constant throughout.

.....

.....[1]

(ii) The average value of the last four samples is the average count rate from 2.0 cm^3 of blood. Determine the volume of blood in the patient's body which has a total count rate of 144 000 per second.

volume = ...[2]

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(iii) Iodine -131 (I) has nucleon number 131 and atomic number 53. It decays into Xenon (Xe) by emitting beta radiation.

Write the nuclear decay equation.

.....[1]

(iv) Sample number 9 is kept.

The count rate is measured after 16 days. Estimate the count rate given that the half-life of iodine-131 is 8.0 days.

count rate = ...[2]

(c) State two factors the doctor must consider when selecting the radioactive isotope to be used for this purpose.

.....

.....

.....

.....[2]

[Total: 10]

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Section B

Answer **one** question from this section.
Answer either **Question 13** or **Question 14**

13 The voltage of a power supply P varies with time as shown in Fig.11.1.

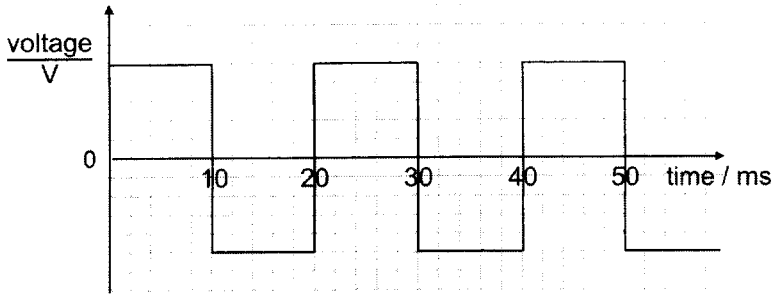


Fig. 13.1

A coil of wire is wrapped around an iron core and connected to power supply P.

A light bar magnet is attached to a paper cone to make a simple speaker as shown in Fig. 13.2.

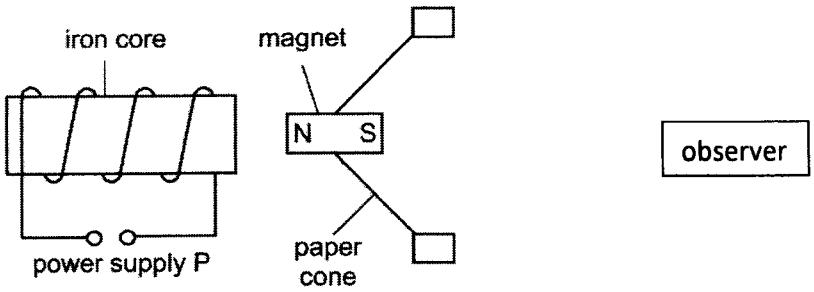


Fig. 13.2

The paper cone vibrates, and a sound is heard by an observer 1.0 m away from the paper cone.

(a) Calculate the frequency of the sound wave.

frequency = ...[2]

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(b) The speed of sound in air is 330 m / s. Calculate the wavelength of the sound wave.

wavelength = ...[1]

(c) Describe how the vibration of the paper cone causes sound to travel to the observer.

.....

.....

.....

.....[3]

(d) Power supply P is replaced with one with a lower voltage and higher frequency.

State how the sound produced changes.

.....[2]

(e) Explain why no sound is heard when power supply P is replaced with a direct current power supply.

.....

.....

.....

.....[2]

[Total: 10]

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14 China launched the Chang-e 6 spacecraft to the far side of the Moon in May 2024 to collect samples from the surface of the Moon. The spacecraft consists of four modules; the lander, the ascender, the orbiter and the return vehicle.

Upon reaching close to the Moon, the lander and ascender modules separated from the spacecraft and combined together to land on the Moon. Fig. 14.1 shows the combined lander-ascender module descending.

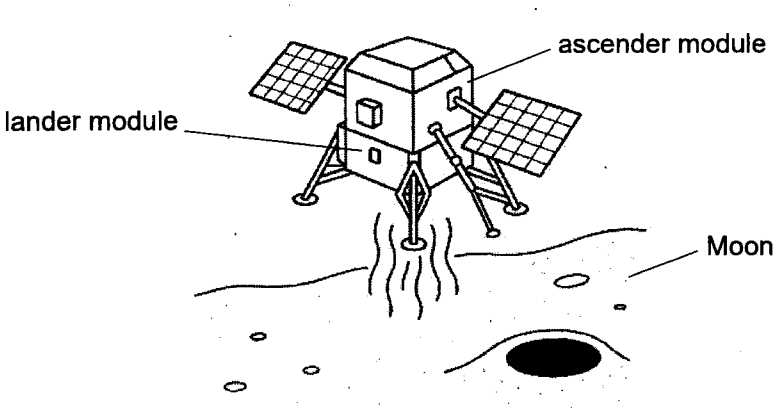


Fig. 14.1

The rocket engine of the lander was fired to slow down the combined lander-ascender module during the descent towards the Moon.

The masses of the lander and ascender modules were 3200 kg and 700 kg respectively. The gravitational field strength on the Moon is 1.6 N / kg.

(a) Explain why deploying a parachute is not an option to slow down the descending combined lander-ascender module.

.....

.....

.....[2]

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(b) At 100 m above the surface of the Moon, the combined lander-ascender module started to descend at a constant speed.

(i) Draw and label on Fig. 14.2 below, the two forces acting on the combined lander-ascender module as it descends at constant speed. Indicate the magnitude of both forces. [2]

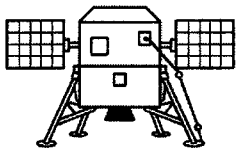


Fig. 14.2

(ii) Explain, using Newton's laws of motion, how the forces acting on the combined lander-ascender module should change to cause it to decelerate as it approaches the Moon's surface.

.....

.....

.....

..... [2]

(c) After collecting the lunar sample, the ascender module separated from the lander module. It was launched using a 3000 N thrust booster to lift it off the Moon's surface. The ascender module will then be combined with the orbiter and return vehicle modules. The combined modules then orbit around the Moon.

(i) Calculate the acceleration of the ascender module as it lifted off the Moon's surface.

acceleration = ... [2]

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(ii) When orbiting around the Moon, the combined modules are moving with constant speed. State and explain whether they are accelerating or not.

.....

.....

.....

..... [2]

[Total: 10]

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

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2025 AHS Physics Prelim Paper 2 Answers

1 **(a)** (Electric) current, (thermodynamic) temperature, amount of substance (any two) [2]

(b) **(i)** Circle the value for the prefix *deci*.

10^{-9} 10^{-6} 10^{-3} 10^{-2} (**10^{-1}**) 10^{3} 10^{6} 10^{9} 10^{12}

[1]

(ii) G , k , m , μ , n [1]

2 **(a)** Calculate the displacement of the car from point A at t = 90 s.

Displacement = area (+) – area (-)

= ½ (50 + 70) (30) - ½ (10) (20) [1]

= 1700 m [1]

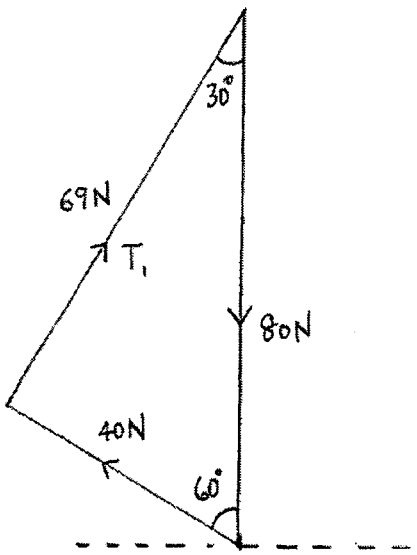
(b) Describe the motion of the car from t = 80 s to t = 90 s.

Travel backwards (to the West) [1] also accept opposite , (negative not accepted)

Accelerating at a constant rate / constant acceleration [1]

also accept descriptions using speed or velocity

3



Correct shape with correct angles [1]

Correct arrows + labels [1]

Magnitude = 69 N +/- 1 N [1]

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4 (a) State the *principle of moments*.

For an object in equilibrium, [1]

The sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot. [1]

(b) Determine the force exerted by the worker at point X.

Sum of anti-clockwise moments = sum of clockwise moments

$20 \times 1.3 = F \times 0.60 + 16 \times 0.85$ [1]

$F = 21$ N [1]

5 (a) Liquid B is mercury, which has a density of 13 600 kg / m^3. The gravitational field strength *g* is taken to be 10 N / kg.

Determine the density of liquid A.

Same atmospheric pressure, hence

$h_A \rho_A g = h_B \rho_B g$ [1 algebraic or numerical form]

$(120 - 15 - 20) \times \rho_A = (120 - 25 - 20) \times 13\,600$

$\rho_A = (75 / 85) \times 13\,600 = 12\,000$ kg / m^3 [1]

(b) Without using any additional apparatus, suggest how you can check that there is no air that is trapped at the top of any one of the inverted glass tubes, while it is at the same place.

Tilt/ lean the inverted tube sideways/push inverted tube A downwards until the closed end is below 85 cm (liquid A) or 75 cm (liquid B) in height [1]

Glass tube fully filled with liquid / no air bubble present [1]

Alternative answers. Push the tube down/ add liquids into the troughs/ tilt the tube sideways [1] ensure that the height of the liquid column remains constant[1]

6 (a) (i) Calculate the change in energy in the kinetic store of the skier as he travelled from point T to point B.

Change in E_k = E_k at B - E_k at T [1 algebraic or numerical must show difference, not just KE formula]

$= ½ (75) (30^2 - 2.0^2)$

= 33 600 J or 34 000 J [1]

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(ii) Hence, determine the height of point T from point B.

Change in E_P = Change in E_k = 34 000

(75) (10) (h) = 34 000

h = 44.8 m or 45 m [1]

(b) Upon reaching point B, the skier digs his skis into the snow and comes to a stop at point P after moving horizontally for 33 m.

Calculate the average braking force that acts on the skier between points B and P.

F x 33 = ½ (75) (30^2)

F = 1020 N or 1000 N [1]

(c) Describe, using ideas about energy stores and transfer pathways, how energy was transferred as the skier moves from point B to point P.

Energy in the kinetic store (of skiers) is transferred to the internal store (of the skiers and the ground) [1]

mechanically (by friction acting over the distance BP) [1]

7 **(a)** Define the *focal length* of a converging lens.

The distance between the optical centre (of lens) and the focal point . [1]

(b) Describe briefly an experiment to determine the focal length of such a lens. You may include a diagram in your description.

Place a lens between a far away/distant object and a screen. (or shown in diagram) [1] also accept object at infinity

Adjust the distance between the lens and the screen until a focused/sharp image is formed. the distance between the lens and the screen is the focal length. [1]

OR

Place a lens between an object and a screen. Move the object and screen until the size of the object and sharp image are the equal/ the same. [1]

The distance between object and lens or image and lens is equal to twice the focal length. (hence divide object distance or image distance by 2 to get focal length. [1]

OR

Place a lens between an object and a screen. Move the screen until a sharp image is produced. Measure the distance between object and image, and the respective sizes of the object and image. [1]

By drawing a ray diagram using the details above, identify the focal point where the light ray cuts the principal axis. [1]

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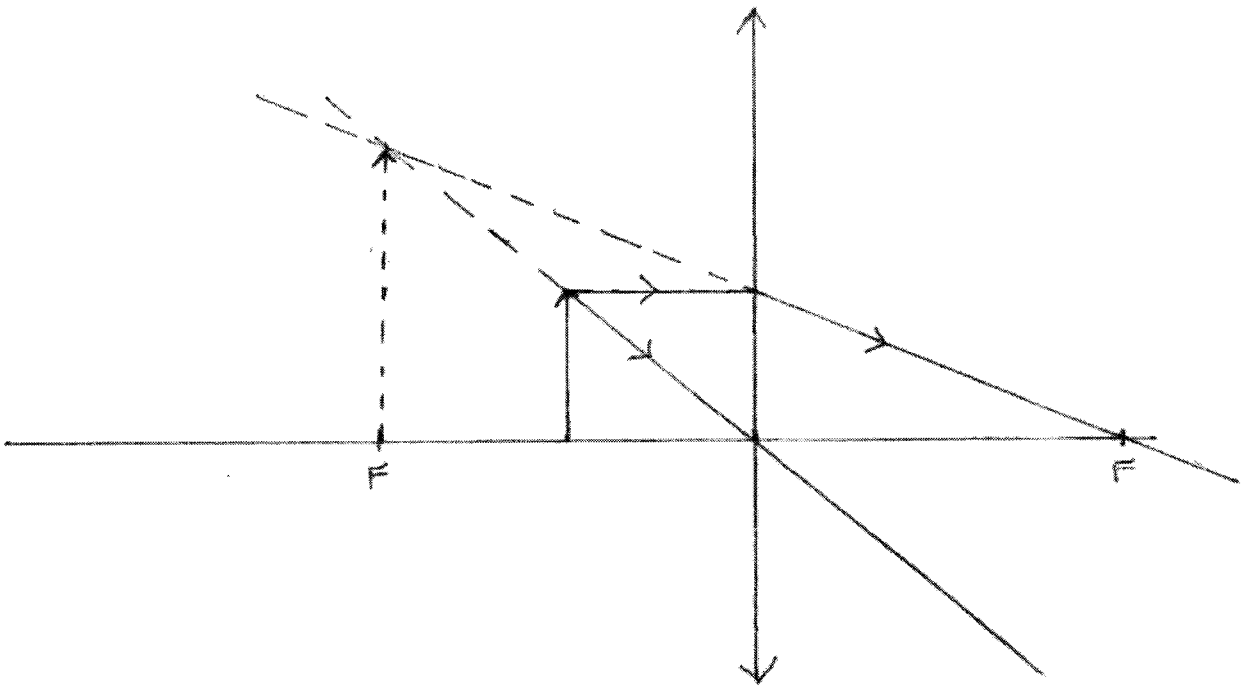
(c) A small object of height 4.0 cm is placed 5.0 cm away from a thin converging lens of focal length 10.0 cm. Using a suitable scale, draw a ray diagram to determine the size of the image.

Suggested scale 1cm:2cm

1 mark for each light ray [2]

1 mark for correct height 8.0 cm +- 0.2 cm (allowance of 1 mm based on scale used)

Penalise [maximum 1] for solid image or solid construction lines



(d) Other than the location and the magnification of the image, state two other characteristics of the image formed.

Virtual, upright [1] each [2]

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8 **(a)** p.d.= 16 V[1]

(b)(i) Calculate the current in the ammeter.

$$I = \frac{V}{R}\ [1\ algebraic\ or\ numerical]$$

$$I = \frac{16}{1+3} = 4.0\ A\ [1]$$

(ii) Calculate the potential difference across the 3.0 Ω resistor.

$$12\ V\ [1]$$

(iii) The 1.0 Ω resistor is replaced with a different resistor. The potential difference across the 3.0 Ω resistor is now 1.5 V.

Calculate the resistance of the new resistor.

$$1.5 = \frac{3}{3+x} \times 16 \quad [1]$$

$$x = 29\ \Omega \quad [1]$$

OR

New current through 3.0 Ω , I = V / R = 1.5 / 3.0 = 0.50 A [1]

R of new resistor = V / I = (16 - 1.5) / 0.50 = 29 Ω [1]

9 **(a)**Complete Fig. 9.1 by calculating the amount of energy used by each appliance. [1]

appliance	power rating / W	time switched on / hours	energy used / kWh
TV and computer	1000	2.0	2.0
kettle	2000	0.20	0.40
lights	800	3.0	2.4
water heater	3500	0.20	0.70
air conditioner	1500	6.0	9.0

1 mark for all correct values [1]

(b) The cost of electricity is 31 cents per unit. Calculate the cost of the electricity usage for one day.

$$total\ energy = 2.0 + 0.4 + 2.4 + 0.7 + 9.0 = 14.5\ kWh\ [1]$$

$$cost = 14.5 \times 0.31 = \$4.50\ [1]$$

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(c) The wires supplying electric current to the water heater are thicker than those supplying current to the lights.

Explain why this is necessary.

As the power supplied is higher, the current flowing through the wires are higher.

Having wire thick will lower the resistance of the wire to reduce energy / power loss / prevent overheating / melting of the wires.

[2 marks for 3 points, 1 mark for 1-2 points]

10 **(a)** Explain why an e.m.f. is induced in the coil as the turntable rotates.

As the turntable rotates, the magnetic flux in/linking the coil changes [1]

also accept magnetic field/ lines passing through/linking /cutting the coil changes

Due to electromagnetic induction, there is an induced e.m.f.. [1]

(b) As one of the magnets approaches the coil, the magnet experiences an opposing force. Explain why.

The induced current produces a north pole near the magnet. [1]

Like poles repel. [1]

Alt.

The magnetic effect of the induced current opposes the change inducing it [max 1]

(c) The graph below shows how the e.m.f. varies with time when the turntable rotates at a constant speed. On Fig. 10.2, draw the graph for 0 to 30 ms to show how the e.m.f varies with time if the turntable rotates at twice the speed. [2]

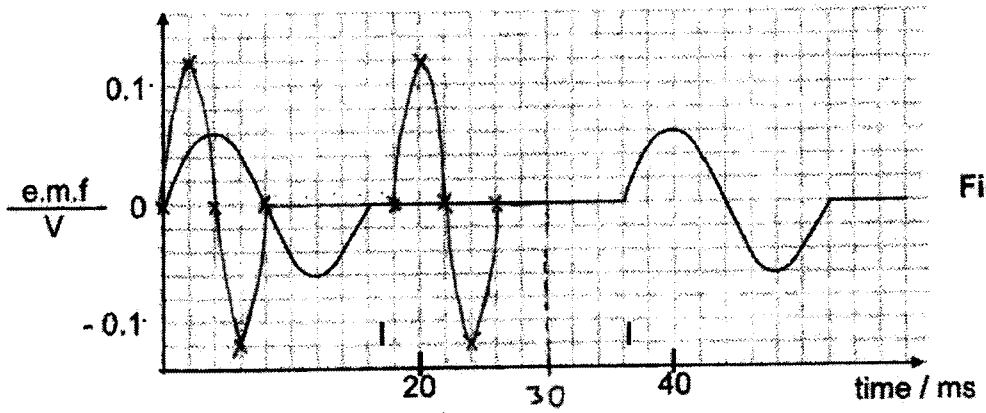


Fig. 10.2

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11 (a) State one other variable that should be kept constant to ensure a fair test.

Size (dimensions) of bowl; size of ice cubes; surrounding temperature (any 1) [1]

(b) Using the information from Table 11.1, suggest which material is better for insulation and explain your choice.

Polystyrene is a better insulator, due to slower rate of energy transfer to ice

Use data to justify [1];

example – after 25 minutes, only 30 g of water is collected in polystyrene bowl while 79 g of water is collected paper cardboard bowl

(c) Using ideas about thermal processes, suggest one reason for the difference in the mass of water collected with and without lid for both materials.

Air is trapped with lid on, and air is a poor conductor of heat / less energy is transferred to ice by conduction. OR

Less energy is transferred to ice by radiation as the lid helps to absorb or reflect some of the radiation [1]

reject convection or evaporation

If more than 1 thermal process is stated, mark only the first one

(d) State and explain whether the bowl should be light-coloured or dark-coloured.

Light coloured; poorer absorber of (infra-red) radiation [1]

Reject absorber of heat (must be specific since the thermal process is radiation)

(e) (i) State what is meant by ***specific latent heat of fusion of water is 340 J / g.***

The 340 J of energy transferred per 1 g of water/ice to change between the solid and liquid states, at constant temperature.

All underlined points: 2 m

2 - 4 underlined points: 1 m

Zero marks if change in temperature is suggested in the answer.

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(ii) Explain why the internal energy of water decreases even though the temperature of water remains constant as it solidifies into ice.

Internal energy decreases because potential energy of the water particles decreases during solidification as the average distance between particles decreases / forces of attraction increase / stronger bonds formed, even though the kinetic energy of the particles remains unchanged. [1]

(iii) Calculate the total amount of energy transferred as 500 g of water at 25.0 °C is cooled to form ice at – 3.0 °C.

Stage 1 (cooling water): $Q = m\,c\,\Delta\theta = (500)\,(4.2)\,(25.0 - 0) = 52\,500$ J

Stage 2 (solidification): $Q = m\,l_f = 500\,(340) = 170\,000$ J

Stage 3 (cooling ice): $Q = m\,c\,\Delta\theta = (500)\,(2.1)\,(0 - (-3.0)) = 3\,150$ J

Total energy transferred = 226 000 J or 230 000 J

[1] for each of the 2 formulae [1] for final answer

12 (a) State two differences between beta particles and gamma rays.

Beta particles are high energy electrons while gamma rays, are electromagnetic waves

Beta particles have higher ionising power than gamma rays

Beta particles are less penetrative than gamma rays

Beta particles have a charge, but gamma rays are uncharged

Beta particles have mass, but gamma rays do not have mass

Any 2

(b) (i) State the reason why different count rates are obtained from samples 6 to 9.

As nuclear decay is a random and spontaneous process. [1]

(ii) The average value of the last four samples is the average count rate from 2.0 cm^3 of blood. Determine the volume of blood in the patient's body which has a total count rate of 144 000 per second.

$average\ value = \frac{40+38+36+40}{4} = 38.5$ [1]

$volume = \frac{144000}{38.5} \times 2.0 = 7500\ cm^3$ [1]

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(iii) Iodine -131 (I) has nucleon number 131 and atomic number 53. It decays into Xenon (Xe) by emitting beta radiation.

Write the nuclear decay equation.

[1] also accept the beta symbol.

(iv) Sample number 9 is kept.

The count rate is measured after 16 days. Estimate the count rate given that the half-life of iodine-131 is 8.0 days.

$$\frac{40}{2^2} = 10\ counts\ per\ second$$

1 mark for recognising 2 half lives

1 mark for final answer

count rate = ...[2]

(c) State two factors the doctor must s when selecting the radioactive isotope to be used for this purpose.

It must have a short half life

It must not be poisonous to the human body

*do not accept it must be able to penetrate the skin as the blood samples are removed from the body

*do not accept harmful as it is too general

Section B

13 (a) Calculate the frequency of the sound wave.

$$f = \frac{1}{0.020} = 50\ Hz$$

1mark for recognising correct period or stating formula. 1 mark for final answer.

(b) The speed of sound in air is 330 m / s. Calculate the wavelength of the sound wave.

$$\lambda = \frac{330}{50} = 6.6\ m$$

(c) Describe how the vibration of the paper cone causes sound to travel to the observer.

As the magnet and paper cone oscillates, it collides with the neighbouring air particles. [1]

Transferring kinetic energy [1] or *cause neighbouring particles to vibrate*

Without transferring the medium [1] *consider BOD if mention air particles oscillate / vibrate about fixed positions*

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(d) Power supply P is replaced with one with a lower voltage and higher frequency.

State how the sound produced changes.

The sound is softer [1]

The pitch is higher [1]

(e) Explain why no sound is heard when power supply P is replaced with a direct current power supply.

If a direct current is used, the magnetic field will not change, [1]

and the magnet/paper cone will remain stationary. [1] or *the magnet will only move once.*

14 (a) Explain why deploying a parachute is not an option to slow down the descending combined lander-ascender modules.

Moon has no atmosphere / very little atmosphere [1]

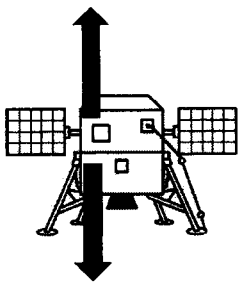
also accept no air on the moon

Cannot create the required (air) resistance / drag to slow down the modules [1]

(b) (i) Draw and label on Fig. 14.2 below, the two forces acting on the lander-ascender modules as it descends at constant speed. Indicate the magnitude of both forces. [2]

Correct labels [1]

Correct magnitude [1]



Lift / upthrust / Upward force = 6240 N or 6200 N

weight = 6240 N or 6200 N

accept w label

(from centre of gravity somewhere in the middle)

Fig. 14.2

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(ii) Explain, using Newton's laws of motion, how the forces acting on the lander-ascender modules should change to cause it to decelerate as it approaches the Moon's surface.

Increase the upward force [1]

Using F=ma or Newton's 2nd Law, negative net force will result in negative acceleration / deceleration [1]

* also accept net force must not be zero. However direction of force and acceleration must tally.

(c)(i) Calculate the acceleration of the ascender module as it lifted off the Moon's surface.

mass of ascender = 700 kg

net upward force = 3000 – (700)(1.6) = 1880 N [1]

a = net F / m = 1880 / 700 = 2.7 m / s^2 [A1]

(ii) When orbiting around the Moon, the modules are moving with constant speed. State and explain whether the modules are accelerating or not.

Since direction of motion of modules are continuously changing, [1]

they are accelerating as their velocity is changing. [1]

mention about direction changing

acceleration is a vector quality

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