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PEICAI SECONDARY SCHOOL
SECONDARY THREE EXPRESS
END OF YEAR EXAMINATION 2021

CANDIDATE
NAME

CLASS

REGISTER NUMBER

SCIENCE (PHYSICS, CHEMISTRY)

5076/01

Paper 1 Multiple Choice

12 October 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and register number 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.

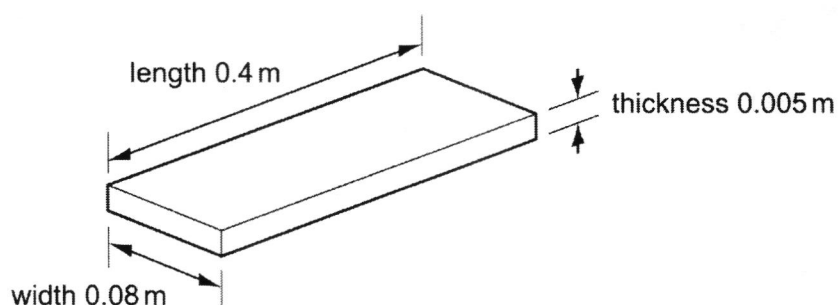
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 18.

The use of an approved scientific calculator is expected, where appropriate.

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

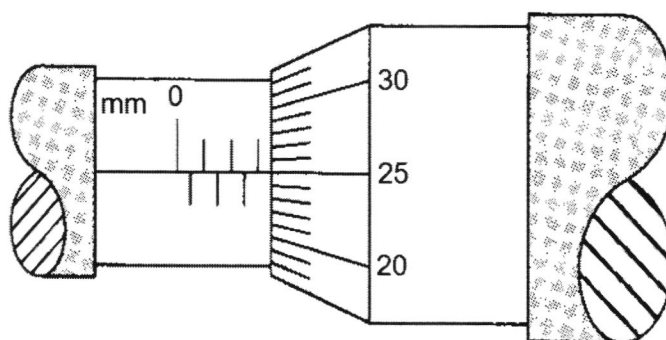
- 1 A manufacturer measures accurately the dimensions of a wooden floor tile. The approximate dimensions of the tile are shown.



Which instruments are used to measure accurately each of these dimensions?

	length	thickness	width
A	metre rule	micrometer	vernier calipers
B	metre rule	vernier calipers	micrometer
C	micrometer	metre rule	vernier calipers
D	vernier calipers	micrometer	metre rule

- 2 What is the reading shown on the micrometer screw gauge below?



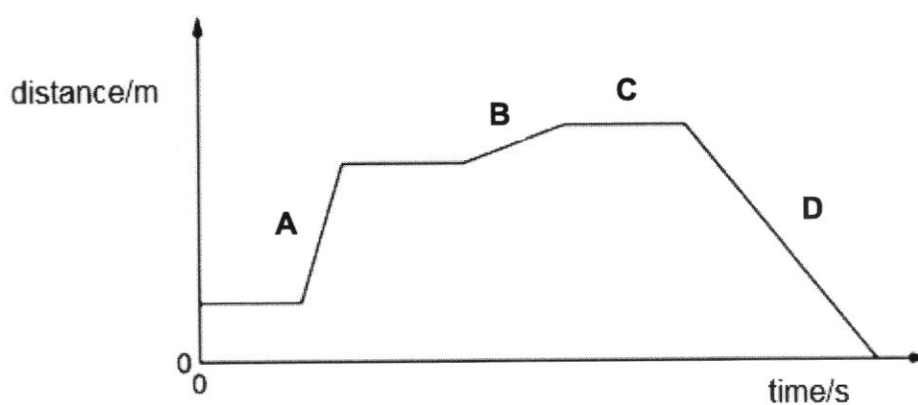
- A** 3.25 mm
- B** 3.75 mm
- C** 6.25 mm
- D** 6.75 mm

3 Which of the following is a vector quantity?

- A pressure
- B speed
- C weight
- D work done

4 The graph shows how the distance of a bike changes with time.

Which section shows the bike being stationary?



5 A car is travelling with an acceleration of 5 m/s^2 .

Which statement describes its motion correctly?

- A The displacement of the car is decreasing at 5 m per second.
- B The displacement of the car is increasing at 5 m per second.
- C The velocity of the car is decreasing at 5 m/s per second.
- D The velocity of the car is increasing at 5 m/s per second.

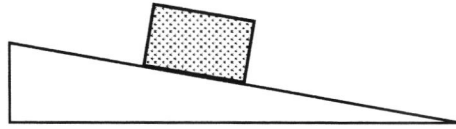
6 The inertia of a body is its resistance to changes in motion.

Which property is a measure of the body's inertia?

- A its density
- B its mass
- C its volume
- D its weight

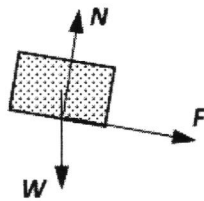
[Turn over

- 7 The diagram shows a block stationary on a rough inclined plane. The forces on the block are its weight, W , normal reaction force, N and friction, F .

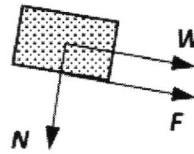


Which of the following shows the correct free-body diagram of the block?

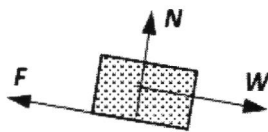
A



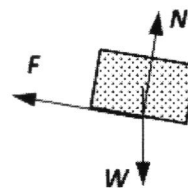
B



C



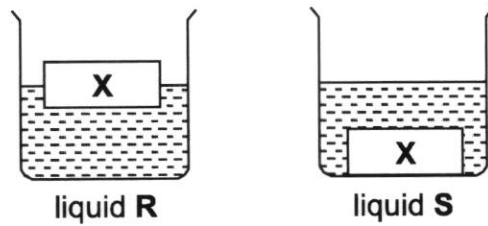
D



- 8 In which of the following cases is friction **not** a useful force?

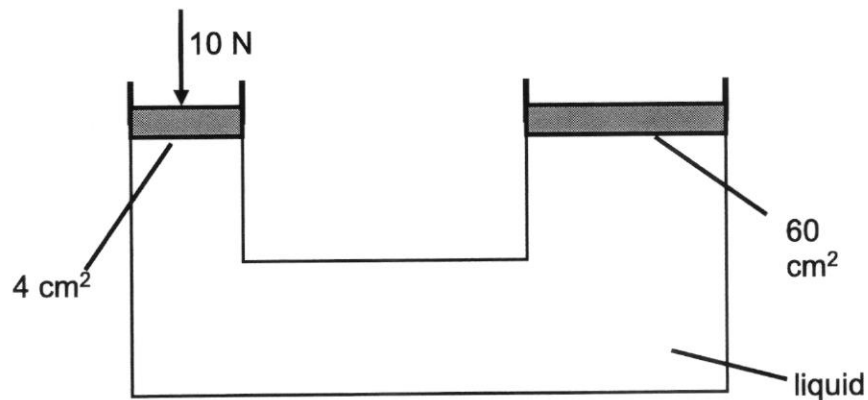
- A A car moves on a slippery road.
- B A gymnast does a handstand on a smooth mat.
- C A hovercraft moves on a cushion of air.
- D A person uses a pen to write on paper.

- 9 The diagram show an object **X** floats in liquid **R** but sinks in liquid **S**.



Which of the statements is correct?

- A Liquid **R** is as dense as liquid **S**.
 - B Liquid **R** is denser than liquid **S**.
 - C Liquid **R** is less dense than liquid **S**.
 - D Object **X** is denser than liquid **R**.
- 10 The diagram shows a simple hydraulic system containing a liquid. A force of 10 N is applied to the small piston.



What is the force acting on the large piston and its direction?

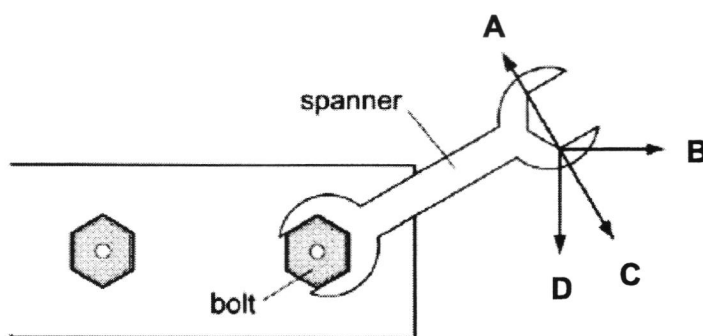
	force / N	direction
A	1.5	up
B	1.5	down
C	150	up
D	150	down

[Turn over

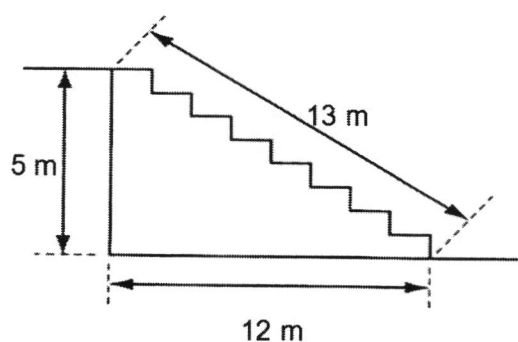
- 11 An astronaut in his spacesuit has a mass of 70 kg on Earth. He can jump 10 cm high off the surface of the Earth. When he is on the Moon, he can jump higher than this.

This is because, on the Moon,

- A his mass is smaller than on Earth.
 - B his mass is the same as on Earth.
 - C his weight is smaller than on Earth.
 - D his weight is the same as on Earth.
- 12 A spanner is used to tighten a bolt by turning it clockwise.
To use the minimum force possible, in which direction must the force act?



- 13 The diagram shows a flight of stairs in a typical HDB block.



A resident of weight 750 N decided to climb the stairs in 10 s.

How much useful work is done by this resident to move up the stairs?

- A 375 J
- B 975 J
- C 3750 J
- D 9750 J

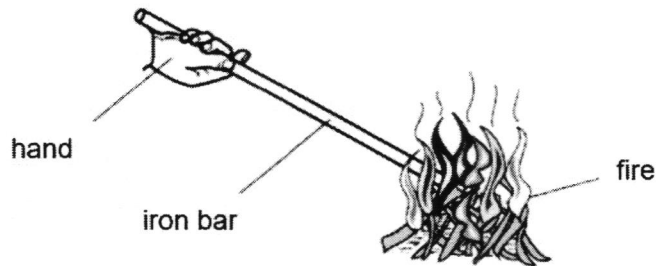
- 14** 1000 J of chemical energy was converted into 850 J of electrical energy. The electrical energy was then converted into 680 J of light energy.

What is a possible reason the light energy produced is not 1000 J?

- A** Energy was destroyed in the process.
 - B** Non-useful energy such as thermal energy was also converted.
 - C** The chemical energy created more energy during the conversion.
 - D** The total energy at the end of the process is always less than that at the beginning of the process.
- 15** A substance consists of particles that are close together and vibrating vigorously. The average speed of the particles is not increasing.
- Which statement best describes the substance?
- A** A liquid is being heated.
 - B** A liquid is undergoing boiling
 - C** A solid is being heated.
 - D** A solid is undergoing melting.
- 16** Which one of the following correctly states the properties of solids, liquids and gases?

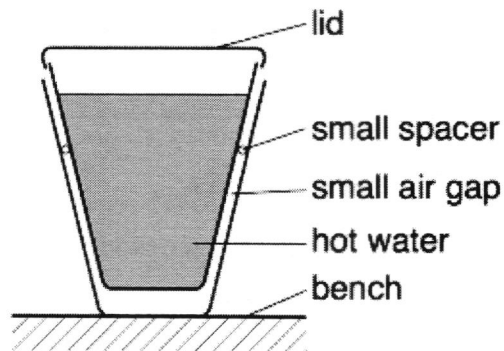
	solids	liquids	gases
A	do not flow	flow easily	flow easily
B	easily compressed	easily compressed	hard to compress
C	fixed shape	fixed shape	no fixed shape
D	no fixed volume	fixed volume	no fixed volume

- 17 An iron bar is held at one end and placed in the fire as shown. After a short while, the other end is too hot to handle.



What is the name of the process for this thermal transfer?

- A conduction
 - B convection
 - C radiation
 - D evaporation
- 18 The diagram shows two plastic cups that are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top.



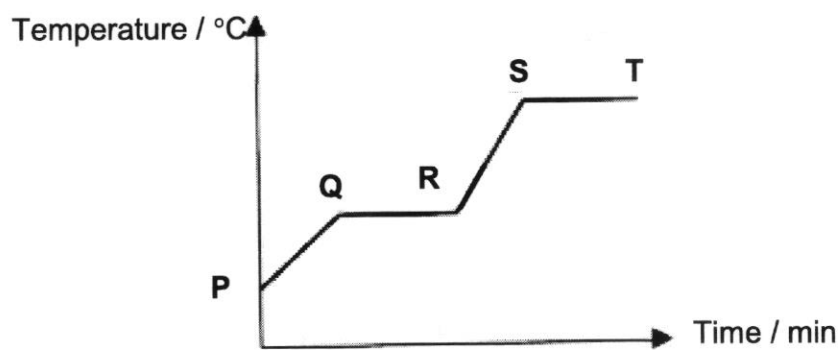
Which statement is correct?

- A Heat loss by radiation is prevented by the small air gap.
- B No heat passes through the sides of either cup.
- C The bench is heated by convection from the bottom of the outer cup.
- D The lid is used to reduce heat loss by convection.

- 19 Boiling and evaporation are different processes.

Which statement is not correct?

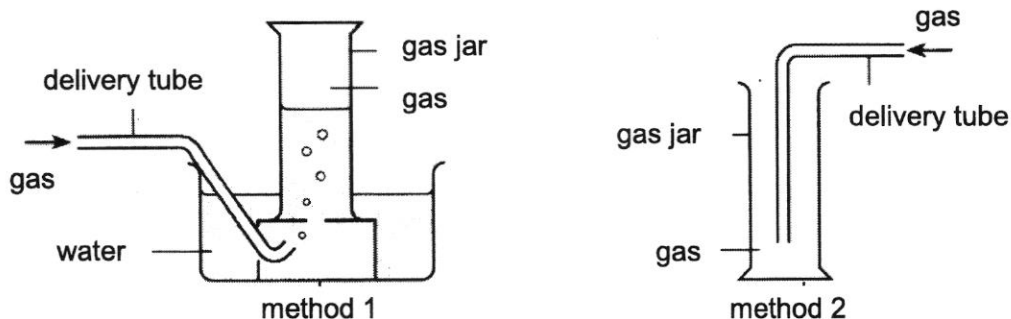
- A Boiling occurs throughout the liquid but evaporation only occurs at its surface.
 - B Evaporation can only occur when the temperature of the liquid is high.
 - C Evaporation causes the temperature of a liquid to fall.
 - D When a boiling liquid is heated, its temperature remains constant.
- 20 A solid substance is placed in a boiling tube and heated steadily. The temperature-time graph of the substance is shown in the diagram.



At which portions is the substance absorbing heat that result in a change of state?

- A PQ and QR
- B PQ and RS
- C QR and ST
- D RS and ST

- 21 The diagrams show two methods of collecting gases.



Which row gives the properties of gas which can be collected by both method?

	property 1	property 2
A	insoluble in water	denser than air
B	insoluble in water	less dense than air
C	soluble in water	denser than air
D	soluble in water	less than air

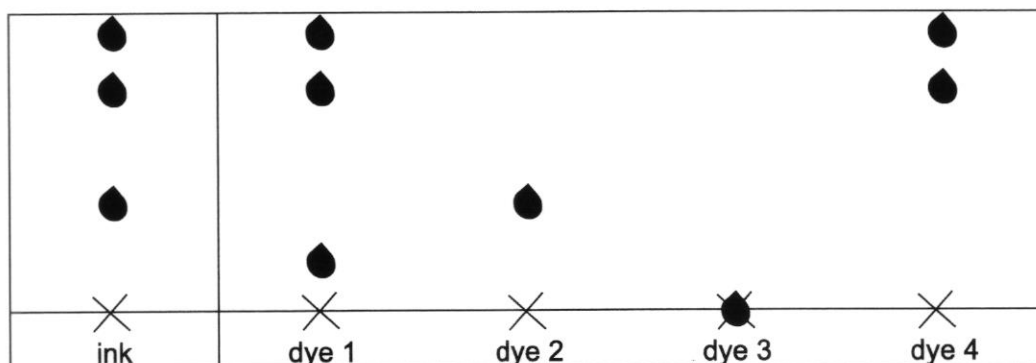
- 22 Substance X has a melting point of -39°C and a boiling point of 357°C .

What is the physical state of substance X at -40°C and 360°C ?

	physical state at -40°C	physical state at 360°C
A	liquid	gas
B	liquid	liquid
C	solid	gas
D	solid	liquid

- 23 A coloured ink is compared with four different dyes using water as the solvent.

The chromatogram produced is shown.



Which statement about this paper chromatography is **not** correct?

- A Dye 3 has no spots as it only contains water.
 - B Dye 3 is insoluble in water.
 - C The ink contains dye 2 and 4.
 - D The starting line is drawn using a pencil.
- 24 Substance X and Y are both soluble in water. However, substance X decomposes easily when heated strongly while substance Y does not.

Which row describes the most suitable method to obtain each of the pure substance from its solution?

	substance X	substance Y
A	crystallisation	evaporation to dryness
B	crystallisation	filtration
C	evaporation to dryness	crystallisation
D	evaporation to dryness	filtration

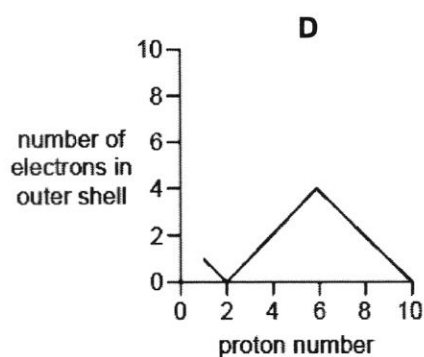
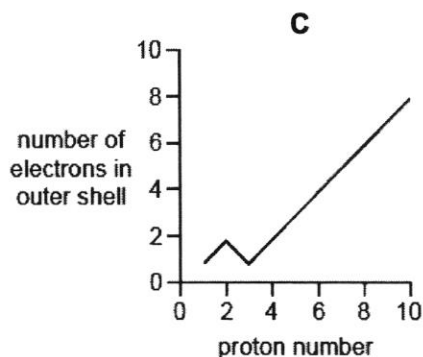
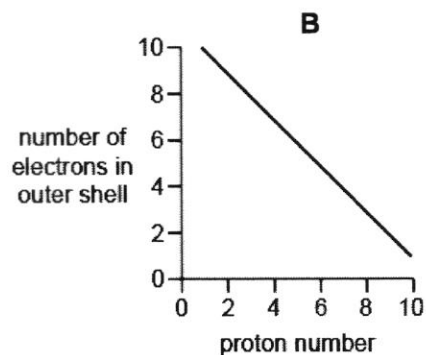
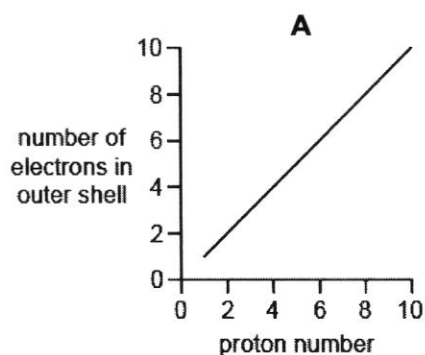
- 25** Potassium nitrate is used as a fertilizer. It is mixed with soil since it occurs naturally.

Given that it is very soluble in hot water, but not very soluble in cold water, how can pure potassium nitrate crystals be obtained from a soil sample?

- A** add cold water, filter while solution is still cold, crystallise
- B** add cold water, filter while solution is still cold, evaporate to dryness
- C** add hot water, filter when the solution cools down, crystallise
- D** add hot water, filter while solution is still hot, crystallise

- 26** The number of electrons in the outer shell of an atom for the first ten elements in the Periodic Table was plotted against their proton number.

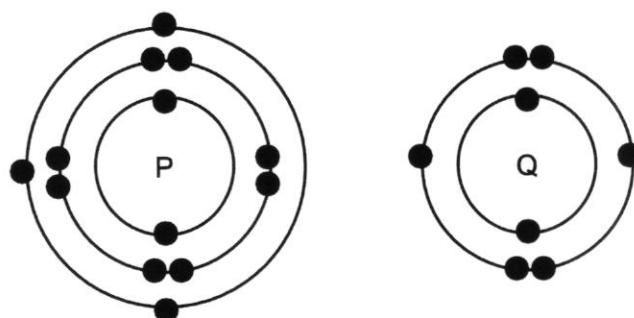
Which graph shows the results correctly?



27 Which pair of elements forms a compound by sharing electrons?

- A aluminium and oxygen
- B calcium and potassium
- C carbon and chlorine
- D sulfur and argon

28 The electronic structures of two atoms P and Q are shown.



P and Q combine together to form a compound.

Which row describes the type of bonding and the forces of attraction present in the compound?

	type of bonding	forces of attraction
A	covalent	electrostatic forces
B	covalent	weak intermolecular forces
C	ionic	electrostatic forces
D	ionic	weak intermolecular forces

29 Lithium chloride, LiCl , is an ionic compound.

Which statement about lithium chloride is **not** correct?

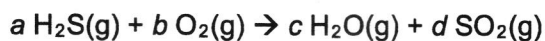
- A It can conduct electricity in any physical state.
- B It has a giant ionic lattice structure.
- C It has high melting point.
- D It is soluble in water.

[Turn over

30 Which ions are present in the compound, $\text{Al}_2(\text{CO}_3)_3$?

- A Al^{2+} and CO_3^{2-}
- B Al^{2+} and CO_3^{3-}
- C Al^{3+} and CO_3^{2-}
- D Al^{3+} and CO_3^{3-}

31 An equation is shown.



Which numbers will correctly balance this equation?

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
A	1	2	2	1
B	2	2	2	2
C	2	3	2	2
D	3	1	2	3

32 Flowers of hydrangea bush bloom in different colours depending on the pH of the soil as shown in the table.

pH value	4.5	5.5	6.0	6.8	7.0
colour of petals	blue	indigo	purple	pink	red

Which substance is added to the soil of a hydrangea bush with indigo flowers so that it produces pink flowers instead?

- A calcium carbonate
- B calcium sulfate
- C ethanoic acid
- D ethanol

- 33 Which row about the reactions of sulfuric acid is correct?

	products with zinc metal	products with zinc carbonate
A	sulfur zincate and hydrogen	zinc sulfate, water and carbon dioxide
B	sulfur zincate and water	zinc sulfate and carbon dioxide
C	zinc sulfate and hydrogen	zinc sulfate, water and carbon dioxide
D	zinc sulfate and water	zinc sulfate and carbon dioxide

- 34 The information of two indicators, X and Y, is given.

indicator	colour in strongly acidic solution	pH at which colour changes	colour in strongly alkaline solution
X	red	5.2	yellow
Y	colourless	9.9	blue

What is the colour observed when each indicator is added to two separate solutions of pH 7.5?

	solution with indicator X	solution with indicator Y
A	red	blue
B	red	colourless
C	yellow	blue
D	yellow	colourless

- 35 Some salts can be prepared through titration when the correct reagents are used.

Which of the following reaction can prepare a salt using the titration method?

- A** an acid with an insoluble base
- B** an acid with a soluble base
- C** an acid with an insoluble metal
- D** an acid with a soluble metal

- 36** Chemicals, such as calcium hydroxide, are often added to the soil to adjust its pH.

What is the purpose of adding such chemicals to the soil?

- A** to decrease pH and neutralise acidity
 - B** to decrease pH and neutralise alkalinity
 - C** to increase pH and neutralise acidity
 - D** to increase pH and neutralise alkalinity
- 37** Which of the following salts can be prepared **without** crystallisation?
- A** copper(II) chloride
 - B** barium chloride
 - C** iron(II) chloride
 - D** silver chloride

- 38** Iodine is a halogen from Group VII of the Periodic Table.

Which row describes the properties of iodine?

	colour	state at room temperature	reaction with aqueous sodium chloride
A	purplish-black	liquid	chlorine displaced
B	purplish-black	solid	no reaction
C	reddish-brown	liquid	chlorine displaced
D	reddish-brown	solid	no reaction

- 39** Which statement about the elements in the Periodic Table is **not** correct?
- A** Across the period, the element has decreasing metallic characteristic.
 - B** Down the group, atom of the element has an increasing size.
 - C** Elements are arranged in order of their nucleon number.
 - D** Elements are arranged in order of their proton number.

40 Which statement is **not** true for all noble gases?

- A** They are insoluble in water.
- B** They are monoatomic.
- C** They can form covalent molecules since they are non-metals.
- D** They have low melting and boiling points.



PEICAI SECONDARY SCHOOL
SECONDARY THREE EXPRESS
END OF YEAR EXAMINATION 2021

CANDIDATE NAME

CLASS

REGISTER NUMBER

SCIENCE (PHYSICS, CHEMISTRY)

5076/02

Paper 2 Physics

7 October 2021

1 hour 15 minutes

Candidates answer on the Question Booklet.
No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you not use appropriate units.

Section A

Answer **all** questions.

Section B

Answer any **two** questions.

Write your answers in the spaces provided on the question paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

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

Perseverance Respect Responsibility Integrity Discipline Empathy

Section A

Answer **all** the questions in the spaces provided.

- 1 (a) Complete the table by filling in the physical quantity measured by each instrument and the symbol for its SI unit.

instrument	base quantity measured	symbol for SI unit
beam balance		
measuring tape		

[2]

- (b) Fig. 1.1 shows the side view of a set-up of a simple pendulum to investigate the relationship between the length of the pendulum and its period.

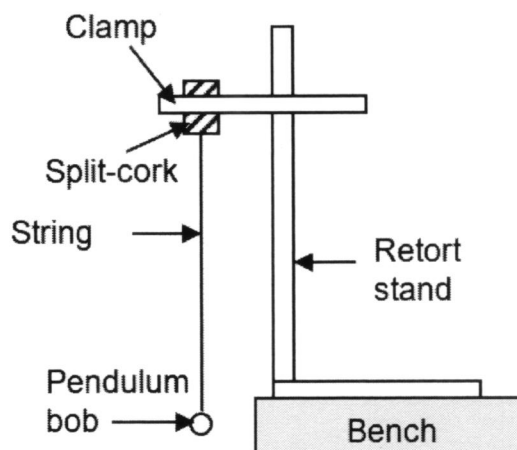


Fig. 1.1

- (i) During a particular experiment, the length of the pendulum is set at 0.400 m. A student then measures the time taken, t , for 20 oscillations. She obtains three sets of data: $t_1 = 25.92$ s, $t_2 = 25.14$ s and $t_3 = 25.46$ s. Calculate the period, T , of the pendulum based on her measured data.

period =s [2]

- (ii) Comment on the accuracy of her measured data by comparing the value of period T in **b(i)** with the theoretical value of period T which can be calculated by the following formula:

$$T = 2\pi \sqrt{\frac{l}{g}}$$

where l = length of the pendulum

$g = 10 \text{ m/s}^2$

$\pi = 3.14$

The data is considered inaccurate when the difference in value is more than 5%.

.....

 [3]

- 2 Fig. 2.1 shows a barge, which is a flat-bottomed boat that is used to transport heavy goods. Steel is a common material used to construct the hull of the barge due to its strength and resistance to sea water corrosion. A small barge has a weight of 500 000 N. The gravitational field strength g is 10 N/kg.

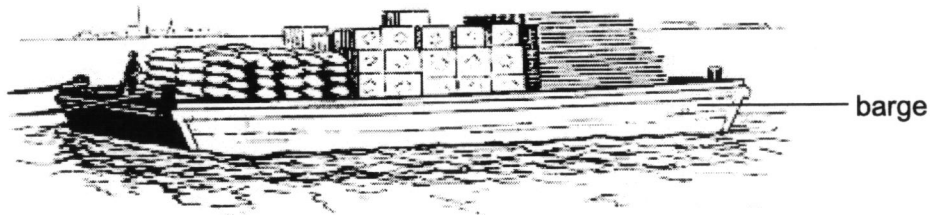


Fig. 2.1

- (a) Seawater has a density of 1 025 kg/m³.
Calculate the minimum volume that the barge needs to have in order for it to float on seawater.

volume =m³ [2]

- (b) The barge is towed from the sea into fresh water that has a density of 1 000 kg/m³.

Explain whether the barge will float higher or float lower in the fresh water as compared to sea water.

.....

 [2]

- 3 A tree trunk is pulled by two tractors with different amount of force as shown in Fig. 3.1.

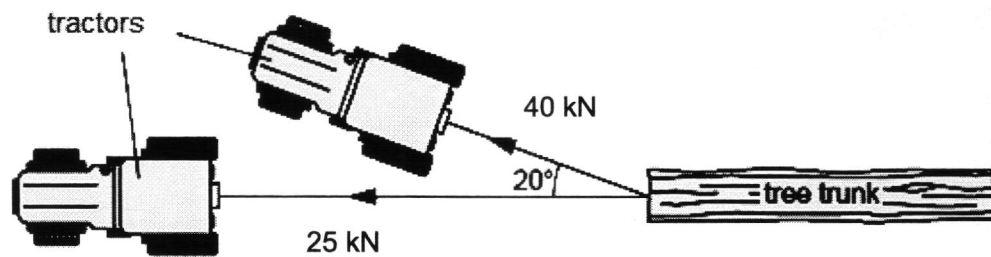


Fig. 3.1

- (a) State the difference between a *scalar* and a *vector* quantity.

.....
 [1]

- (b) In the space below, draw a vector diagram to scale in order to determine the resultant force acting on the tree trunk.

scale is 1 cm :kN [1]

resultant force, $F =$ kN [2]

- 4 Fig. 4.1 shows a 100 N force acting on a box of mass 30 kg. The box moves across a horizontal rough floor at a constant speed without tipping.

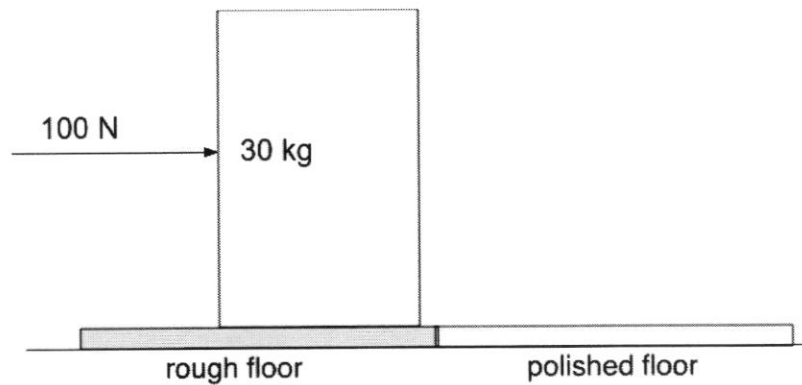


Fig. 4.1

- (a) State the size of the frictional force acting on the box when moving across the rough floor. Explain your answer.

.....

 [2]

- (b) As the box moves onto the polished section of the floor, the 100 N horizontal force continues to act on the box. The frictional force acting on the box is now 40 N.

Calculate the acceleration of the box.

acceleration = m/s^2 [2]

- 5 The stability of a lorry is tested, as shown in Fig. 5.1. The ramp is tilted as much as possible without the lorry falling over. The ramp is then fixed and the lorry remains at rest in the position shown.

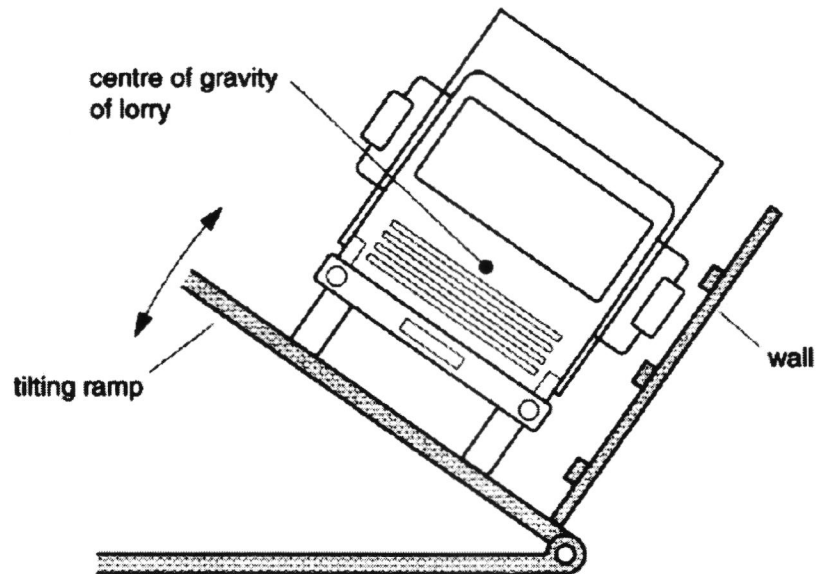


Fig. 5.1

- (a) Define *centre of gravity*.

.....
[2]

- (b) On Fig. 5.1, draw an arrow to represent the weight, **W**, of the lorry. [1]

- (c) Explain why the lorry does not fall over onto the wall.

.....

 [2]

- 6 Fig. 6.1 shows a student standing on soft mud. The student does not sink into the mud.



Fig. 6.1

- (a) Define *pressure*.

.....
[1]

- (b) The boy has a mass of 60 kg.

Calculate the force of his body acting on the mud. The gravitational field strength g is 10N/kg.

force = N [2]

- (c) The area of one of his shoe in contact with the mud is 0.015 m^2 .

Calculate the pressure the student exerts on the mud, when standing as shown in Fig. 6.1.

pressure = Pa [2]

- (d) The student lifts one foot off the mud. The other foot sinks into the mud.

Explain why this happens. A calculation is **not** required.

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

- 7 A man moves a rock onto the back of a lorry, using a wheelbarrow and ramp. Fig. 7.1 shows where he places the rock in the wheelbarrow and where he applies his effort to the handle of the wheelbarrow.

The rock and wheelbarrow together weigh 500 N.

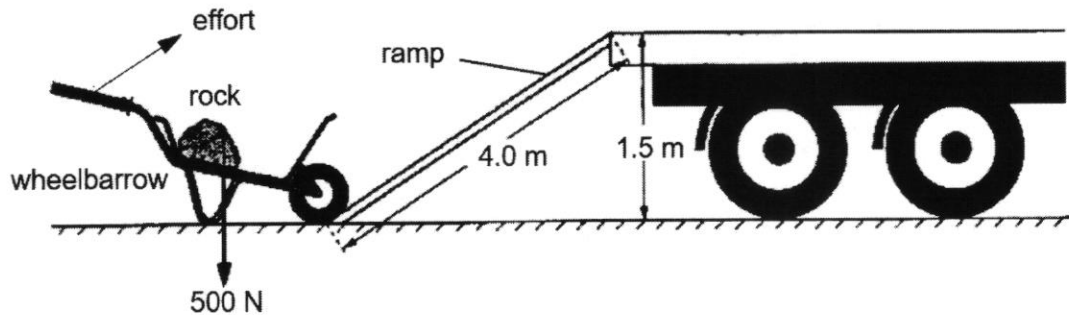


Fig. 7.1

- (a)(i) By using the wheelbarrow, the man is able to exert an effort that is less than 500 N in order to move the rock up the ramp.

Explain why this is so.

.....
 [1]

- (ii) State one way in which Mr Ang could reduce this effort.

.....
 [1]

- (b)(i) Calculate the work done against gravity in moving the rock and wheelbarrow up the ramp onto the back of the lorry.

work done = J [2]

- (ii) The work done against friction in moving the rock and wheelbarrow up the ramp is 150 J.

Calculate the total work done.

work done = J [1]

- 8 Fig. 8.1 shows the arrangement of the molecules of a substance in its different states of matter.

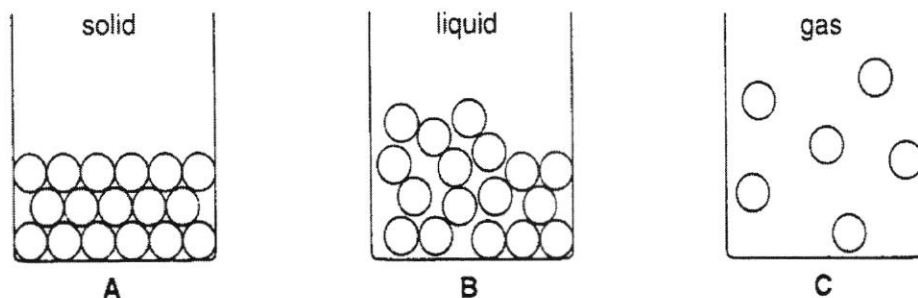


Fig. 8.1

- (a) State one difference between the **arrangement** of the molecules of the substance in container **A** and container **C**.

.....

 [1]

- (b) State which arrangement **A**, **B** or **C** contains the most energetic molecules.

..... [1]

- (c) Describe what happens to the molecules in container **B** as the temperature rises. Assume that the substance did not undergo any change of state.

.....
 [1]

- 9 A pupil places some solid wax in an oven which is set at 70 °C. After 15 minutes of heating, he takes the melted wax out of the oven.

Fig. 9.1 shows how the temperature of the wax varies with time.

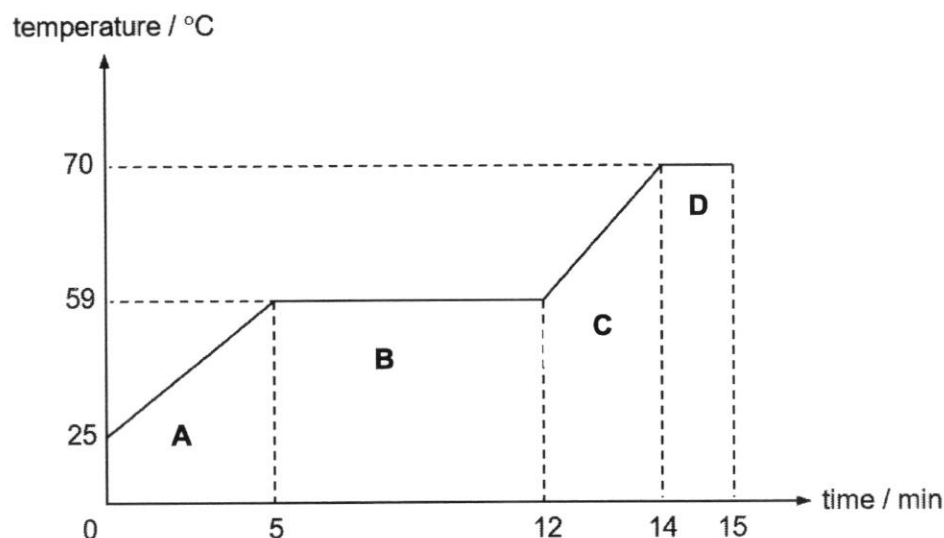


Fig. 9.1

- (a) State the process that occurred at section D.

..... [1]

- (b) State whether the forces of attraction between particles and average speed of molecules *decrease*, *increase* or *remain constant* for the time intervals stated.

Write your answers directly in the table below.

time interval	forces of attraction between particles	average speed of molecules
0 min to 5 min		
5 min to 12 min		
12 min to 14 min		

[3]

- (c) Explain, in terms of energy changes, why the temperature of the wax remains constant at section B despite thermal energy being absorbed throughout.

.....

 [2]

Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

- 10** A cafe wants to design its own cup for its own brew of coffee. The cafe carries out a scientific experiment to determine

- the best material for making the cup,
- the best colour for making the cup.

Fig. 10.1 shows four different cups, each filled with 350 ml of hot coffee.

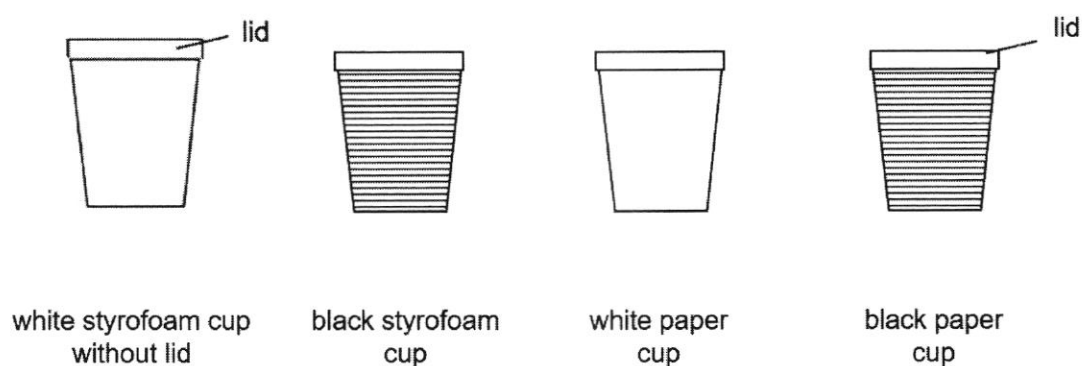


Fig. 10.1

Table 10.1 shows the temperature of the coffee from the four cups measured every 2 minutes.

Table. 10.1

	styrofoam cup		paper cup	
	white	black	white	black
time / min	temperature / °C	temperature / °C	temperature / °C	temperature / °C
0	100	100	100	100
2	92	91	87	87
4	84	82	77	76
6	78	75	69	67
8	74	68	61	59
10	69	62	56	52

- (a) Explain why all four cups must start with coffee of the same initial temperature.

.....[1]

- (b) State which of the four cups has the smallest fall in temperature.

.....[1]

- (c) Explain why styrofoam is a suitable material for making the cup.

.....

 [2]

- (d) From the results in the table, state and explain whether the material or the colour is a more important variable in the design of the cup.

.....

 [2]

- (e) Explain why the lid helps to keep the coffee hot.

.....

 [2]

- (f) Some coffee from the experiment is spilled on top of a ceramic table. After some time, the water evaporated, leaving behind the coffee stain on the table. Explain the phenomenon using the Kinetic Model of Matter.

.....

 [2]

- 11 Fig. 11.1 shows the speed-time graph of an object falling through the air from rest until it hits the ground. The mass of the object is 0.8 kg.

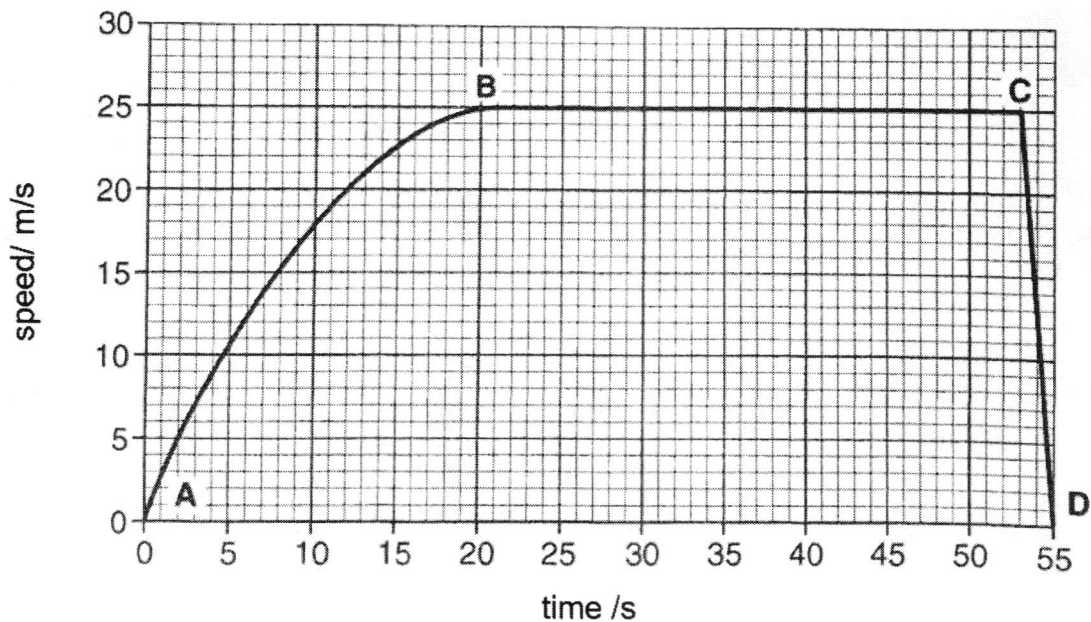


Fig. 11.1

- (a) State the magnitude of the acceleration of the object between points B & C.

acceleration = m/s^2 [1]

- (b) Describe the motion of the object between points A and B.

.....
 [1]

- (c) Use the weight of the object and the air resistance to explain the motion of the object between points A and B.

.....

 [3]

- (d) State the magnitude of the air resistance experienced by the object between points B and C. (Assume $g = 10 \text{ N/kg}$)

..... [1]

- (e) Calculate the distance moved by the object from 20 s to 55 s.

distance = m [2]

- (f) Calculate the acceleration of the object between points C and D.

acceleration = m/s^2 [2]

- 12 Fig. 12.1 shows a crane using an electrical motor to lift a wrecking ball of mass 200 kg. The motor lifts the wrecking ball up a vertical height of 0.3 m. Take the gravitational field strength to be 10 N/kg.

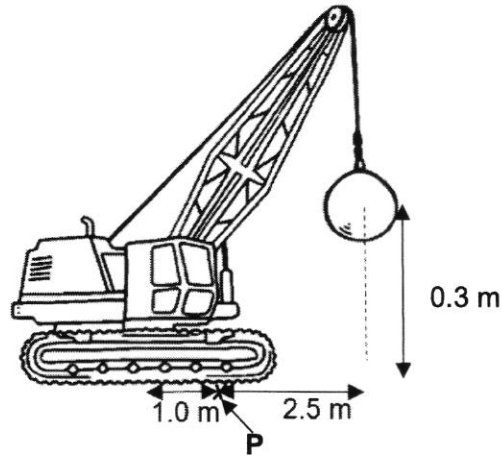


Fig. 12.1

- (a)(i) Calculate the gain in gravitational potential energy of the wrecking ball as it is raised up a vertical height of 0.3 m.

gravitational potential energy = J [2]

- (ii) Given that the motor is able to lift the wrecking ball up a vertical height of 0.3 m in 10 s, calculate the power of the motor.

power = W [2]

- (iii) Calculate the maximum speed of the wrecking ball after it has been released.

maximum speed = m/s [2]

- (b) The crane operator extends the crane arm out, as shown in Fig. 12.1. Point **P** is the base of the crane where the pivot is. The wrecking ball and the centre of gravity of the crane is 2.5 m and 1.0 m away from point **P** respectively. Given that the crane is in equilibrium, calculate the weight of the crane.

weight = N [2]

- (c) Suppose that you want to make the crane more stable. Suggest two changes you can make to the crane to increase its stability.

.....

.....

..... [2]

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Paper 1 Answers

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

Marker's Remarks on Specific Questions

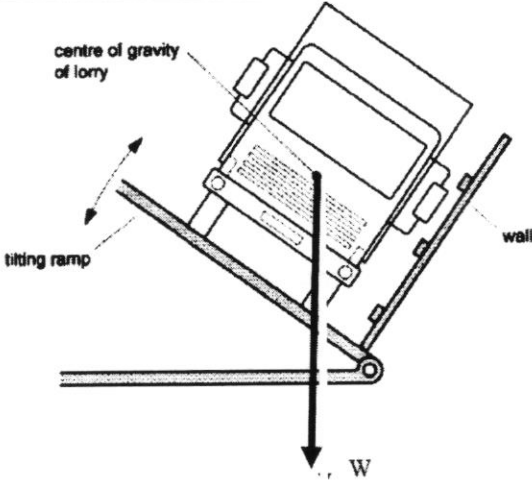
Multiple Choice Questions

Please include remarks for the following: ■ Questions where > 50 % of candidates tend to exhibit common errors, misconceptions, difficulties in a certain principle of topic, etc.	Question No.	Marker's Remarks

Marker's Remarks on Specific Questions

Qn No.	Marking Scheme (showing suggested and all possible/alternative answers) <i>(Please include any alternative answers/rejected answers or points to take note of after marking, <u>within the marking scheme</u>)</i>	Mark (C1/A1/B1)									
1a	<table border="1"> <thead> <tr> <th>Instrument</th><th>Base quantity measured</th><th>symbol for SI unit</th></tr> </thead> <tbody> <tr> <td>beam balance</td><td>Mass</td><td>kg</td></tr> <tr> <td>measuring tape</td><td>Length</td><td>m</td></tr> </tbody> </table>	Instrument	Base quantity measured	symbol for SI unit	beam balance	Mass	kg	measuring tape	Length	m	B2
Instrument	Base quantity measured	symbol for SI unit									
beam balance	Mass	kg									
measuring tape	Length	m									
1bi	Average time for 20 oscillations = = 25.51 s Period, T = $\frac{25.51}{20}$ = 1.28 s	C1 A1									
1bii	= = 1.26 s (3 s.f.) Comparing 1.26 s and 1.34 s, the percentage difference = $\frac{1.28 - 1.26}{1.26} \times 100\% = 1.59\%$ which is < 5%. Hence, her measured data was accurate / t_1 was inaccurate / only t_2 and t_3 were accurate.	C1 C1 A1									
2a	Minimum volume needed to float = $\frac{50\,000}{1\,025}$ = 48.8 m³ (3 s.f.)	C1 A1									
2b	The barge will float lower in fresh water as compared to sea water.	B1									

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	The difference between the densities of the barge and fresh water is smaller compared to the difference between the densities of the barge and sea water.	B1
3a	A scalar quantity is a quantity that only has magnitude only but a vector quantity has both magnitude and direction .	B1
3b	1cm : 5kN 64 kN (Accept 63.5 to 64.5) Include directions Correct vector diagram/orientation Correct answer	B1 B1 B1
4a	100 N As the box moves at zero acceleration/ there is zero resultant force the frictional force equals to the horizontal force.	B1 B1
4b	$F - f_r = ma$ $100 \text{ N} - 40 \text{ N} = (30\text{kg})(a)$ $a = 2 \text{ m/s}^2$	C1 A1
5a	The centre of gravity is the point where the whole weight of an object appears to act on.	B1 B1
5b		B1
5c	The vertical line of the weight / line of action of the weight through the C.G passes through the tyre (pivot), thus no moment is produced . Hence, the lorry does not fall over on the all. Or The vertical line of the weight / line of action of the weight through the C.G falls within the base area of the lorry, thus the	B1 B1

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	weight of the lorry creates an anti-clockwise moment about its tyre and so lorry does not fall over on the wall.				
6a	Pressure is defined as the force acting per unit area/force per unit area.	B1			
6b	F = weight = 60 (10) = 600 N	C1 A1			
6c	Total area = 0.015×2 = 0.030 m^2 Pressure = Force/ Area P = $600/0.030$ P = 20 000 Pa	C1 A1			
6d	Same force acts on a smaller contact area. Greater pressure is exerted on the ground.	B1 B1			
7ai	The distance of the effort to the pivot is further than the distance of the distance of rock to the pivot. Hence, a lesser effort is required to produce a moment of the same magnitude.	B1			
7aii	Move the rock closer to the pivot / Position his effort further from the pivot.	B1			
7bi	work done = 500×1.5 = 750 J	C1 A1			
7bii	work done = $750 + 150$ = 900 J	A1			
8a	Solid – regular, orderly arrangement and closely packed Gaseous state – random, disorderly, far away from one another.	B1			
8b	C	B1			
8c	Molecules slide past one another / move faster	B1			
9a	boiling	B1			
9b	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">time interval</td><td style="text-align: center;">forces of attraction between particles</td><td style="text-align: center;">average speed of molecules</td></tr> </table>	time interval	forces of attraction between particles	average speed of molecules	B3
time interval	forces of attraction between particles	average speed of molecules			

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	0 min to 5 min	remain constant	increases	
	5 min to 12 min	decreases	remain constant	
	12 min to 14 min	remain constant	increases	
9c	The thermal energy is used to overcome the forces of attraction between particles and not increase the speed of the substance. Therefore, internal kinetic energy remains constant . As internal kinetic energy remains constant, the temperature of the wax also remains constant			B1 B1
Section B				
10a	It is to ensure a fair experiment.			B1
10b	It is the white Styrofoam cup.			B1
10c	Styrofoam is a poor conductor of heat as it traps pockets of air. Therefore, it conducts/transfer heat away slowly , keeping the coffee hot.			C1 A1
10d	The material is a more important factor. The temperature difference between the cups that have different materials but the same colour is much greater than cups with the same materials but different colours .			C1 A1
10e	The lid prevents a convection current from being set up in the air . Hence it reduces heat loss by convection . OR The lid prevents the less dense hot air from rising and the denser cold air from sinking onto the coffee . This helps to reduce heat loss by convection .			C1 A1
10f	The water molecules in the coffee gains heat from the surroundings . Some of the water molecules would gain enough energy to overcome the forces of attraction between the particles and			B1 B1

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	escape into the atmosphere, leaving behind the less energetic molecules. This would continue until all the water molecules escape into the atmosphere, leaving behind the coffee grains which are solids.	
11a	0 m/s ²	A1
11b	The object is falling with decreasing acceleration .	B1
11c	As speed increases, air resistance also increases but weight remains unchanged. The resultant force decreases. Using $F = ma$, the acceleration also decreases.	B1 B1 B1
11d	8 N	A1
11e	Distance = area under the graph $= 0.5 \times (35+33) \times 25$ $= 850 \text{ m}$	C1 A1
11f	$a = (v-u) / t$ $= (0 - 25) / (55 - 53)$ $= -12.5 \text{ ms}^{-2}$	C1 A1
12ai	GPE = mgh $= (200)(10)(0.3)$ $= 600 \text{ J}$	C1 A1
12aii	$P = 600 / 10$ $= 60 \text{ W}$	C1 A1
12aiii	By Conservation of Energy, GPE = KE $600 = \frac{1}{2}mv^2$ $600 = \frac{1}{2}(200)v^2$ $v = 2.45 \text{ m/s}$	C1 A1
12b	By Principle of Moments, Sum of clockwise moment = Sum of anti clockwise moment $W(1) = 2.5(2000)$ $W = 5000 \text{ N}$	C1 A1

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12c	Increase the base surface area	B1
	Lower the centre of gravity by adding more mass to the base	B1

Areas of focus for improvement (to be discussed with level teachers)

<u>Problems identified</u>	
<u>Suggestions for remediation</u>	