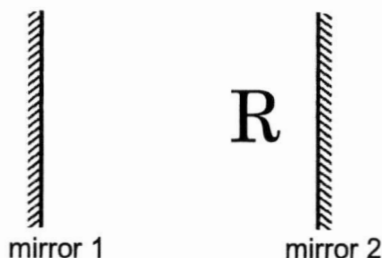


Section A (30 marks)

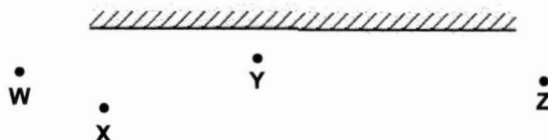
Answer **all** the questions on the OTAS provided.

- 1 An object (**R**) is placed in between two plane mirrors, 1 and 2.



What are the characteristics of the final image seen after two reflections in mirrors 1 and 2 respectively?

- A real, not upright and not laterally inverted
 - B real, upright and laterally inverted
 - C virtual, not upright and laterally inverted
 - D virtual, upright and not laterally inverted
- 2 The diagram below shows the positions of four people, **W**, **X**, **Y** and **Z**, standing in front of a mirror.



Whose image(s) can be seen by person **W**?

- A **W** only
 - B **W** and **X**
 - C **X** and **Z**
 - D **Y** and **Z**
- 3 The bottom surface of a glass block is silvered to act as a mirror. Which diagram correctly shows the path of a light ray as it enters this block from the top surface?

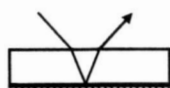
A



C



B



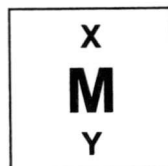
D



- 4 Which of the following compounds contains two atoms of nitrogen?

A NaNO_3
 B NH_3
 C N_2O
 D NO_2

- 5 The diagram below shows the symbol of element **M**.



Given that the electronic configuration of **M** is (2, 3) and it has 6 neutrons, what are the values of **X** and **Y** respectively?

- A 3 and 6
 B 3 and 11
 C 5 and 6
 D 5 and 11
- 6 Xavier is participating in a 16-km race. There are 2 compulsory hydration stations (each lasting 3 minutes) along the track where all runners must stop to have a quick drink.

If Xavier is running at a speed of 20 km/h, what is the minimum time that he would take to complete this race?

- A 48 minutes
 B 54 minutes
 C 1 hour 4 minutes
 D 1 hour 10 minutes
- 7 As an astronaut travels from Earth to outer space, how does his weight and mass change?

	Weight	Mass
A	drops to zero	decreases
B	drops to zero	remains the same
C	remains the same	decreases
D	remains the same	drops to zero

- 8 The extension of a spring balance was 12 mm when a 50-gram object was hung on it.

What would the extension of the spring balance be, if a 4 N object was hung instead?

- A 1 mm
 B 9.6 mm
 C 12.5 mm
 D 96 mm
- 9 Felicia weighs 500 N on Earth. Given that the gravitational field strengths on Earth and Moon

[Turn over]

are 10 N/kg and 1.7 N/kg respectively, what is her weight on the Moon?

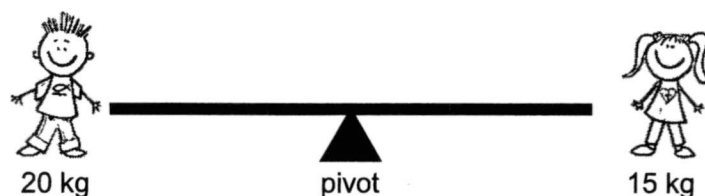
- A 85 N
- B 170 N
- C 295 N
- D 500 N

- 10 Jennifer stood on a weighing scale to measure her mass. She first stood on the scale on both feet, then changed to standing on one foot.

Which of the following statements is true?

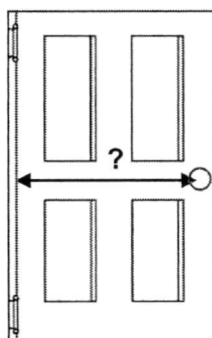
- A The pressure exerted on the scale doubled when she changed to standing on one foot.
- B The pressure exerted on the scale halved when she changed to standing on one foot.
- C The reading on the weighing scale doubled when she changed to standing on one foot.
- D The reading on the weighing scale halved when she changed to standing on one foot.

- 11 The diagram below shows two children on the opposite ends of a seesaw.



How should the children position themselves so that the seesaw will be in equilibrium?

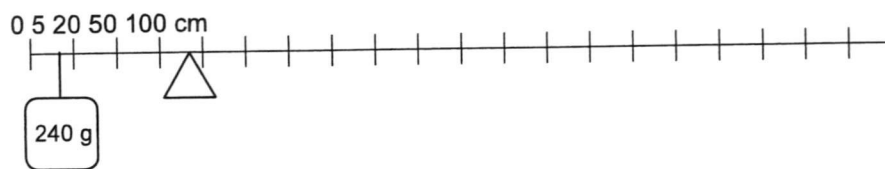
- A Both children should sit at the far ends of the seesaw.
 - B Both children should sit equal distance from the pivot.
 - C The girl should sit further away from the pivot as compared to the boy.
 - D The girl should sit nearer to the pivot as compared to the boy.
- 12 A door requires a minimum moment of 50 Nm in order to open it.



What is the minimum distance of the door knob from the hinges if the door is to be pulled open with a force of 200 N at the door knob?

- A 0.25 m
 - B 0.5 m
 - C 4.0 m
 - D 10 m
- 13 The diagram shows a uniform metre rule pivoted at 20-cm mark. It is kept in equilibrium by a

suspended mass of 240 g.



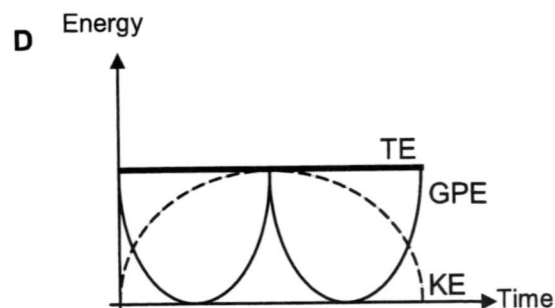
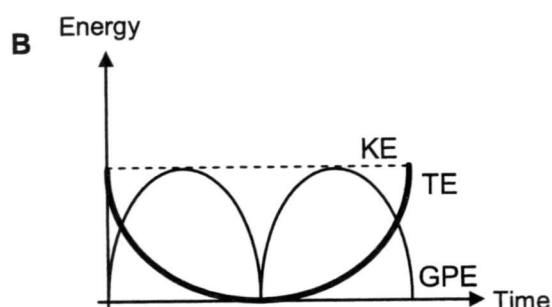
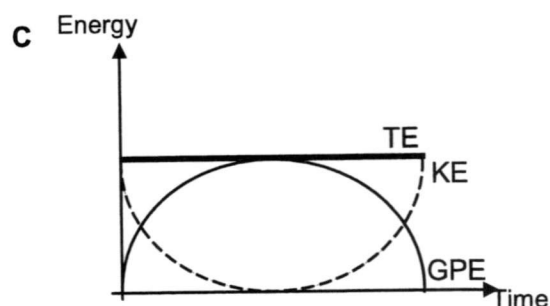
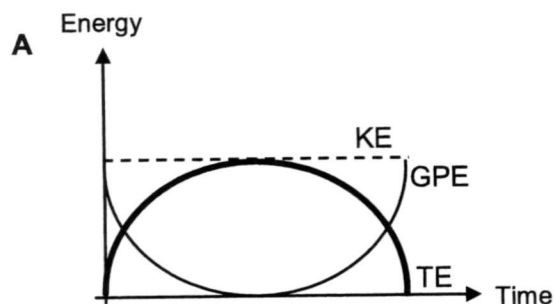
What is the mass of the rule, if the mass acts at the 50-cm mark?

- A 12 g
- B 72 g
- C 120 g
- D 360 g

- 14 A ball is thrown vertically upwards and allowed to fall as shown.

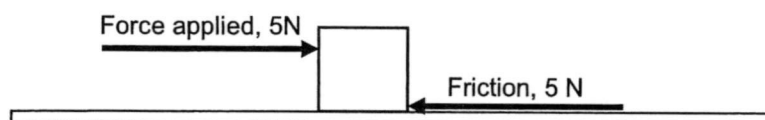


Which of the following graphs correctly show the variation of its gravitational potential energy (GPE —), kinetic energy (KE ---) and total energy (TE —) with time?



- 15 The diagram shows two forces acting on a stationary object in opposite directions.

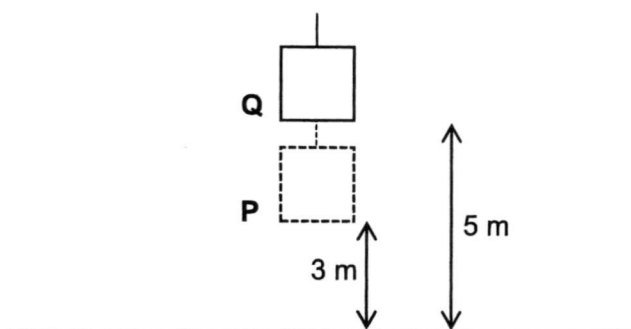
[Turn over]



Which of the following statements is correct?

- A The object moves in the same direction as the force applied.
- B The object moves in the same direction as the friction.
- C There is no work done as the object remains stationary.
- D There is work done as the force is applied to the object.

- 16 An object is lifted at a constant speed by a rope from point **P** to point **Q** by a force of 30 N as shown.

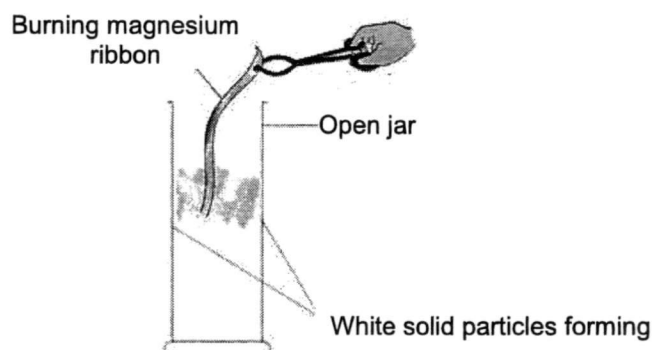


What is the work done in lifting the object?

- A 10 N
- B 60 N
- C 90 N
- D 150 N

Refer to the diagram below for Questions 17 and 18.

The diagram below shows the experiment of burning a magnesium ribbon in air.



- 17 What is the identity of the white solid particles?
- A Magnesium
 - B Magnesium carbonate
 - C Magnesium chloride
 - D Magnesium oxide
- 18 Which of the following statements can be inferred from the diagram?

- A It is a chemical change as a new product is formed.
- B It is a chemical change as the reaction is irreversible.
- C It is a physical change as it involves a change of state of magnesium.
- D It is a physical change as the reaction is reversible.

- 19 Ken dipped red litmus paper into an unknown liquid, and it remained red. He concluded that the liquid was acidic. However, his teacher said that the test was incomplete.

Which of the following will be the most appropriate method to confirm whether the liquid was acidic or not?

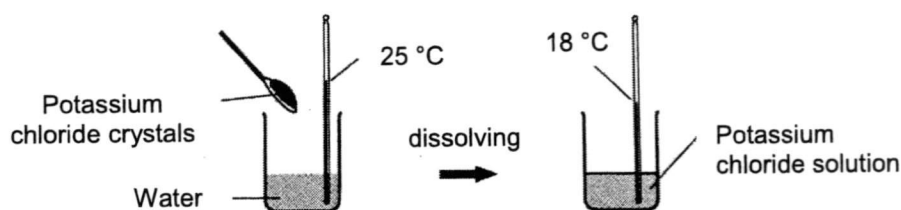
- A Mix the liquid with alkali
- B Taste the liquid to see if it is sour.
- C Test the liquid with blue litmus paper.
- D Touch the liquid to see if it is soapy.

- 20 The table below shows the colour scale of a pH indicator.

pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
colour	yellow				green				blue						

Which two solutions can be differentiated by this indicator?

- A baking soda and bleach
 - B battery acid and lemon juice
 - C bitter gourd juice and detergent
 - D gastric juice and salt solution
- 21 The diagram below shows an experiment of dissolving potassium chloride crystals in water.



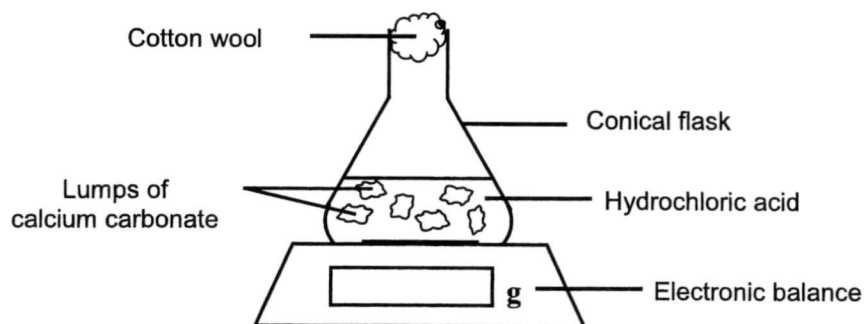
The table below shows the conclusions made by four students on this experiment.

Andy	: This is a physical change as no new substance is formed.
Dora	: This is a chemical change as there is a change in temperature.
Ernie	: This is a chemical change as a new solution is formed from crystals.
Mindy	: This is a physical change as dissolving is a reversible reaction.

Which student(s) is(are) correct?

- A Andy only
 - B Andy and Mindy
 - C Dora only
 - D Dora and Ernie
- 22 The diagram below shows the reaction between hydrochloric acid and calcium carbonate.

[Turn over

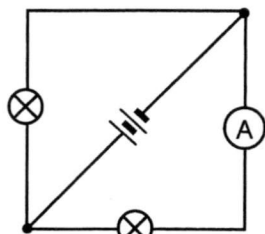


Which of the following statements is **incorrect**?

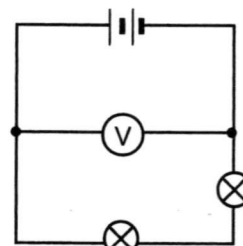
- A The ions of calcium carbonate and hydrochloric acid rearrange to form new products.
- B The reading on the electronic balance before and after the experiment is the same.
- C Using calcium carbonate powder will increase the rate of the reaction.
- D Water is formed in this chemical reaction.

23 Which of the following light bulbs are **not** connected in series?

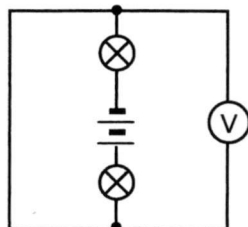
A



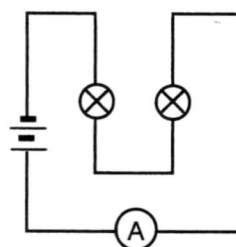
C



B



D

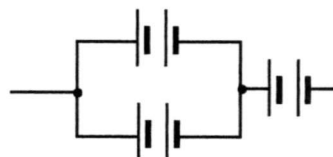


24 Which of the following will give a total voltage of 6 V if each dry cell is 1.5 V?

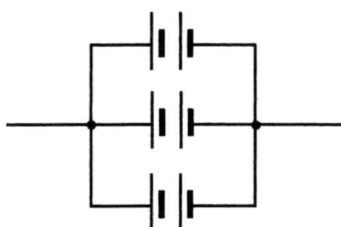
A



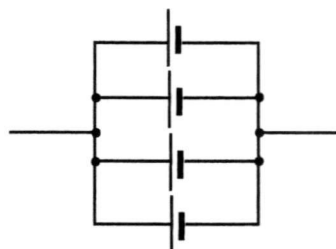
C



B

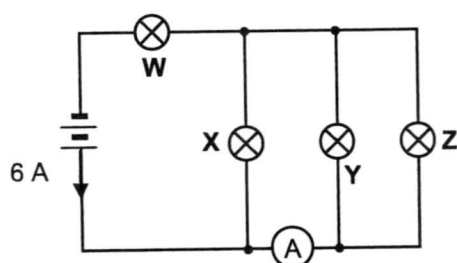


D



Refer to the diagram below for Questions 25 and 26.

The diagram shows an electric circuit with identical light bulbs **W**, **X**, **Y** and **Z**.



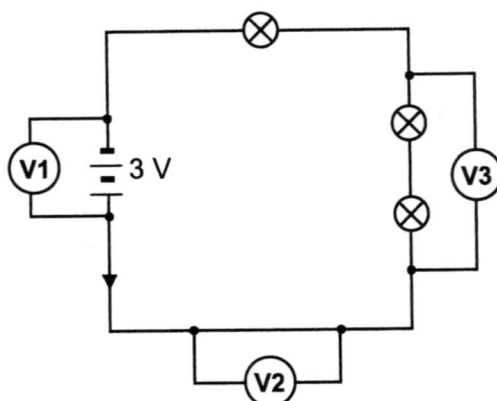
25 What is the reading on the ammeter?

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

26 Which light bulb, upon removal from the circuit, will cause the rest of the three light bulbs to go out?

- A Light bulb **W**
- B Light bulb **X**
- C Light bulb **Y**
- D Light bulb **Z**

27 The diagram below shows an electrical circuit with three identical light bulbs and three voltmeters (**V1** to **V3**).

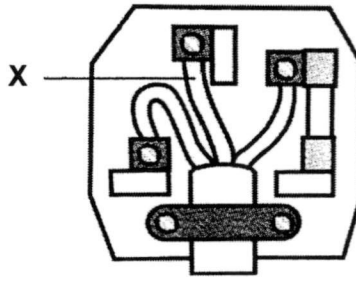


What are the readings on the three voltmeters?

	V1	V2	V3
A	0 V	0 V	2 V
B	3 V	0 V	2 V
C	3 V	3 V	2 V
D	3 V	3 V	3 V

28 The diagram below shows a three-pin plug.

[Turn over



What is the colour of wire X?

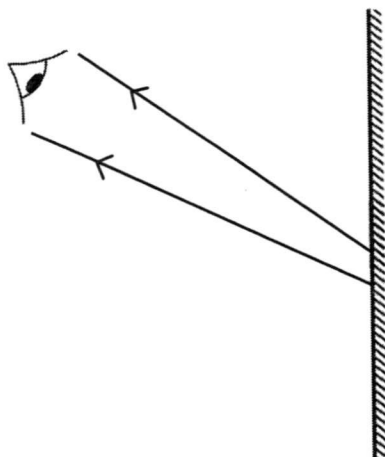
- A Blue
- B Brown
- C Green and yellow
- D Red

- 29 Which of the following explains why a fuse is used in an electrical appliance?
- A To prevent large currents from flowing into the electrical appliance.
 - B To raise the power supply to the correct level for the electrical appliance.
 - C To reduce the loss of electrical energy.
 - D To reduce the resistance in the conducting wires.
- 30 A hair dryer is marked "240 V, 160 W". Which of the following best explains the rating of 160 W?
- A It converts 160 J of electrical energy into other forms of energy per hour.
 - B It converts 160 J of electrical energy into other forms of energy per second.
 - C It converts 160 J of heat energy into other forms of energy per hour.
 - D It converts 160 J of heat energy into other forms of energy per second.

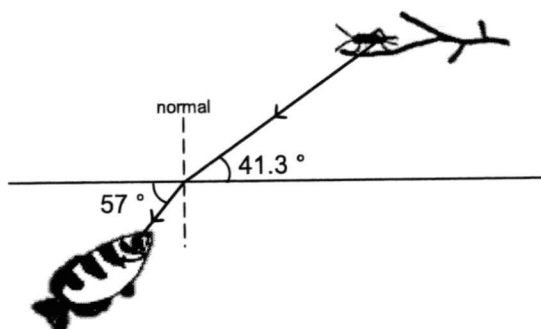
Section B (40 marks)

Answer **all** the questions in the spaces provided on the question booklet.

- 1 The diagram below shows incomplete rays coming from an image to the eye.



- (a) Locate the position of the image and label this point as **A'**. [2]
 (b) Locate the position of the object and label this point as **A**. [1]
 (c) Complete the ray diagram. [1]
- 2 The diagram below shows what happened when an archerfish aims for its prey above the pond water.



Calculate the refractive index (n) of the pond water.

[3]

- 3 (a) Complete the word equation for a reaction between acid and metal.

[2]

[Turn over

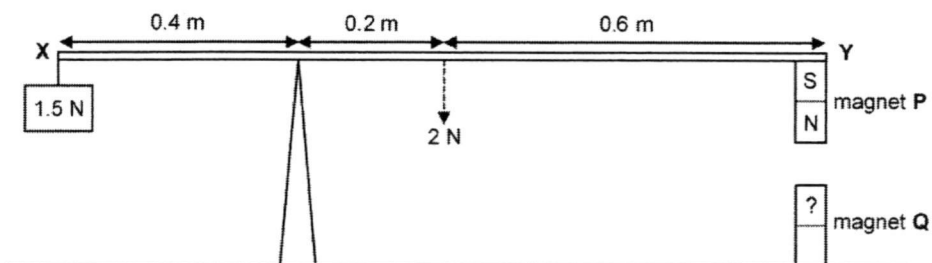
..... + Magnesium \rightarrow Magnesium chloride +

- (b) Draw “dot and cross” diagrams to show the ionic bonding in magnesium chloride, given that its chemical formula is MgCl_2 . [4]

- (c) Electronic configuration of chloride ion = (.....) . [1]

- 4 The diagram below shows a 2 N uniform rod **XY**. A pivot is placed at 0.4 m from end **X**. The rod has magnet **P** firmly attached to end **Y**, and a 1.5 N box hung at end **X**.

The rod is in equilibrium when a magnet, **Q**, is placed directly below magnet **P**. Both magnets **P** and **Q** weigh 1 N each.



- (a) Calculate the total moment generated by the weight of the rod and magnet **P**. [2]

- (b) Calculate the moment generated by the box. [1]

- (c) To balance the rod, which pole (*North or South*) should be at the top of magnet **Q**. [2]

Explain your answer.

.....

.....

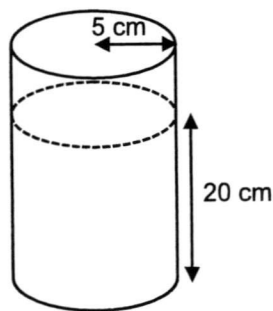
.....

.....

(d) Calculate the force exerted by magnet Q.

[2]

- 5 The diagram below shows a cylindrical container with a radius of 5 cm. It is filled with water (density = 1g/cm^3) to a height of 20 cm.



- (a) Given that the volume of a cylinder is $\pi r^2 h$, calculate the volume of the water.

(Take $\pi = 3.14$) [1]

- (b) Calculate the weight of the water. (Take $g = 10\text{ N/kg}$)

[3]

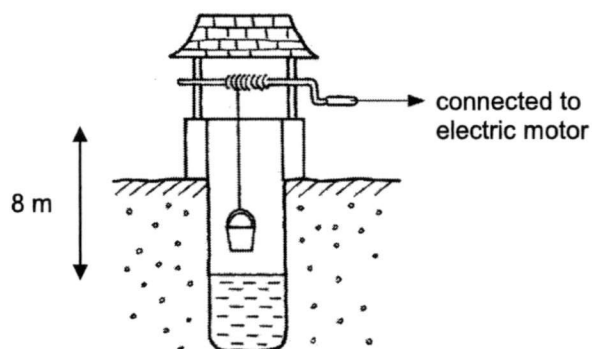
- (c) Calculate the pressure exerted by the water on the base of the can.

[3]

[Turn over]

Leave your answer in SI unit.

- 6 The diagram below shows a 10-kg pail of water being pulled up a well by an electric motor.



Given that it takes 5 seconds to lift the pail of water, calculate the power output of the electric motor. (Take $g = 10 \text{ N/kg}$)

[2]

- 7 Using **all** the materials given below, draw a circuit diagram so that the voltage across the light bulbs will be high.

light bulb $\times 2$

dry cell $\times 2$

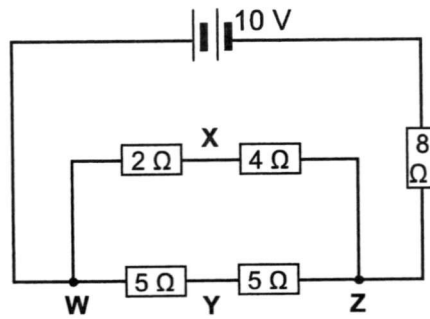
wires (unlimited)

closed switch $\times 1$

[2]



- 8 The diagram below shows an electric circuit.



(a) Calculate the effective resistance of the circuit. [3]

(b) Calculate the current passing through the battery. [2]

(c) Calculate the voltage across the $8\ \Omega$ resistor. [1]

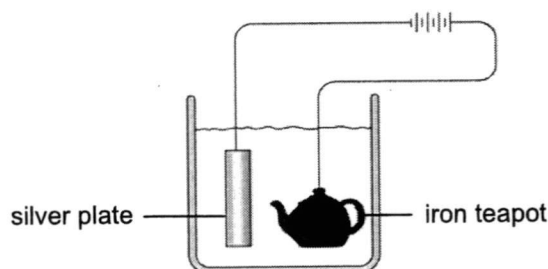
(d) Calculate the current passing the branch **WXZ**. [2]

[Turn over

- (e) When the car hits the water, it will lose 12 kJ of energy for every metre travelled.

Given that **C** is 20.8m, calculate the speed of the car just before it hits the bumper at position **D**. [3]

- 10 (a) The following process is performed to prevent the iron teapot from rusting.



- (i) Name the process shown. [1]

.....

- (ii) Describe what will happen to the teapot after 15 minutes. [1]

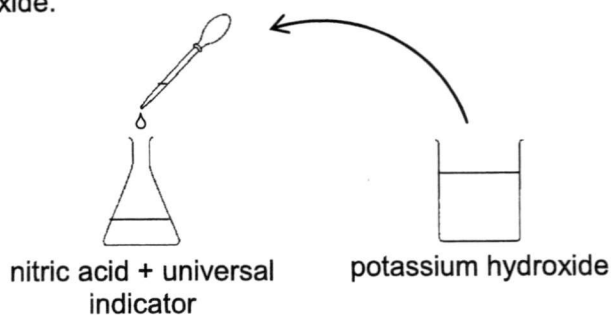
.....

- (iii) Explain why coating the iron teapot with silver can prevent it from rusting. [1]

.....

.....

- (b) The diagram below shows a neutralization reaction between nitric acid and potassium hydroxide.



Potassium hydroxide is added to the nitric acid, 2 ml at a time until a total volume of 20 ml potassium hydroxide is added. The estimated pH value of the solution is recorded when the potassium hydroxide is added.

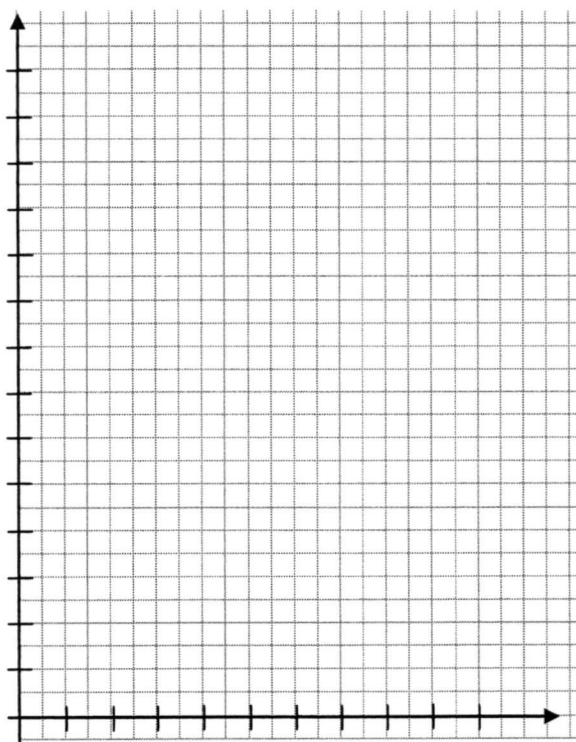
[Turn over]

The table below shows the results.

Volume of potassium hydroxide added (ml)	Estimated pH value of solution
0	2
2	2
4	2
6	3
8	4
10	5
12	9
14	10
16	11
18	11
20	11

- (i) Write down the word equation for this neutralization reaction. [1]

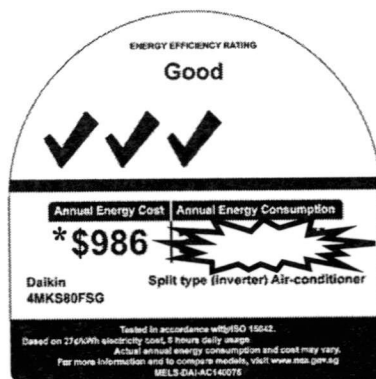
- (ii) Plot the result and draw a graph of pH value (y-axis) against the volume of potassium hydroxide added (x-axis). [4]



- (iii) From your graph, determine the volume of potassium hydroxide needed to neutralize the nitric acid. [1]

- (iv) State the colour of the mixture when the volume of potassium hydroxide stated in (iii) is added. [1]

- 11 The diagram below shows atom label on an air-conditioner.



The information at the bottom of the label is shown below:

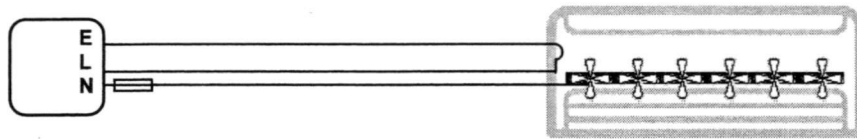
Tested in accordance with ISO 15042.
Based on \$0.27 per kWh electricity cost, 8 hours daily usage. Actual annual energy consumption and cost may vary. For more information and to compare models, visit www.nea.gov.sg
MFIS-DAI-AC140075

- (a) Based on the above information, calculate the amount of energy, in kWh, used by this air-conditioner in a day. **assume that "annual" = 365 days* [2]
- (b) Hence, calculate the power, in W, of the air-conditioner. [2]
- (c) Given that the air-conditioner has a voltage of 230 V, calculate the amount current it draws when in use. [1]
- (d) Which of the three fuses, 5 A, 7A or 10 A, should be used for this air-conditioner? [1]
- (e) With reference to your answer in (d), explain why the other two fuses are [2]

[Turn over]

unsuitable.

- (f) The diagram below shows how the air-conditioner is wired to the mains supply. The earth, live and neutral wires are labelled as **E**, **L** and **N** respectively.



There are **two** mistakes in the wiring. State how these mistakes should be corrected.

[2]

1.

2.

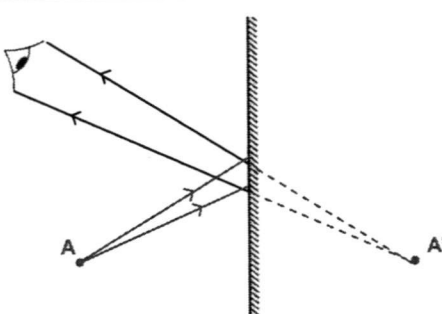
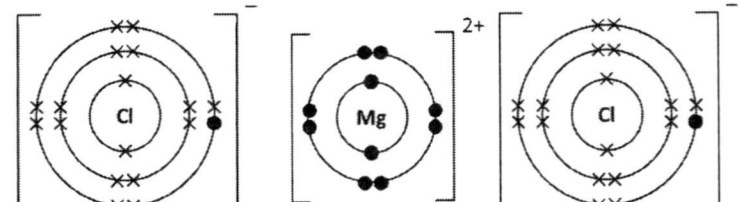
End of Paper

Answer Key

dsQ1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
D	D	B	C	D	B	B	D	A	A
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	A	C	C	C	B	D	A	C	D
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
B	B	A	C	D	A	B	C	A	B

Section B

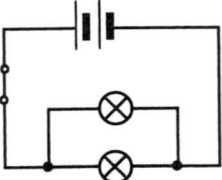
- wrong s.f. → -1m from overall
- missing/wrong unit → -1m from overall
- drawing in pen → -0.5m from overall

Question		Answer
1	a	 <p>(a) Extend the rays accurately behind the mirror (1m) Label the point as A' (1m)</p> <p>(b) <u>Equidistant</u> between image and object. (0.5m) Label the object as A. (0.5)</p> <p>(c) One pair of ray from A to mirror (0.5m) Arrow heads are drawn and in correct direction (0.5m)</p> <p>Marks deduction:</p> <ul style="list-style-type: none"> - ½m for missing/wrong usage of dotted lines (for virtual) and solid lines (for real) - ½ m for drawing extra light rays (either in virtual or real world)
	b	
	c	
2		<p>* angle of incidence = $90 - 41.3 = 48.7$ ----- 1m</p> <p>* angle of refraction = $90 - 57 = 33$ ----- 1m</p> <p>* ZERO if student did not label/identify the value for $\angle i$ or $\angle r$ AND after that, sub the value wrongly into the formula)</p> <p>$n = \sin \angle i / \sin \angle r$ $= \sin (48.7) / \sin (33)$ $= 1.3793$ ≈ 1.38 (3 s.f.) ----- 1m (<u>Correct</u> substitution AND answer)</p>
3	a	<p>Hydrochloric acid + Magnesium → Magnesium chloride + Hydrogen (1m) (1m)</p> <p>0m for spelling mistake</p>
	b	

Answer Key

		<p>Correct number of electrons for Mg ion (1m) Correct number of electrons for each Cl ion (2m) Show one valence electron in each Cl is obtained from Mg (1m)</p> <p>Marks deduction:</p> <ul style="list-style-type: none"> • -½m for missing square bracket(s) • -½m if missing/wrong charge(s) • -½m if the two Cl ions are side by side (two negative ions should repel) • -½ m if students use "<u>dot+cross</u>" as a <i>single</i> electron symbol ✖
	c	(2, 8, 8)
4	a	$(0.2 \times 2) + (0.8 \times 1)$ $= 1.2 \text{ Nm}$
	b	$1.5 \times 0.4 = 0.6 \text{ Nm}$
	c	<p>North pole. (1 m) The repulsion will generate <u>more anticlockwise moment</u> (1 m) to balance the rod.</p>
	d	<p>Let F be the force of magnet Q.</p> <p>Additional anticlockwise moment required: $1.2 - 0.6 = 0.6 \text{ Nm}$ ---- 1 m (ecf ONLY if working shows clearly is (a) – (b))</p> <p>$0.8 \times F = 0.6$ $F = 0.75 \text{ N}$ ----- 1 m</p> <p>Alternative answer: Let x be the resultant force of magnets P and Q; F be the force of magnet Q.</p> <p>$0.6 = 0.4 + 0.8x$ $0.8x = 0.2$ $x = 0.25$ ----- 1m</p> <p>$F = 1 - x$ $= 1 - 0.25$ $= 0.75 \text{ N}$ ----- 1m</p>
5	a	<p>Vol of water $= 3.14 \times 5 \times 5 \times 20$ $= 1570 \text{ cm}^3$</p>
	b	<p>Mass of water $= 1 \times 1570$ ----- 1m for applying $M = D \times V$ (NO mark if no clear working is shown) $= 1570 \text{ g}$ $= 1.57 \text{ kg}$ -----1m</p> <p>Weight = mass x g $= 1.57 \times 10$ $= 15.7 \text{ N}$ ----- 1m</p>
	c	<p>Area of the base $= 3.14 \times 5 \times 5$ $= 78.5 \text{ cm}^2$ ----- 1m $= 0.00785 \text{ m}^2$ ----- 1m</p> <p>Pressure $= 15.7 / 0.00785$ $= 2000 \text{ Pa}$ ----- 1m</p>
6		<p>Gain in GPE OR Workdone $= 10 \times 10 \times 8$ $= 800 \text{ J}$ ----- 1m</p> <p>Power $= 800 / 5$ $= 160 \text{ W}$ ----- 1m</p>

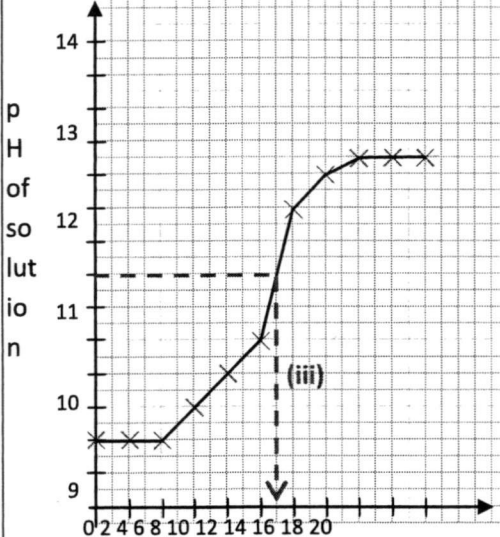
Answer Key

7			 <p>Correct symbols for dry cells <i>and</i> light bulbs (0.5m) Dry cells are in <u>series</u> (0.5m) Light bulbs are in <u>parallel</u> (0.5m) Correct symbol for a <u>closed</u> switch (0.5m)</p> <p>Marks deductions from overall Q7:</p> <ul style="list-style-type: none"> -1m if it is a <u>short circuit</u> (i.e. circuit will not work at all) - ½ m if students did not use dots to show that the wires are joined together
8	a		$\left. \begin{array}{l} R_{WXZ} = 2 + 4 = 6 \\ R_{WYZ} = 5 + 5 = 10 \end{array} \right\} 1\text{m}$ $\frac{1}{R} = \frac{1}{6} + \frac{1}{10}$ $\frac{1}{R} = \frac{8}{30}$ $R = \frac{30}{8} \text{ OR } 3.75 \text{ ----- } 1\text{m}$ $R_{\text{eff}} = \frac{30}{8} \text{ or } 3.75 + 8$ $= 11.75$ $\approx 11.8 \Omega \text{ (3 s.f.) ----- } 1\text{m}$
	b		$V = IR$ $\text{Emf} = I_T \times R_{\text{eff}}$ $10 = I \times 11.75 \text{ ----- } 1\text{m}$ $I = 0.85106$ $I \approx 0.851 \text{ A (3 s.f.) ----- } 1\text{m}$
	c		$V = IR$ $= 0.85106 \times 8$ $= 6.8085$ $\approx 6.81 \text{ V (3 s.f.) ----- } 1\text{m}$
	d		$\text{Voltage of WXZ} = 10 - 6.8085$ $= 3.1915 \text{ V ---- } 1\text{m (ecf if working shown } 10 - (c))$ $\text{Current of WXZ} = V/R$ $= 3.1915 / 6$ $= 0.53191$ $\approx 0.532 \text{ A (3 s.f.) --- } 1\text{m}$

Section C

Question		Answer	Marks
9	a	<ul style="list-style-type: none"> Energy cannot be created or destroyed; (½ m) It can only be converted from one form into another form. (½ m) 	1
	b	$\text{GPE} = mgh$ $= 500 \times 10 \times 50 \text{ ----- } 1\text{m (for applying formula correctly)}$ $= 250\,000 \text{ J ----- } 1\text{m}$	2
	c	$250\,000 / 2 = 125\,000 \text{ ----- } 1\text{m (for "(b) ÷ 2")}$ $\text{KE} = \frac{1}{2} mv^2$ $125000 = (0.5)(500)(v^2) \text{ ----- } 1\text{m (for applying formula correct)}$ $v^2 = 500$	3

Answer Key

		$v \approx 22.4 \text{ m/s}$ (3 s.f.) ----- 1m (ecf for wrong value of KE)		
	d	250 000 J	1	
	e	Amount of energy lost = $20.8 \times 12 \text{ kJ}$ = 249.6 kJ OR 249 600 J ----- 1m KE before hitting bumper = $250\,000 - 249\,600$ --- 1m (for "(d) – previous value") = 400 J KE = $\frac{1}{2}mv^2$ 400 = $\frac{1}{2}(500)(v^2)$ $v^2 = 1.6$ $v \approx 1.26 \text{ m/s}$ (3 s.f.) ----- 1m (ecf for KE value)	3	
10	a	i	Electroplating	1
		ii	The surface of the teapot will be coated with a layer of silver.	1
		iii	It will reduce the exposure of iron to oxygen and moisture.	1
	b	i	Nitric acid + Potassium hydroxide \rightarrow Potassium nitrate + water	1
		ii	<div><p>1m - label y-axis as pH of the solutionAND - label x-axis as the volume of potassium hydroxide (with unit)</p><p>1m - mark the scales for both axes</p><p>1m - at least 9 of the points are correct</p><p>1m - the graph is drawn (accept both line and curve)</p></div>	4
		iii	11 ml (ecf; refer to student's graph, award as long as it is the value of x when y = 7)	1
		iv	Green	1
11	a	$986 / 0.27 = 3651.9 \text{ kWh}$ ----- 1m $3651.9 / 365 = 10.005$ $\approx 10.0 \text{ kWh}$ ----- 1m (ecf for annual energy consumption)	2	
		$10.005 \text{ kWh} / 8 \text{ h} = 1.2506 \text{ kW}$ ----- 1m (ecf for daily energy consumption) $1.2506 = 1250.6 \text{ W}$ $\approx 1250 \text{ W}$ (3 s.f.) ----- 1m (ecf as long as correct conversion)	2	
	b	$P = VI$ $1250 = 230 (I)$ $I = 5.43 \text{ A}$ (3 s.f.) ----- 1m	1	
	c	7 A (allow ecf)	1	
	d	5A: Rating is lower than operating current (5.43 A). Fuse will melt when one tries to use the appliance.	2	

Answer Key

		10A: Excessive current will flow through the fuse and damage the appliance.	
	e	1) The live wire should be connected to the neutral wire/fans. <i>(½m if student states "the live wire should not be connected to the earth wire")</i> 2) The fuse should be placed on the live wire <i>(½m if student states "fuse should not be on neutral wire", answer is incomplete as it did not omit Earth wire)</i>	2