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NGEE ANN SECONDARY SCHOOL

O

PRELIMINARY EXAMINATION

SCIENCE PHYSICS/CHEMISTRY

5086/01

PAPER 1

23 August 2024

1 h

Additional Optical Answer Sheet
Materials:

READ THESE INSTRUCTIONS FIRST

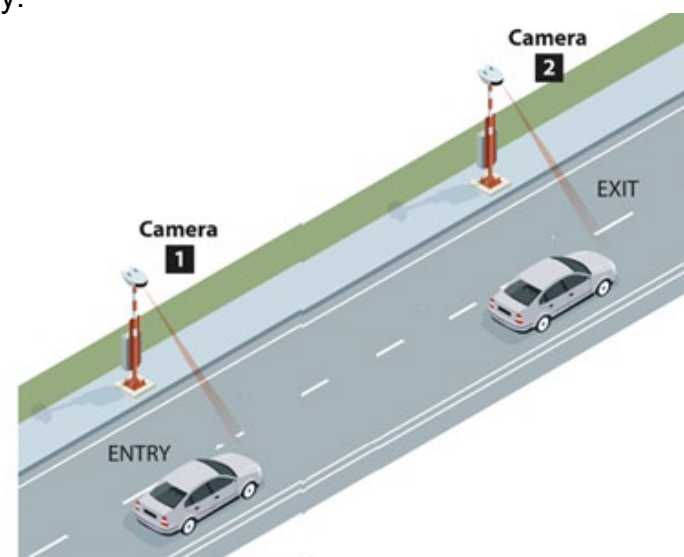
1. Write in soft pencil.
2. Do not use staples, paper clips, highlighters, glue or correction fluid.
3. Write your name and index number on the Optical Answer Sheet in the spaces provided unless this has been done for you.
4. There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.
5. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Answer Sheet.
6. **Read the instructions on the Optical Answer Sheet very carefully.**
7. Each correct answer will score one mark. A mark will not be deducted for a wrong answer. The total number of marks for this paper is **40**.
8. Any rough working should be done in this booklet.
9. A copy of the Data sheet and Periodic Table are printed on page **20** and **21** respectively.
10. The use of an approved scientific calculator is expected, where appropriate.

This document consists of **21** printed pages and **1** blank page.

1 Which pair consists of two vector quantities?

- A velocity and moment
- B pressure and force
- C mass and energy
- D potential difference and acceleration

2 The diagram shows two cameras used to determine the average speed of a car along a stretch of road. Cameras 1 and 2 detect the entry and exit of the vehicle along that stretch respectively.



The diagrams below show the times at which cameras 1 and 2 capture the entry and the exit of the vehicle. The distance between the two cameras is 800 m.



At entry



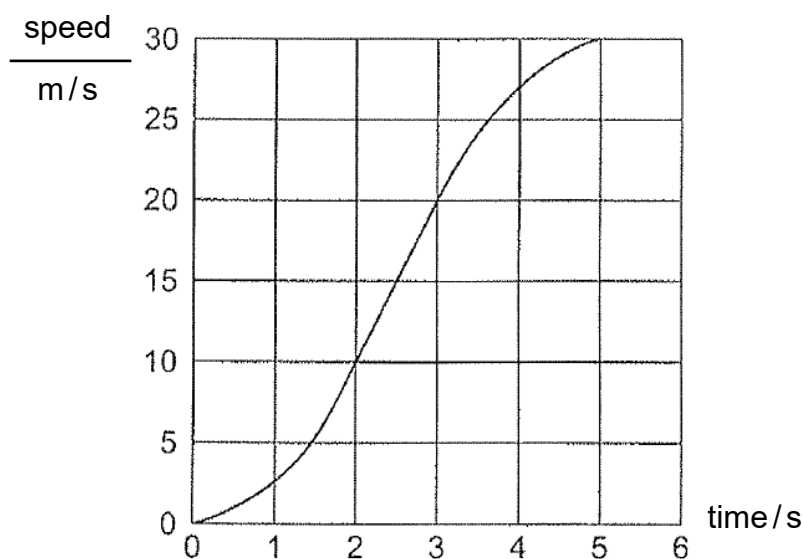
At exit

What is the average speed of the vehicle between the two cameras?

- A 6.6 m/s B 7.4 m/s C 8.4 m/s D 31 m/s

- 3 The graph shows the speed of a car as it starts from rest.

During part of this time, the acceleration is uniform.



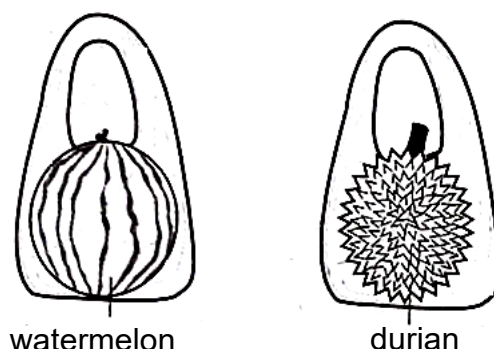
What is the magnitude of this uniform acceleration?

- A** 5.0 m/s² **B** 6.0 m/s² **C** 10 m/s² **D** 20 m/s²
- 4 An astronaut sits in a space shuttle which takes off from the surface of the Earth.

During his journey into space, what happens to the mass and weight of the astronaut due to the gravitational field of the Earth?

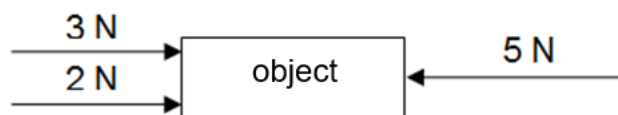
	mass	weight
A	unchanged	increases
B	unchanged	decreases
C	decreases	increases
D	decreases	decreases

- 5 The diagram shows a watermelon and durian placed in two similar plastic bags. Both the watermelon and durian have the same mass.



Why is the plastic bag containing the durian more likely to tear than the one containing the watermelon?

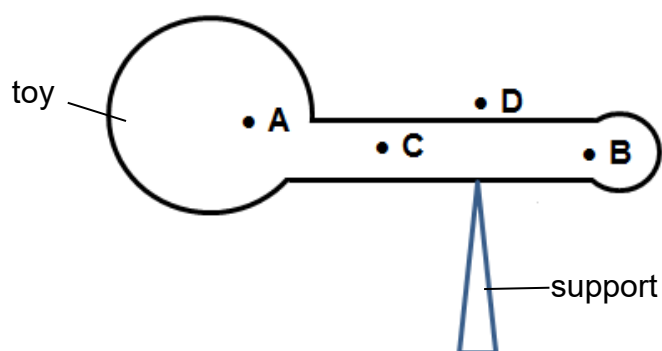
- A** The force exerted by the durian on the plastic bag is larger than that exerted by the watermelon on the plastic bag.
- B** The force exerted by the durian on the plastic bag is smaller than that exerted by the watermelon on the plastic bag.
- C** The pressure exerted by the durian on the plastic bag is smaller.
- D** The pressure exerted by the durian on the plastic bag is larger.
- 6 An object is moving to the right at constant speed. It is then acted upon by the three forces as shown in the diagram below.



What is the effect of these three forces on the motion of the object?

- A** The object moves to the right with constant speed.
- B** The object moves to the right with a constant acceleration.
- C** The object moves to the left with constant speed.
- D** The object comes to a stop immediately.

- 7 The diagram shows a toy being balanced on the tip of a support



Which point is likely to be the centre of gravity of the toy?

- 8 A boat pulls a fishing net with some fish for 5.0 km. The force it has to apply is 2000 N.

What is the work done in pulling the net with the fish?

- A** 10 kJ **B** 10 MJ **C** 10 GJ **D** 10 TJ

- 9 A substance consists of particles that are close together and moving past each other at random.

During heating, the substance changes its state of matter.

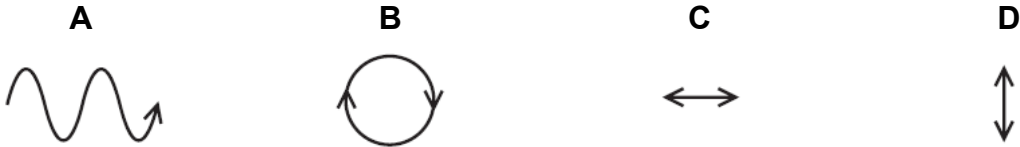
What happened to the substance and its internal kinetic energy during change in state?

	substance	internal kinetic energy
A	changes from solid to liquid	unchanged
B	changes from solid to liquid	increases
C	changes liquid to gas	unchanged
D	changes liquid to gas	increases

- 10** A sound wave travels from a point X to a point Y.

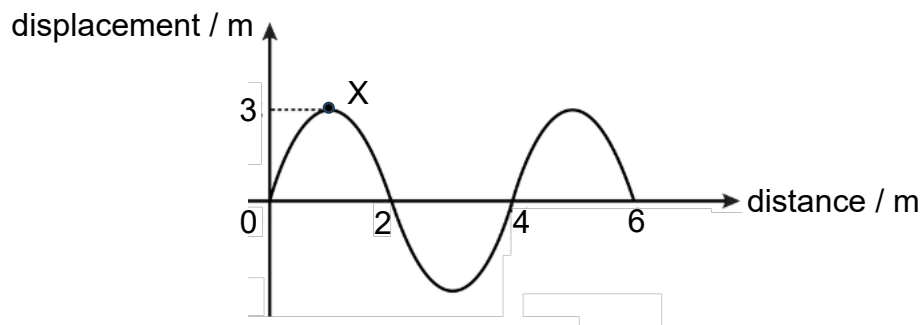


Which diagram represents the movement of the air molecules, due to the sound waves, in the region between X and Y?



- 11** The diagram shows the displacement-distance graph of a wave travelling along a rope at a particular instant. Particle X in the rope has a displacement of 3 m.

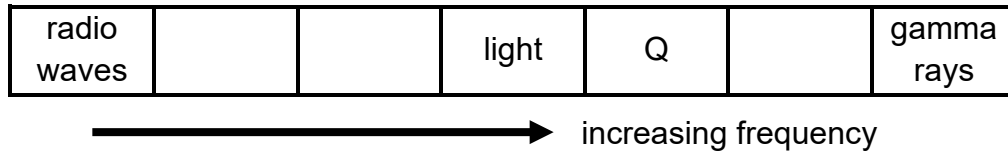
For the next 0.2 s, particle X moves a distance of 3 m.



Which statement is correct?

- A** The period of the wave is 0.8 s.
- B** The wavelength of the wave is 2 m.
- C** The wave is a longitudinal wave.
- D** The speed of the wave is 0.8 m/s.

- 12** The diagram shows the main components of the electromagnetic spectrum arranged in the order of increasing frequency. Some of the components are labelled.

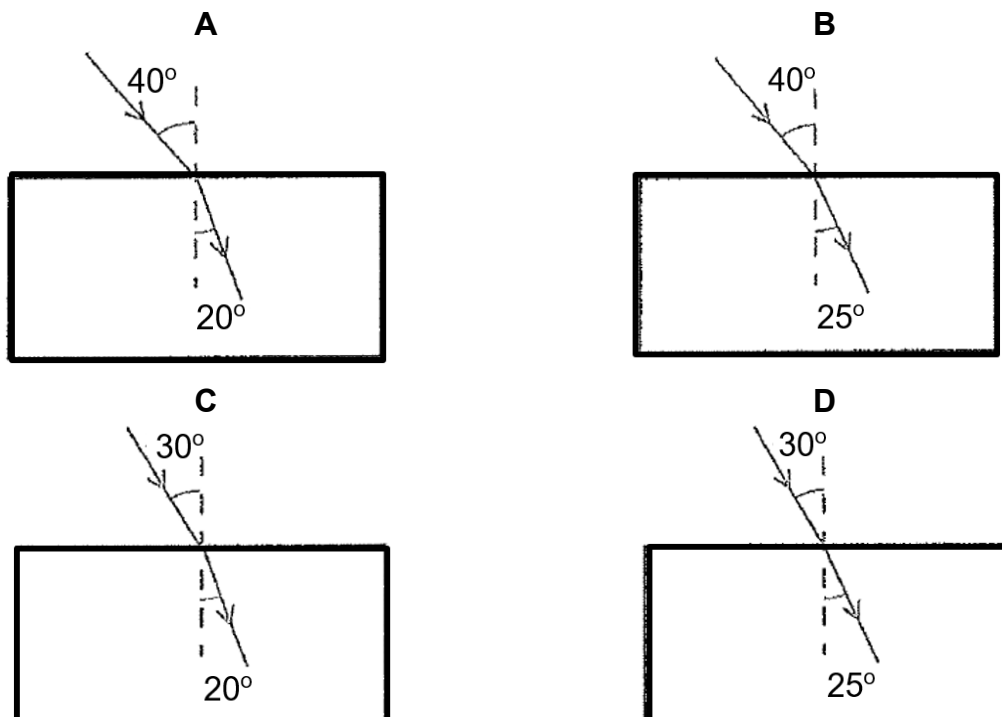


Which row describes electromagnetic wave Q?

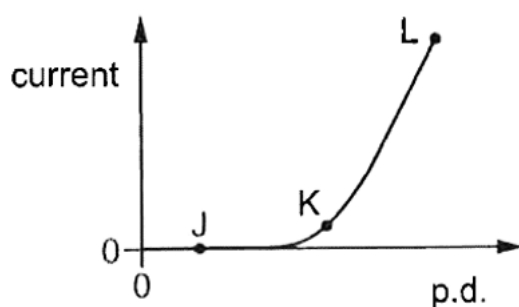
	name of Q	application of Q
A	infrared waves	sterilise medical equipment
B	infrared waves	television remote controller
C	ultraviolet waves	sterilise medical equipment
D	ultraviolet waves	television remote controller

- 13** Light travels from air into a transparent block.

Which block is made from the material in which the speed of light is 1.97×10^8 m/s ?



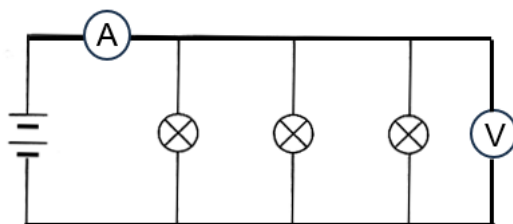
- 14** The graph shows how the current in an electrical device varies with the potential difference (p.d) across it.



What is the order of the resistance values of the electrical device at points J, K and L?

	largest	→	smallest
A	J	K	L
B	J	L	K
C	K	L	J
D	L	K	J

- 15** Three similar light bulbs are connected to a set of batteries as shown in the diagram.



The filament of one of the bulbs breaks.

What happens to the voltmeter reading and ammeter reading?

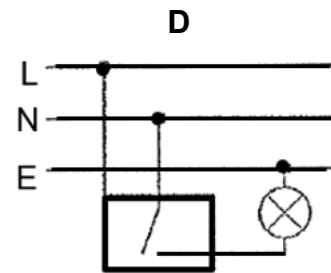
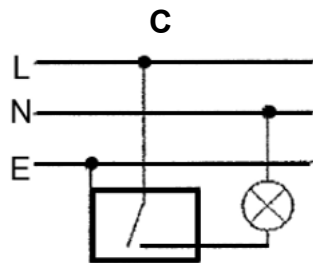
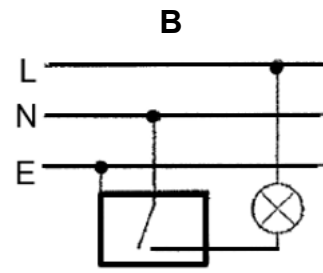
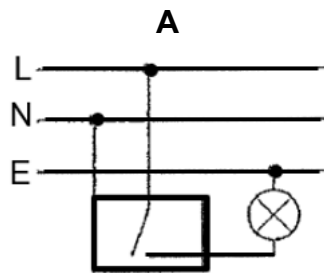
	voltmeter reading	ammeter reading
A	decreases	increases
B	decreases	decreases
C	unchanged	increases
D	unchanged	decreases

- 16** The power rating of a 37-inch LCD television is 300 W. The consumer is charged 30 cents per kWh of energy transferred electrically from the mains supply.

What is the cost of using LCD television for 5 hours?

- A** 45 cents **B** 450 cents **C** 4500 cents **D** 45 000 cents

- 17** Which diagram shows the correct connections for a switch and lamp in a light circuit?



key

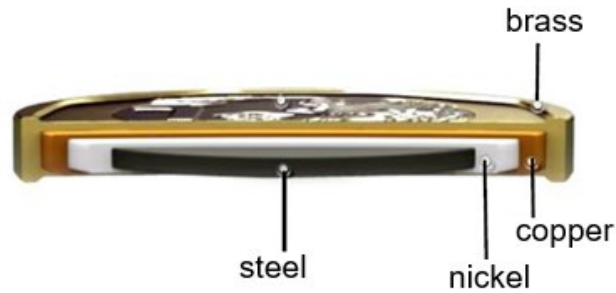
L live

N neutral

E earth

 metal case

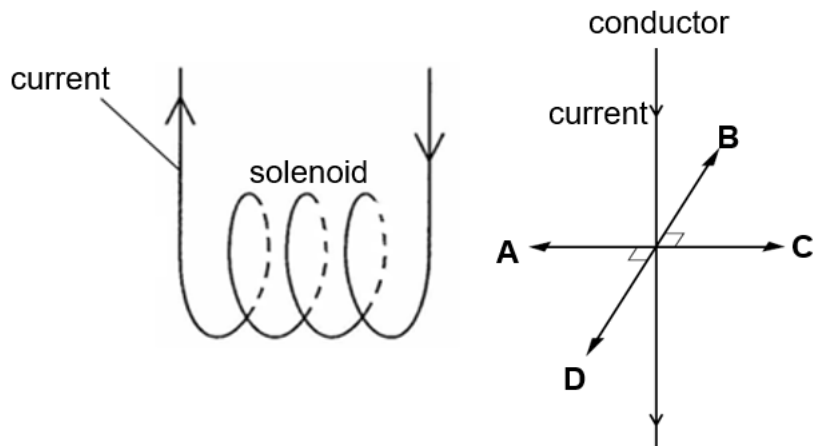
- 18** The diagram shows the cross-sectional composition of a third series Singapore \$1 coin and the metals that are used to construct the coin.



A magnet is placed near to the coin and the coin is attracted to the magnet.

Which of the following pair of metals accounts for the attraction?

- A** steel and copper
 - B** copper and brass
 - C** brass and nickel
 - D** steel and nickel
- 19** The diagram shows a solenoid near to a conductor. Current flows through the solenoid and conductor in the direction as shown.



A magnetic force exerts on the conductor.

What is the direction of the force on the conductor?

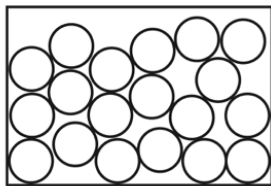
- 20** A researcher wants to use a radioactive source with a count rate of 100 counts per second for an experiment he plans to start at 10.00 am.

He has four different sources, each of which has a count rate of 400 counts per second at 9.00 am.

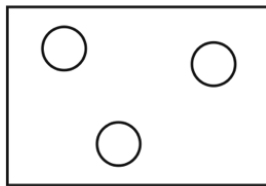
Which source should he choose?

- A** a source with a half-life of 15 minutes
- B** a source with a half-life of 20 minutes
- C** a source with a half-life of 30 minutes
- D** a source with a half-life of 60 minutes

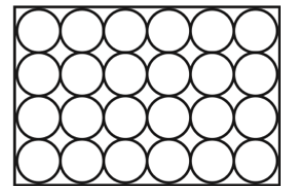
- 21** The arrangements of particles of a substance in three different physical states are shown.



state 1



state 2

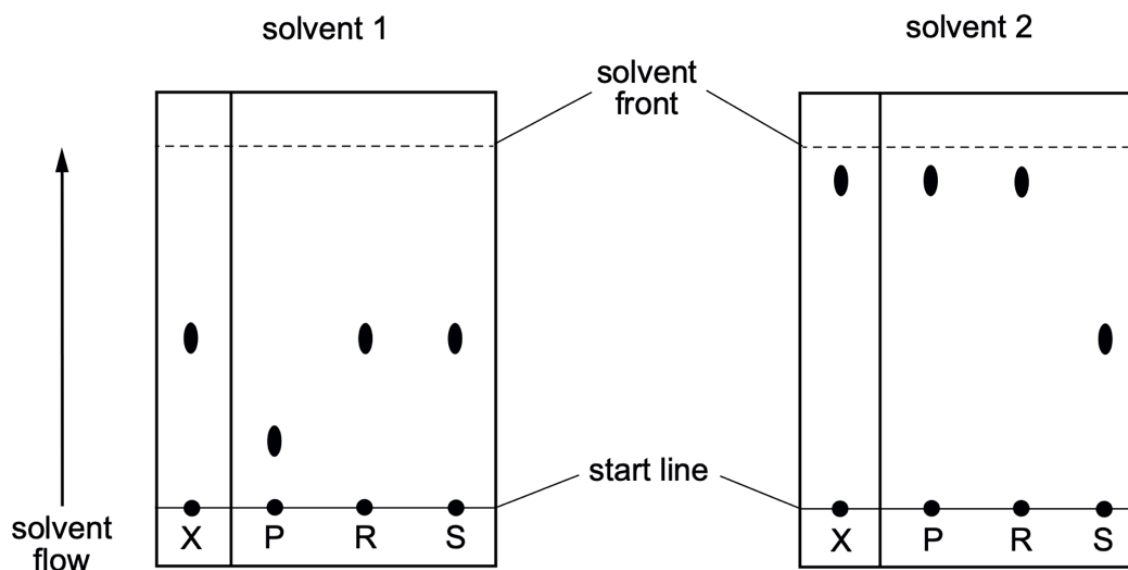


state 3

Which statement is correct?

- A** State 1 changes to state 3 by evaporation.
- B** State 2 changes to state 1 by freezing.
- C** State 1 changes to state 2 by condensing.
- D** State 3 changes to state 2 by sublimation.

- 22** Solution X contains one or more of three substances, P, R and S. Two different solvents are used to produce two chromatograms comparing solution X with the three substances. The results are shown.



What does X contain?

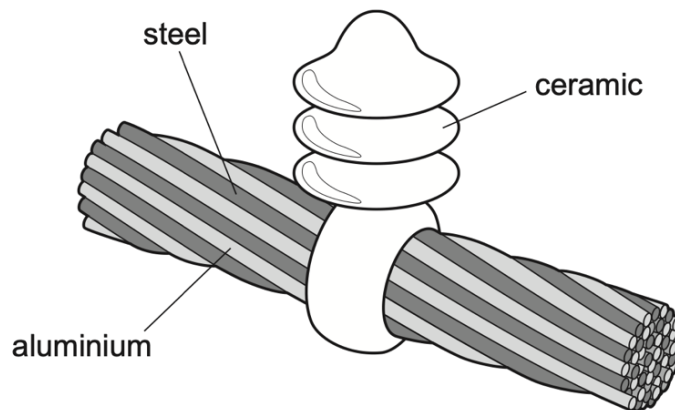
- A** R only
B P and R
C R and S
D P, R and S
- 23** The relative abundance of three different isotopes of lead in a sample of lead ore is shown in the following table.

isotope	% abundance	Ar
1	50	206
2	25	208
3	25	209

What is the relative atomic mass of the lead in the sample?

- A** 207.00
B 207.25
C 207.50
D 207.67

- 24** The diagram shows a section of an overhead power cable.



Which statement explains why a particular substance is used?

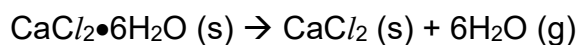
- A** Aluminium has a low density and is a good conductor of electricity.
 - B** Ceramic is a good conductor of electricity.
 - C** Steel can rust in damp air.
 - D** Steel is more dense than aluminium.
- 25** A compound of element X has the formula XC_4 and a relative formula mass of 190. What is element X?
- A** cadmium, Cd
 - B** gadolinium, Gd
 - C** sulfur, S
 - D** titanium, Ti

- 26** The pH value of some of the common household substances are shown below.

household substance	pH value
bicarbonate of soda	9
bleach	12
drain cleaner	14
lemonade	2
milk	6
vinegar	3

Which statement is correct?

- A** Drain cleaner can neutralise bicarbonate of soda.
 - B** Lemonade, milk and bicarbonate of soda are all acidic.
 - C** Milk, lemonade and vinegar are all bases.
 - D** Vinegar can neutralise bicarbonate of soda.
- 27** 54.75 g of hydrated calcium chloride crystals are heated to produce anhydrous calcium chloride and water vapour.



What is the mass of anhydrous calcium chloride formed?

- A** 0.5 g
- B** 25.9 g
- C** 27.8 g
- D** 43.7 g

- 28** Y gives a white precipitate when aqueous silver nitrate is added.

When heated with aqueous potassium hydroxide, Y gives off a gas that turns moist litmus paper blue.

What is Y?

- A** ammonium chloride
- B** ammonium sulfate
- C** sodium chloride
- D** sodium hydroxide

- 29** X, Y and Z are three metals.

When Z is heated with the oxide of X, the metal X is formed.

When X is added to a solution of Y^{2+} ions, no reaction takes place. What is the order of reactivity of the metals?

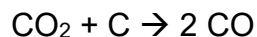
	least reactive	—————→	most reactive
A	X	Y	Z
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

- 30** Which statements about elements in Group 1 of the Periodic Table are correct?

- 1 They become less reactive going down the group.
- 2 Sodium forms positive ions more easily than lithium.
- 3 Their melting points increase going down the group.
- 4 Rubidium is more dense than sodium.

- A** 1 and 2
- B** 1 and 3
- C** 2 and 4
- D** 3 and 4

- 31** Carbon dioxide reacts with carbon to form carbon monoxide.



Which row describes what happens to the carbon dioxide and to the carbon during the reaction?

	carbon dioxide	carbon
A	oxidised	oxidised
B	oxidised	reduced
C	reduced	oxidised
D	reduced	reduced

- 32** Excess magnesium ribbon is reacted with 10 cm³ of dilute hydrochloric acid. The hydrogen gas produced is collected and measured.

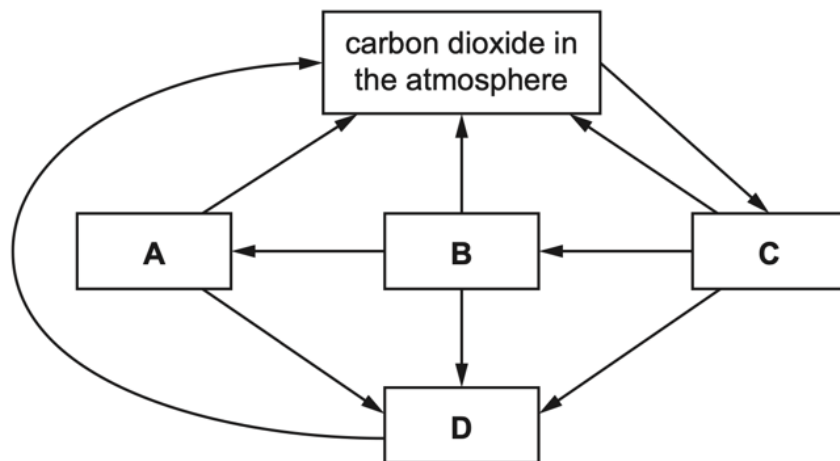
Which change to the reaction conditions would increase the rate of reaction **and** the volume of the hydrogen produced?

- A** Use a lower temperature.
- B** Use a transition metal catalyst.
- C** Use concentrated hydrochloric acid.
- D** Use powdered magnesium.

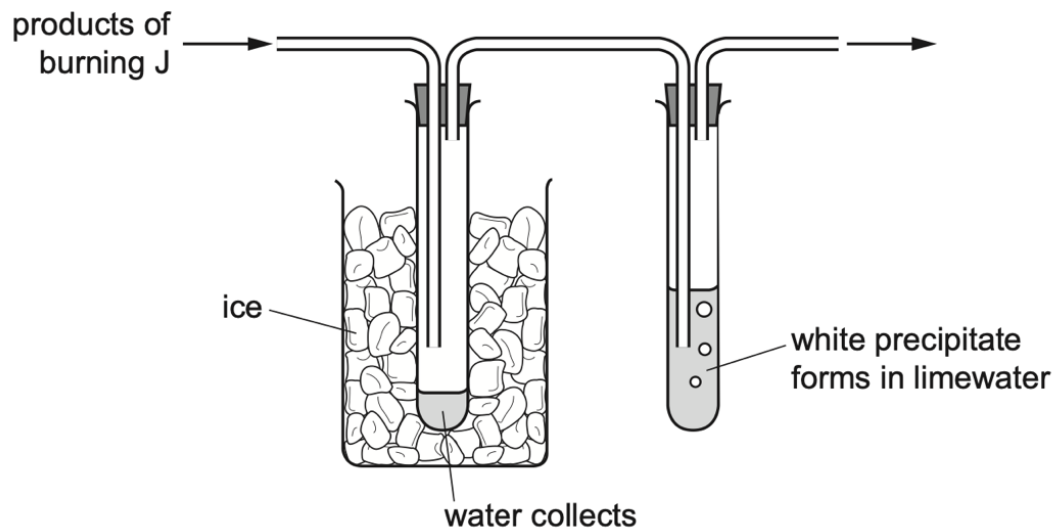
- 33** Which row identifies a substance present in clean air and a substance that is a pollutant in air?

	present in clean air	pollutant in air
A	oxides of nitrogen	nitrogen
B	carbon dioxide	sulfur dioxide
C	carbon monoxide	lead compounds
D	nitrogen	argon

- 34 Which labelled box represents plants in the carbon cycle?



- 35 The products formed by burning substance J are passed through the apparatus shown.



What is substance J?

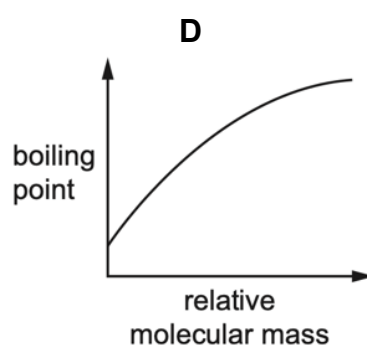
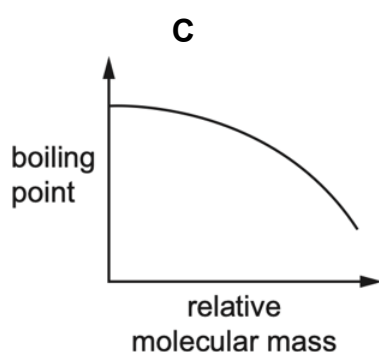
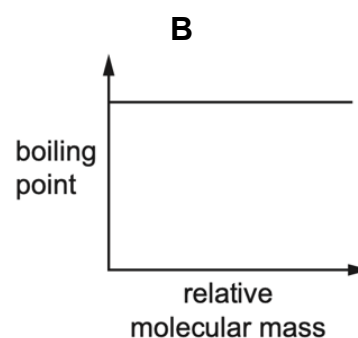
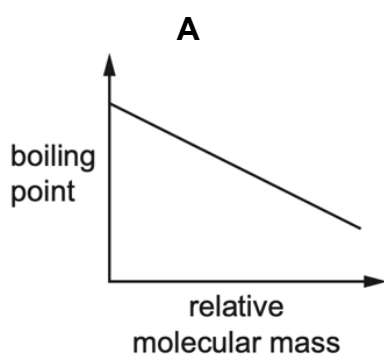
- A** carbon monoxide
- B** hydrogen
- C** propane
- D** sulfur

- 36** Methane reacts with an excess of chlorine in the presence of ultraviolet light to form a mixture of products.

How many of these products contain one carbon atom and one or more chlorine atoms?

- A** 1
B 2
C 3
D 4

- 37** Which graph represents the change in boiling point of the alcohols as their relative molecular mass increases?



- 38** Ethanoic acid, CH_3COOH , reacts with magnesium carbonate.

Which of the following equation represents the reaction?

- A** $\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow \text{CH}_4\text{C}_2\text{O}_5\text{Mg}$
B $\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow \text{CH}_2\text{COOMg} + \text{H}_2\text{O} + \text{CO}_2$
C $2\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow (\text{CH}_4\text{C}_2\text{O}_3)_2\text{Mg}$
D $2\text{CH}_3\text{COOH} + \text{MgCO}_3 \rightarrow (\text{CH}_3\text{COO})_2\text{Mg} + \text{H}_2\text{O} + \text{CO}_2$

- 39** Some plastics can be recycled using the physical method or the chemical method. Before recycling is carried out, the plastic waste needs to undergo the pre-treatment process.



Which of the following is the correct sequence to the pre-treatment process?

- A** manual sorting → shredding into smaller pieces → washing
 - B** manual sorting → washing → shredding into smaller pieces
 - C** shredding into smaller pieces → washing → manual sorting
 - D** washing → shredding into smaller pieces → manual sorting
- 40** What happens to plastic waste when left in the environment?



- A** It is a biodegradable material so it eventually disintegrates.
- B** It never fully goes away as it breaks into little pieces.
- C** The animals will consume the plastic waste.
- D** There is no plastic waste as all plastic is recycled.

-- End of paper --

Data Sheet**Colours of Some Common Metal Hydroxides**

aluminium hydroxide	white
calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
zinc hydroxide	white

The Periodic Table of Elements

Group																			
1	2	1 H hydrogen 1												13	14	15	16	17	18
		Key																	
		proton (atomic) number atomic symbol name relative atomic mass																	
3 Li lithium 7	4 Be beryllium 9																		
11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12								
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84		
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131		
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –	
87 Fr francium	88 Ra radium	89–103 actinoids		104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson	
lanthanoids		57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175			
actinoids		89 Ac actinium	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium			

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).
The Avogadro constant, L = 6.02 × 10²³ mol⁻¹.

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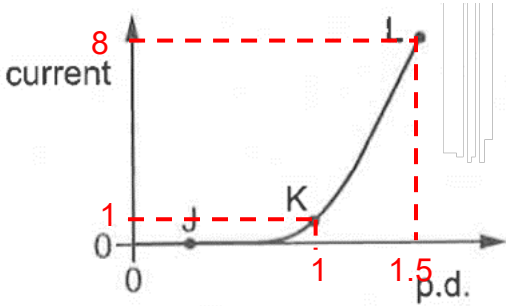
Ngee Ann Secondary School
2024 Sec 4 Science (Physics, Chemistry) (5086)
Prelim Paper 1 (Physics component)

1	A	6	A	11	A	16	A
2	D	7	D	12	C	17	C
3	C	8	B	13	B	18	D
4	B	9	C	14	A	19	B
5	D	10	C	15	D	20	C

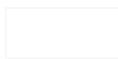
Qn	Solution	Ans
1	Vector quantities are quantities with both magnitude and direction only. From the list given, the vector quantities are: force, acceleration, velocity, moment.	A
2	Time taken by the car to travel a distance of 800 m $= 2 \text{ min } 1 \text{ sec} - 1 \text{ min } 35 \text{ sec}$ $= 61 - 35$ $= 26 \text{ s}$ Average speed $= \text{distance travelled} / \text{time taken}$ $= 800 / 26$ $= 31 \text{ m / s (2 sf)}$	D
3	Concept: Gradient of speed-time graph = acceleration. Hence, the section that corresponds to uniform acceleration will be the section of the speed-time graph with constant gradient (a straight line graph) Uniform acceleration $= \text{gradient of straight line graph between time} = 2 \text{ s and time} = 3 \text{ s}$ $= (20 - 10) / (3 - 2)$ $= 10 \text{ m / s}^2$	C

4	Mass is the amount of matter in a body. Since there is no change in the amount of matter in the astronaut at all times, the mass is a constant, regardless of location. From surface of Earth to the space, the gravitational field strength of Earth decreases. Since weight = mass x gravitational field strength, the weight will decrease.	B
5	Both the watermelon and the durian have the same mass and hence the same weight. The force exerted by the durian on the plastic bag will be equal to that exerted by the watermelon on the plastic bag. But the surface area of contact between the watermelon and plastic bag is larger than that between the durian and plastic bag. Since pressure = force / area, the pressure exerted by the durian on the plastic bag will be larger and hence the plastic bag is likely to tear.	D
6	The resultant of the three forces is zero. But since the object is already in the state of motion and moving to the right before the three forces applied, by Newton's 1st Law, the object will continue to move with a constant speed along a straight line (and in the same direction).	A
7	There is no other force acting on the toy, except weight of the toy. Hence, in order for the toy to be balanced, the line of action of weight of the toy should pass through the support so that the moment due to the weight of the toy will be zero (and does not cause any turning effect). Hence, centre of gravity of the toy should be at point D.	D
8	Work done = force x distance travelled in the direction of the force = $2000 \times (5.0 \times 10^3)$ = 10 000 000 J = 10 MJ	B
9	Since particles are close together and moving past each other at random, this tells us that the substance is in a state of liquid. Hence, the substance is changing from liquid to gas. During the change in the state of matter, the temperature is a constant. Hence, the internal kinetic energy of particles will be constant.	C

10	Sound wave is a longitudinal wave. The direction of particle motion is parallel to the direction of wave motion, and the particle is moving about their undisturbed position.	C
11	For point X to travel back to its original position, the total time taken required = $4 \times 0.2 = 0.8 \text{ s}$ Hence, the period is 0.8 s. Note: (1) Rope can only produce transverse wave. (2) wavelength of the wave is 4 m. (3) speed of the wave = $4 / 0.8 = 5.0 \text{ m / s}$	A
12	This is a recall question on the trend of the EM waves arranged in terms of increasing frequency, and the application of ultraviolet rays. Note: Infra-red is used for TV remote controller	C
13	refractive index = speed of light in vacuum / speed of light in medium = $3.0 \times 10^8 / (1.97 \times 10^8)$ = 1.53 Since light travels from air into block, using $n = \sin i / \sin r$ $1.53 = \sin 40^\circ / \sin r$, $r = 25^\circ$	B

14	For point J, when current is zero and p.d is non-zero, using $R = V / I$, this means that the resistance must be large. To compare K and L, we can have use some fictitious values as follows to compare the current and p.d:  Therefore, resistance at K = 1 unit and resistance at L = $1.5 / 8 < 1$ unit. Hence, resistance at L is the smallest.	A
15	All the light bulbs and the voltmeter are connected parallel to the battery. Hence, regardless what happens to the other light bulbs, the p.d across each light bulb and the voltmeter is always equal to e.m.f of battery. Hence, there is no change to the voltmeter reading at all times. Using $R = V / I$, since R and V are the same for all the light bulbs, the current flowing through each light bulb will be the same. Hence, with one light bulb become faulty, there will be lesser current flowing through the ammeter. Hence, ammeter reading will decrease.	D
16	Power of TV in kW = $300 / 1000 = 0.30$ kW Total energy in kWh = power in kW x Time in hour = 0.30×5 = 1.5 kWh Cost in using the TV = $1.5 \times 30 = 45$ cents.	A
17	Switch must be placed along the live wire. Device is connected between the live wire and the neutral wire. Earth wire is connected to the metal casing.	C

18	In the diagram, we have the following: (1) magnetic materials are nickel, steel. (2) non-magnetic materials are brass and copper. Therefore, the pair that can be attracted to magnet is option D.	D
19	Using right hand grip rule on the solenoid, the left end of the solenoid is a N-pole and hence the right end of the solenoid is S-pole. Hence, the conductor is experiencing a magnetic field (due to the current in the solenoid) and the direction of this magnetic field is pointing to the left. Using Fleming's Left Hand Rule, the force acting on the conductor will be pointing in the direction of B.	B
20	Source A will undergo a total of four cycle of half-lives within an hour. The count per second at 9.00 am $= 400 \times (1/2) \times (1/2) \times (1/2) \times (1/2)$ $= 25$ Source B will undergo a total of three cycle of half-lives within an hour. The count per second at 9.00 am $= 400 \times (1/2) \times (1/2) \times (1/2)$ $= 50$ Source C will undergo a total of two cycle of half-lives within an hour. The count per second at 9.00 am $= 400 \times (1/2) \times (1/2)$ $= 100$ Source D will undergo a total of one cycle of half-lives within an hour. The count per second at 9.00 am $= 400 \times (1/2)$ $= 200$	C



Name: Register no: Class:



NGEE ANN SECONDARY SCHOOL



PRELIMINARY EXAMINATION

SCIENCE (PHYSICS/CHEMISTRY)

5086/02

PAPER 2

23 August 2024

1 h 15 min

Additional materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams, graphs, tables or rough working.

Section A

Answer **all** questions.

Section B

Answer **any one** questions out of two.

Write your answers in the spaces provided.

At the end of the examination, fasten all your papers securely together.

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

For Examiner's Use

Question	Marks
Section A	/55
Section B	/10
Total	/65

Checked by student: _____

Date: _____

This document consists of **17** printed pages and **1** blank page (Including this cover page)

Section A – 55 Marks

Answer all questions in the spaces provided.

- 1 Fig. 1.1 shows the speed-time graph of a car.

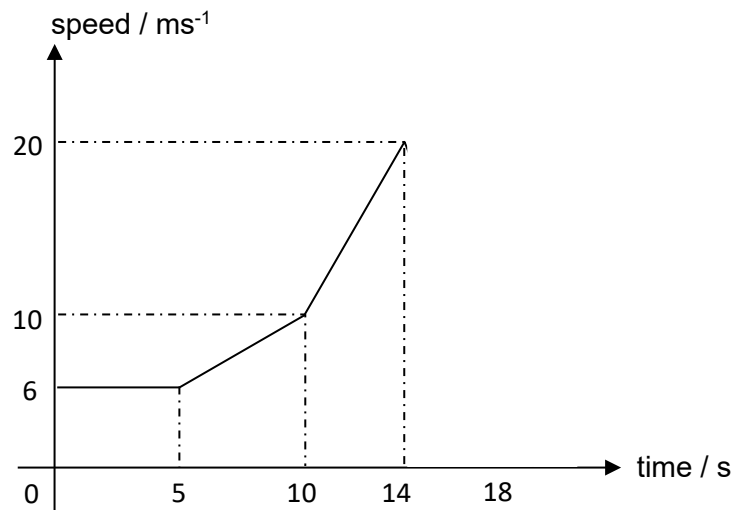


Fig. 1.1

- (a) Describe the difference in the motions of the car during the time from the 10th to the 14th second and the time from the 5th to the 10th second.

.....
 [1]

- (b) Calculate acceleration of the car from the 10th to the 14th second.

Acceleration = m/s² [2]

- (c) The car moves with uniform deceleration to rest from the 14th to the 18th second. Complete the graph on Fig. 1.1 to represent this. [1]

- (d) Calculate the distance moved for the first 10 seconds.

Distance = m [2]

- 2 Fig 2.1 shows a bus of mass 2400 kg moving along a straight road. The engine produces a forward force of 12000 N. The bus also experiences a total retarding force of 3200 N.

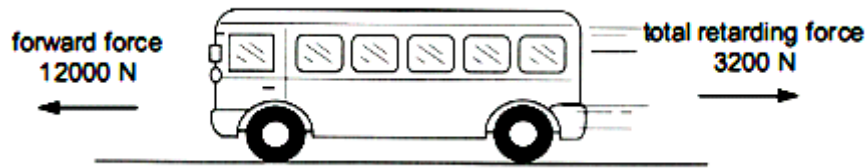


Fig 2.1

- (a) Calculate the acceleration of the bus.

Acceleration =m/s² [2]

- (b) The acceleration of the bus gradually decreases until the bus comes to a uniform speed although the driving force remained constant. Explain why this happens.

.....

[2]

- 3 Fig. 3.1 shows a uniform metre rule balanced on a pivot at the 40 cm mark. The metre rule balances when a load of 5 N is suspended at the 20 cm mark.

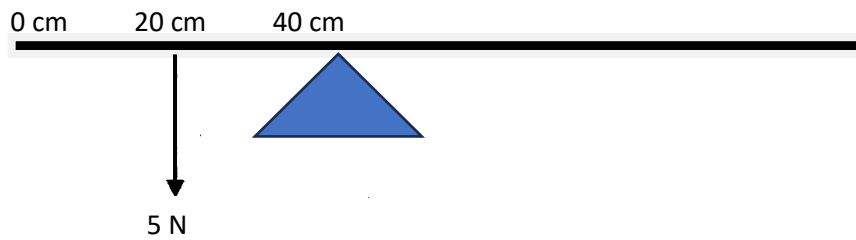


Fig. 3.1

- (a) On Fig. 3.1, indicate the weight of the rule acting in the correct position. [2]
- (b) Calculate the weight of the metre rule.

Weight = N [2]

- 4 A Bunsen burner is used to heat a beaker full of water.

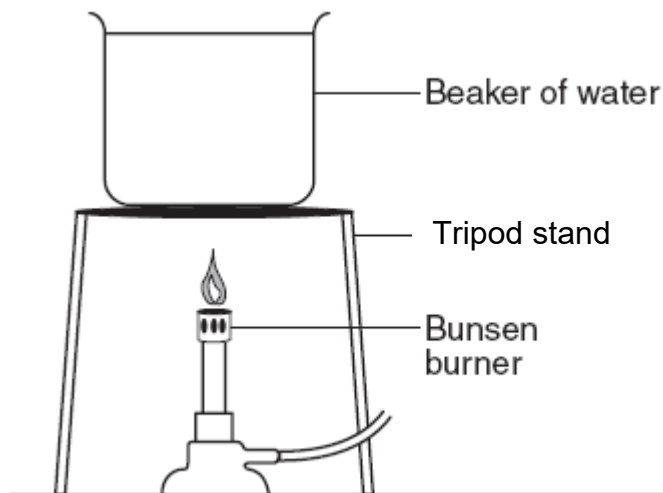


Fig 4.1

- (a) State the process whereby energy is transferred from the tripod stand to the bottom of the beaker.

.....[1]

- (b) (i) Draw the direction of the convection current set up within the beaker of water [1]

- (ii) Explain how energy is transferred through the water.

.....

.....

.....

.....

.....[2]

- (c) Compare the molecular structure of water and water vapour in terms of their intermolecular forces and distance between molecules. [2]

	Intermolecular forces	Distance between molecules
Water		
Water vapour		

- 5 When a vacuum flask is used, heat loss by conduction, convection and radiation are greatly reduced. Explain how the following features reduce energy transfer to the surrounding.

- (a) The plastic stopper.

.....

.....[1]

- (b) Vacuum between double glass.

.....

.....[1]

- (c) The wall of the glass is silvered.

.....

.....[1]

- 6 Fig 6.1 shows sea waves approaching a beach at a speed of 1.2 m/s.

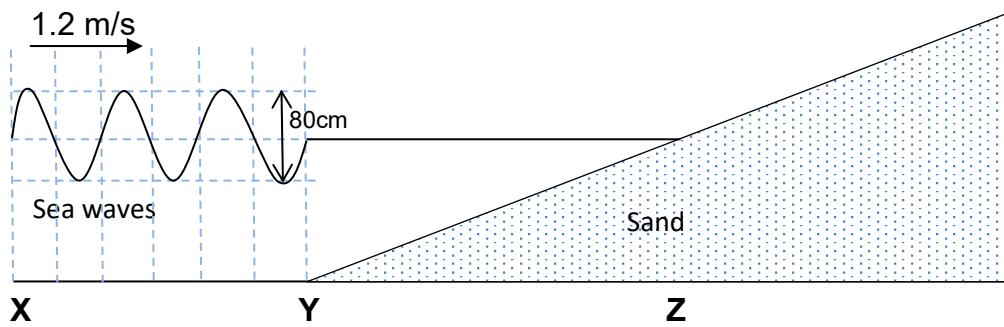


Fig 6.1

The wave takes 3.0 s to travel from **X** to **Y**.

- (a) State, in metre, the size of the amplitude of the sea wave.

Amplitude =m [1]

- (b) Calculate the distance between **X** and **Y**.

Distance =m [1]

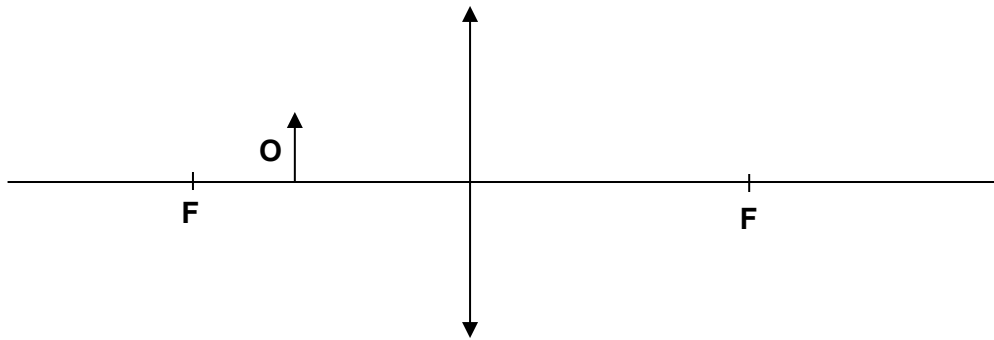
- (c) Calculate the wavelength of the wave.

Wavelength =m [1]

- 7 (a) The diagram below shows an object **O** placed in front of a converging lens. Using ray diagrams, locate and draw the image of **O**. Label it as **I**.

F is the focal points of the lens.

[2]



- (b) State two characteristics of the image formed.

.....[1]

- 8 Fig. 8.1 shows a small and charged sphere S suspended by an insulating thread. It is attracted towards a large positive charged metal sphere L supported on an insulating stand.

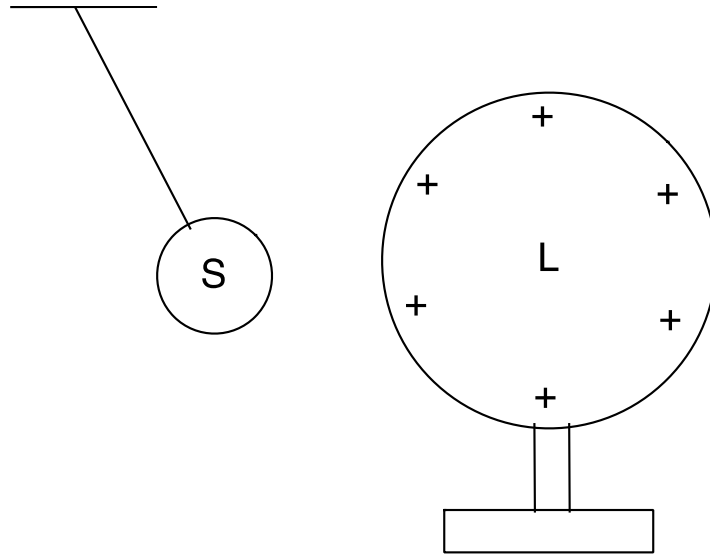


Fig. 8.1

- (a) Draw and label on Fig. 8.1, all the forces acting on sphere S. [2]

- (b) Explain why S is attracted towards L.

.....
[1]

- 9 Fig. 9.1 shows an ultrasound emitted downwards from a ship. The ultrasound is reflected from the seabed and is detected as it arrives back at the ship.

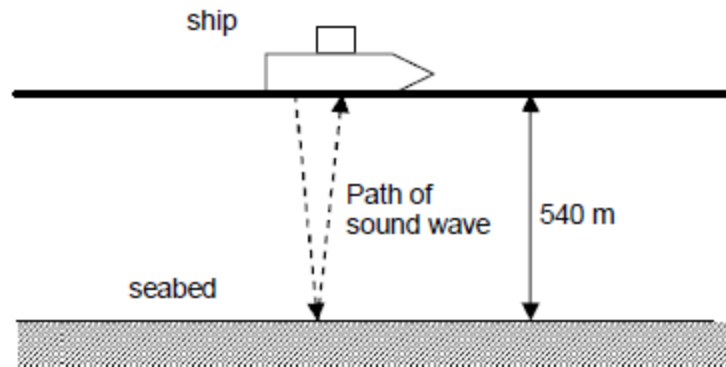


Fig. 9.1

The time between emitting the ultrasound and detecting it back at the ship is 0.58 s.
The seabed is 540 m below the ship.

- (a) Describe the movement of sound waves in the water.

.....
[1]

- (b) Calculate the speed of sound in seawater.

Speed of sound = m/s [2]

- (c) If the frequency of the sound is doubled, state the effect, if any, this has on the speed of the ultrasound.

.....
[1]

10 Fig 10.1 shows an electric circuit.

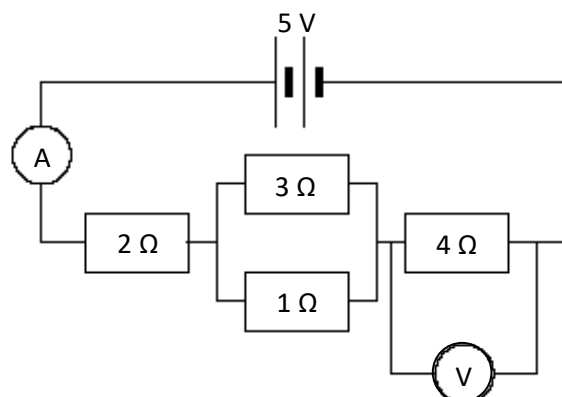


Fig. 10.1

(a) Calculate the total resistance of the circuit.

(b) What is the reading on the ammeter?

Resistance = Ω [2]

Ammeter = A [2]

(c) Calculate the charge that passes through the ammeter in 1 min.

Charge = C [2]

- 11** The activity of a radioactive source was measured at the same time each day for 5 days. The results after allowing for background radiation are shown in table 11.1.

Time / days	0	1	2	3	4	5
Activity / Bq	120	75	48	30	19	12

Table 11.1

- (a)** On grid of Fig. 11.1, draw a graph to show how the activity of the radioactive source varies with time.

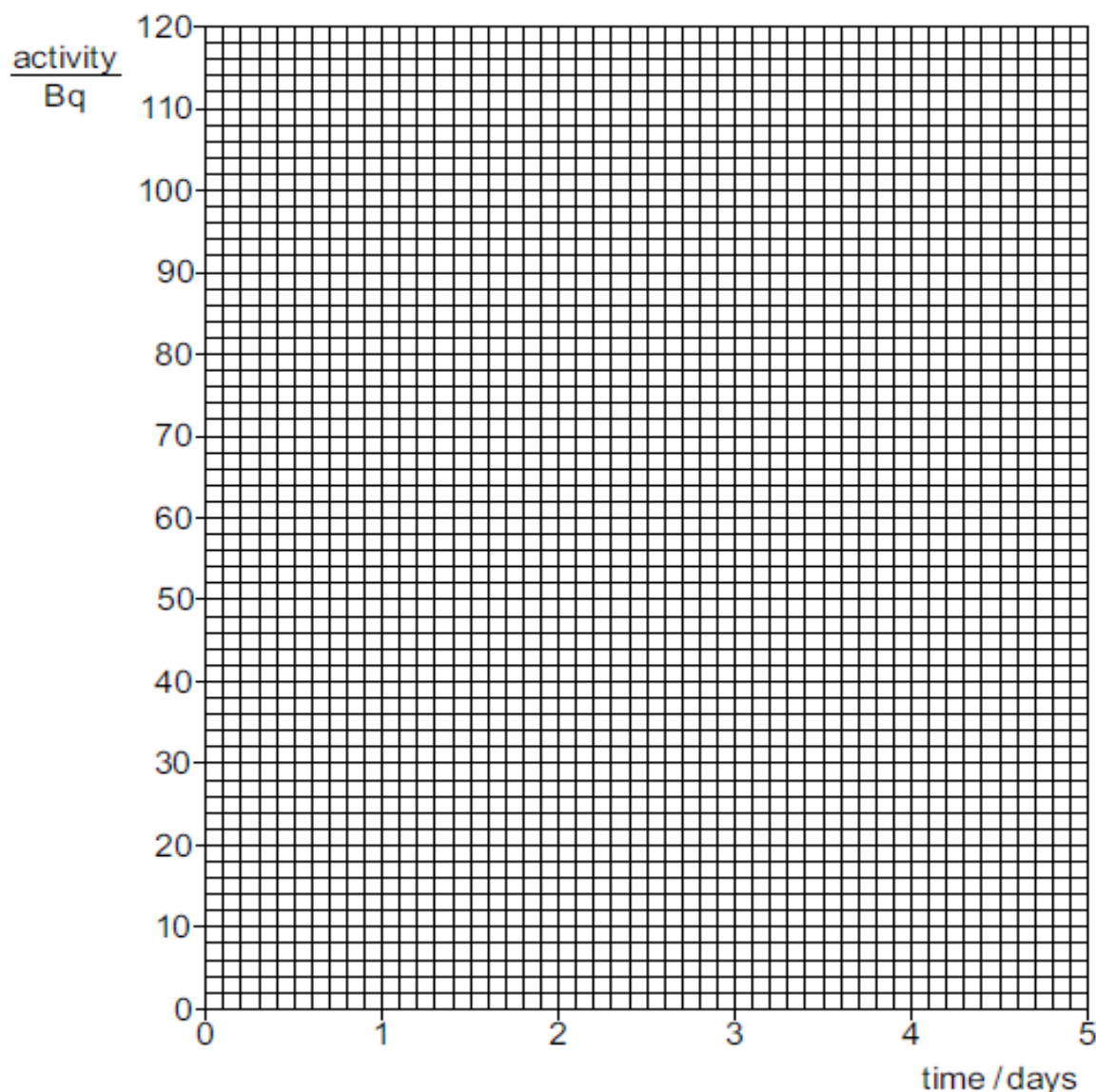


Fig. 11.1

[1]

- (b)** Determine the half-life of the source. Show, using at least 2 half-lives, on your graph how you arrive at your answer.

Half-life =days [2]

- 12 (a)** Mary was scolded by her father for wasting electricity. When he went to her bedroom, no one was there but the following electrical appliances were turned on:

500 W television, 2 x 60 W bulbs, 250 W hi-fi set and 12 kW air-conditioner.

Mary was in fact in the bathroom for the past half an hour. Determine the amount of money wasted by leaving those appliances on while she was having a bath, given that 1 kWh of electricity cost \$0.28.

Amount of money wasted = \$..... [3]

- (b)** Fig. 12.1 shows a cross-sectional view of the electric kettle and the live, neutral and earth terminals of a household electricity supply.

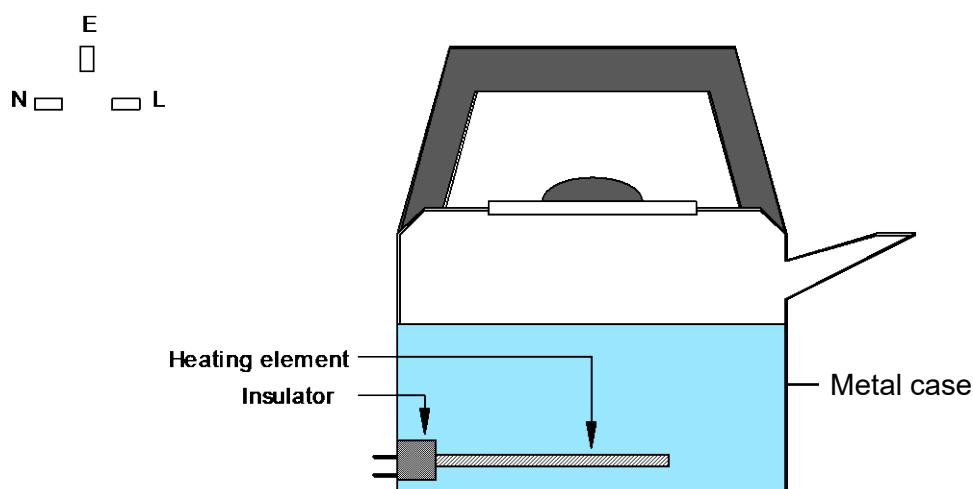


Fig. 12.1

- (i)** Complete Fig. 12.1 by showing how the wires are to be correctly connected from the terminals to the kettle. [2]
- (ii)** Include a fuse and a switch in your diagram. [1]

(iii) Explain how a fuse acts as a safety device.

.....

.....

.....

.....[1]

(iv) The 2 kW electric kettle is connected to a 240 V supply. Determine the currents flowing in the live and earth wires?

Current in live wire =A [2]

Current in earth wire =A [1]

Section B – 10 marks

Answer any **ONE** question out of the two questions.

- 13** A steel ball of mass 300 kg is suspended from the jib of a crane as shown in Fig. 13.1.

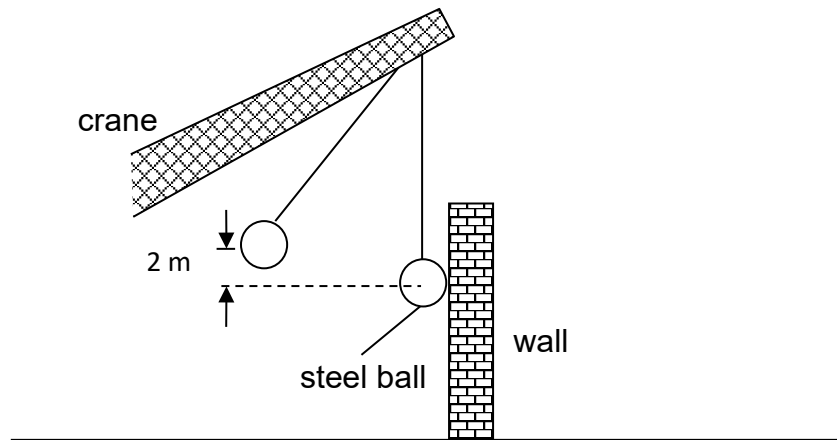


Fig. 13.1

In order to demolish the wall, the steel ball is pulled away from the wall to a height of 2 m and then released from rest.

- (a)** State the principle of conservation of energy.

.....

[2]

- (b)** Calculate the energy in the kinetic store that the ball has when it hits the wall. State the assumption you have made in arriving at your answer. Take g , the acceleration due to gravity as 10 m/s^2 .

Assumption :.....
[3]

- (c) On impact, the ball will transfer 30% of its energy to the wall. Calculate the rebound height at which the ball will reach after impact.

Rebound height = m [3]

- (d) Calculate the power transfer to the wall if the impact occurs in 0.01 s.

Power = W [2]

14 Fig. 14.1 below shows the structure of a simple temporary electromagnet.

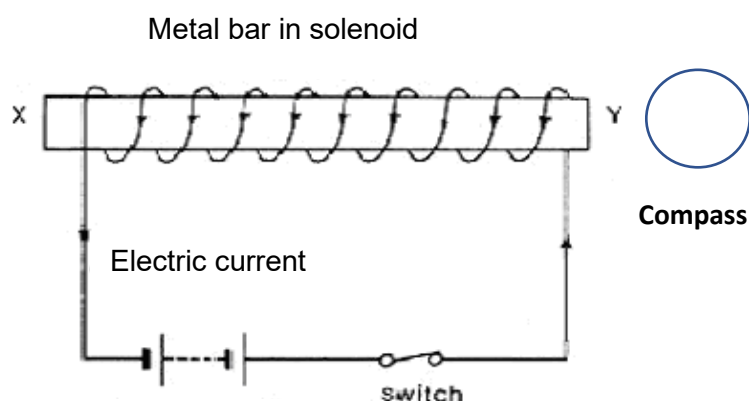


Fig. 14.1

(a) What metal could the bar be made of?

.....[1]

(b) Suggest two ways to make the electromagnet stronger.

.....
[2]

(c) When the switch is closed, state the polarity at **X**?

.....[1]

(d) Sketch on the above diagram the shape of the magnetic field around the metal bar.

[1]

(e) A compass is placed near to end **Y** of the metal bar as shown in the diagram. Draw an arrow to indicate the direction of the compass.

[1]

- (f)** Fig. 14.2 shows a circuit breaker that consists of an electromagnet. Explain how the circuit breaker works when a high current surges from X to Y.

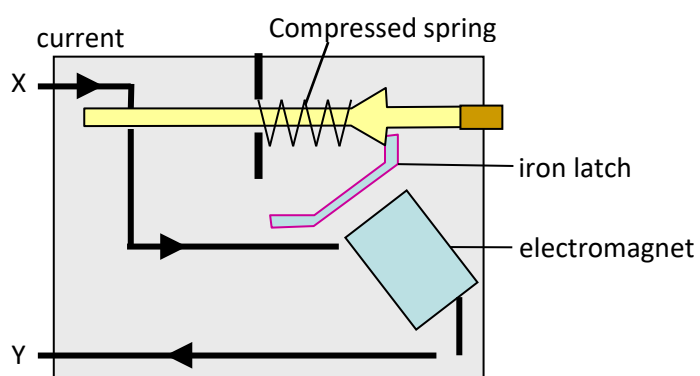


Fig. 14.2

.....[3]

- (g)** Name another application of electromagnet.

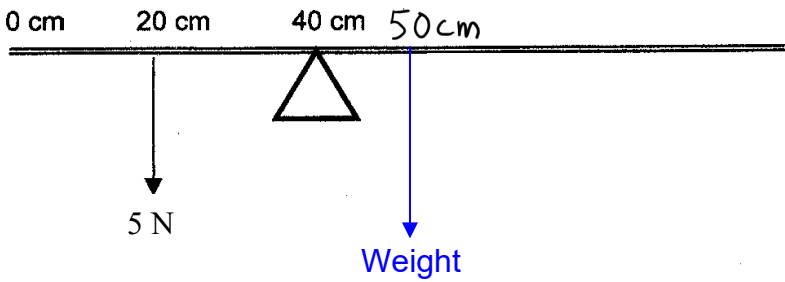
.....[1]

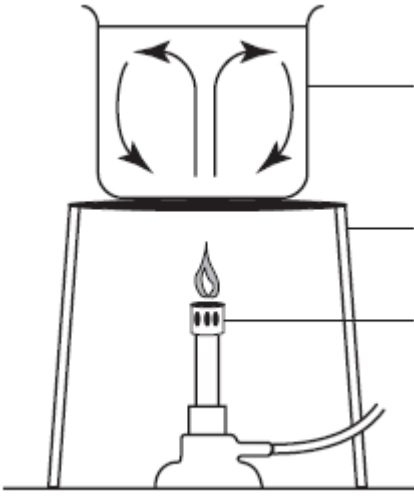
---End of Paper---

NGEE ANN SECONDARY SCHOOL
Sec 4 Express
Science(Physics) 5086
Preliminary Examination 2024
Marking Scheme

Paper 2 Section A – Structured Questions (55 marks)

1	(a)	Acceleration is greater during the time from the 10 th second to the 14 th second than the time from the 5 th second to the 10 th second.	B1
	(b)	Acceleration = gradient = 10/4 = 2.50 m/s ²	M1 A1
	(c)		B1 – negative uniform gradient
	(d)	Distance = area under graph = (5×6) + [1/2(6+10)×5] = 70.0 m	M1 A1
Total			6
2	(a)	$F - f = ma$ $12\,000 - 3200 = 2400a$ $8\,800 = 2400a$ $a = 3.67 \text{ m/s}^2$	M1 A1
	(b)	The retarding force continues to <u>increase due to air resistance until it balances the forward force.</u> When the <u>total retarding force is equal to the driving force,</u> <u>resultant force is zero</u> and the bus moves at <u>constant speed.</u>	B1 B1
Total			4

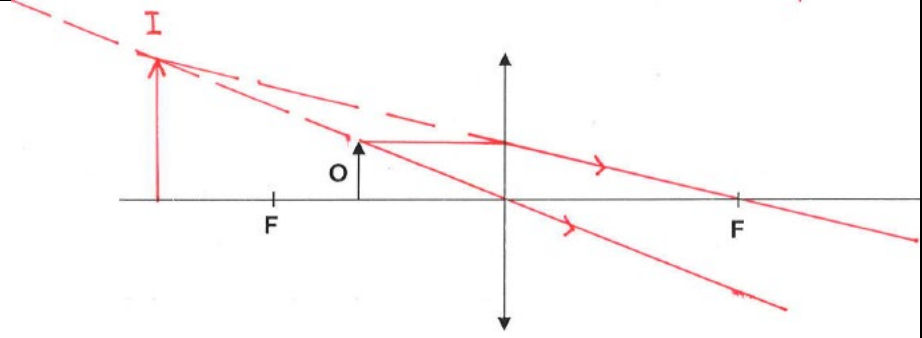
3	(a)	 B1 – Correct labelled 50 cm mark B1 – Correct weight drawn acting vertically down at 50cm mark	
	(b)	By Principle of Moments, taking moments about the pivot, sum of clockwise moment = sum of anticlockwise moment $W \times 0.1 \text{ m} = 5 \times 0.2 \text{ Nm}$ $W = 10.0 \text{ N}$	M1 A1
		Total	4

4	(a)	Conduction	B1
	(b)	(i) 	B1
		(ii) Water at the bottom gets <u>heated</u> and <u>expands</u>, <u>decreases in density</u> and <u>rises</u> to the top. <u>Cooler</u> surrounding water that has <u>higher density</u> <u>sinks</u> in to take its place. This sets up a <u>convection current</u> to transfer heat throughout the liquid.	B1 B1

	(c)		<table><tr><td></td><td>Intermolecular forces</td><td>Spacing/Distance between molecules</td></tr><tr><td>Water</td><td>strong</td><td>Close together</td></tr><tr><td>Water vapour</td><td>weak</td><td>Far apart</td></tr></table>		Intermolecular forces	Spacing/Distance between molecules	Water	strong	Close together	Water vapour	weak	Far apart	B1 B1
	Intermolecular forces	Spacing/Distance between molecules											
Water	strong	Close together											
Water vapour	weak	Far apart											
			Total	6									

5	(a)		The plastic stopper is a poor conductor of heat hence reduces heat loss by conduction. OR The stopper prevents warm air from escaping whereby preventing convection and evaporation from taking place.	B1
	(b)		Vacuum between double glass wall prevents convection/conduction as convection/conduction requires a medium to take place.	B1
	(c)		The wall of the glass is silvered so that infra-red radiation is reflected back to the liquid. OR Silver is a poor emitter of heat hence heat is radiation away slowly.	B1
			Total	3

6	(a)		Amplitude = 0.400 m	B1
	(b)		Distance = $1.2(3) = 3.60$ m	B1
	(c)		Wavelength = $3.6/3 = 1.20$ m	B1
			Total	3

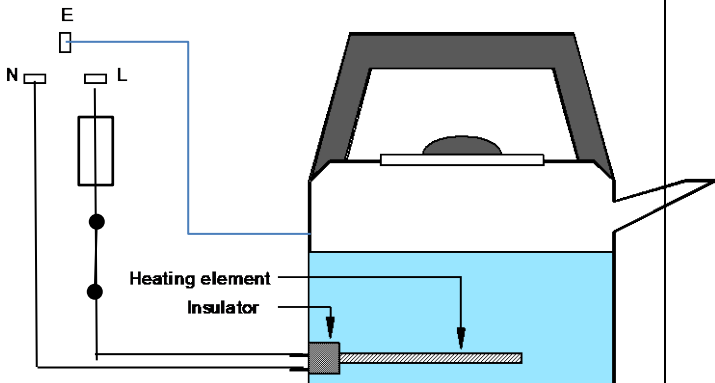
7	(a)		 B1 – 2 rays drawn correctly B1 – Image drawn upright correctly with label I	
	(b)		Upright and magnified or virtual	B1
			Total	3

8	(a)		3 correct forces drawn and labelled [B2] minus [1] for each force missing
	(b)	Sphere S is negatively charged and unlike charges attract.	B1
Total			3

9	(a)	Sound waves travels as a longitudinal wave where the particles' vibration is parallel to the direction of wave travel. OR Sound wave travels as a series of compression and rarefaction	B1
	(b)	Speed of sound = $2d/t$ (with formula) = $2 \times 540/0.58$ = 1860 ms^{-1} (to 3 sf)	M1 A1
	(c)	No effect	B1
Total			4

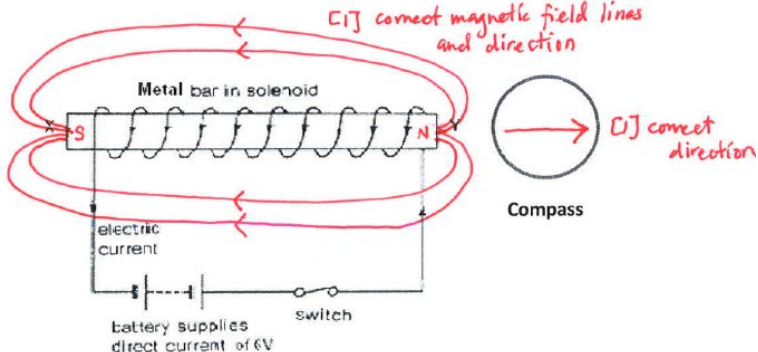
10	(a)	$R_T = 2 + (1/3 + 1/1)^{-1} + 4$ = 6.75Ω	M1 A1
	(b)	$I = V/R$ (with formula) = $5/6.75$ = 0.741 A	M1 A1
	(c)	$Q = I \times t$ (with formula) = $0.741 \times 1 \times 60$ = 44.5 C	M1 A1
Total			6

11	(a)		All points plotted to within $\frac{1}{2}$ small square and Smooth curve joining all points	B1
	(b)		1.5 $\pm$ 0.1 days (unit necessary) Lines or other markings on graph to show at least TWO half lives have been used to determine the answer.	B1 B1
			Total	3

12	(a)		Total power on = $500 + 120 + 250 + 12000$ $= 12870 \text{ W}$ Total energy used in $\frac{1}{2}$ hour = $(12870 \times \frac{1}{2})/1000$ $= 6.435 \text{ kWh}$ Money wasted = 6.435×0.28 $= \\$1.80$	M1 M1 A1
	(b)	(i)	2 m for all 3 wires connected correctly, 1 m for at least 2 wires correctly connected, no marks for either 1 or no wires connected correctly 	B1 B1
		(ii)	1m for both fuse and switch correctly connected	B1
		(iii)	When current <u>exceeds the fuse rating</u> , the fuse will <u>melt and break the circuit</u> , hence preventing the large current from reaching the appliance.	B1
		(iv)	$P = IV$ $I = P/V$ (with formula) $= 2000/240$ $= 8.33 \text{ A}$ Current in live wire = 8.33 A Current in earth wire = 0 A	M1 A1 A1
			Total	10

Paper 2 Section B – Essay Questions (20 marks)

13	(a)		Principle of Conservation of energy states that energy cannot be created or destroyed but gets converted from one form to another. Total energy remains constant	B1 B1
	(b)		Kinetic energy upon impact = loss in gravitational potential energy $= mgh$ $= 300 \times 10 \times 2$ $= 6\,000\text{ J}$ There is no energy lost to the surroundings. All the GPE is converted to KE just before impact.	M1 A1 B1
	(c)		GPE gained after impact = 0.7×6000 $= 4\,200\text{ J}$ $mgh = 4200$ $300 \times 10 \times h = 4200$ $h = 4200/3000$ $= 1.40\text{ m}$	M1 M1 A1
	(d)		Power lost = energy / time $= (6000 - 4200) / 0.01$ [ecf from (b) and (c)] $= 1800 / 0.01$ $= \underline{180\,000\text{ W}}$ OR : Power lost = $(0.3 \times 6000) / 0.01$ [ecf from (b)] $= \underline{180\,000\text{ W}}$	M1 A1
			Total	10

14	(a)	Soft Iron	B1
	(b)	- Increase number of turns of the coil - Increase the current	B1 B1
	(c)	South	B1
	(d) (e)	 B1 – Correct magnetic field lines drawn B1 = Correct compass direction	
	(f)	When a high current passes from X to Y, the <u>electromagnet becomes strongly magnetised</u>. It <u>attracts the iron latch</u>, causing the compressed spring attached to the safety bar to move to the right and break the circuit. The circuit breaker can be reset by pushing the safety bar back when the current stops flowing and the iron latch is no longer attracted to the solenoid.	B1 B1 B1
	(g)	Moving-coil loudspeaker/ammeter/circuit breaker/used in scrapyards to separate magnetic materials from non-magnetic materials	B1
Total			10