Note: Some Questions are from the old Syllabus

Name | Reg. No | Class

3EX

PHYSICS 6091/01

Paper 1 Multiple Choice [25 Marks]

END OF YEAR EXAMINATION
October 2022

Additional Materials: OTAS

2 hour 15 minutes
(with Paper 2)

Instructions to Candidates

Do not start reading the questions until you are told to do so.

Write in soft pencil.

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

Write your name, class, and index number on the OTAS provided.

DO **NOT** WRITE IN ANY BARCODES.

Information for Candidates

There are **twenty-five** 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 **OTAS**.

Read the instructions on the OTAS 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.

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

Unless otherwise stated, take the gravitational field strength on earth g to be 10.0 N/kg.

Setter: Mr Johnson Tay

Vetter: Ms Mok Pei Jiun

Section A

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

1 A student writes down a few physical quantities he learnt in Physics.

weight mass force distance time moment pressure

How many scalar quantities are listed?

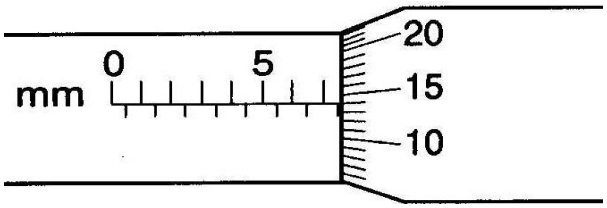
A 3 **B** 4 **C** 5 **D** 6

2 To obtain density of a given iron nugget, we need to measure its mass and volume.

Which pair of instruments can be used?

A measuring cylinder and beam balance
B measuring cylinder and vernier calipers
C stopwatch and beam balance
D stopwatch and vernier callipers

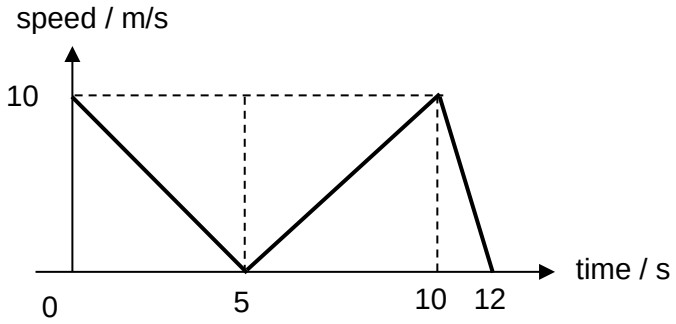
3 An engineer used a micrometer screw gauge to measure the diameter of a wire. The reading is shown below.



What is the radius of the wire?

A 3.82 mm **B** 5.14 mm **C** 7.64 mm **D** 15.28 mm

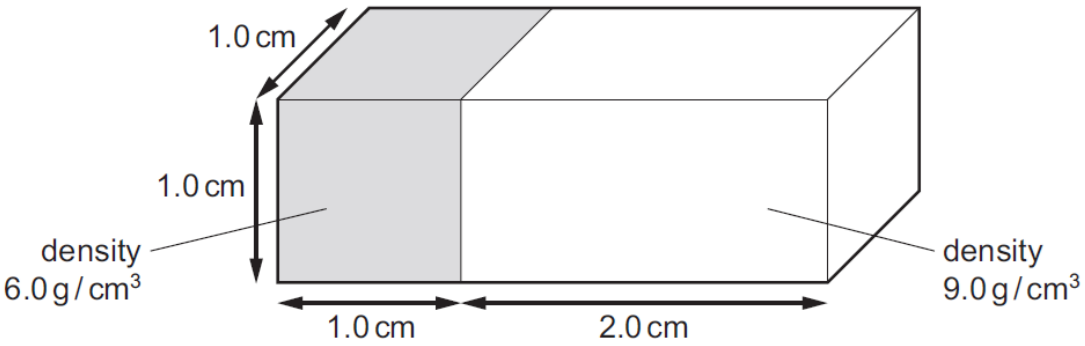
4 The motion of an object is represented by the speed-time graph as shown below.



Which statement is false?

A The average speed of the object was 5.0 m/s.
B The deceleration of the object for the first 5 s of its motion was 2.0 m/s^2.
C The object was at rest twice.
D The total distance travelled was 60 m.

5 The diagram shows a block made of two parts of different densities, 6.0 g/cm^3 and 9.0 g/cm^3 respectively.



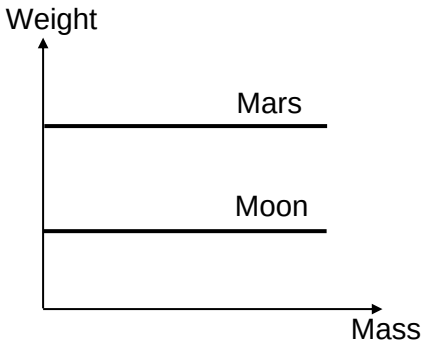
What is the overall density of the block?

A 7.0 g/cm^3 **B** 7.5 g/cm^3 **C** 8.0 g/cm^3 **D** 15.0 g/cm^3

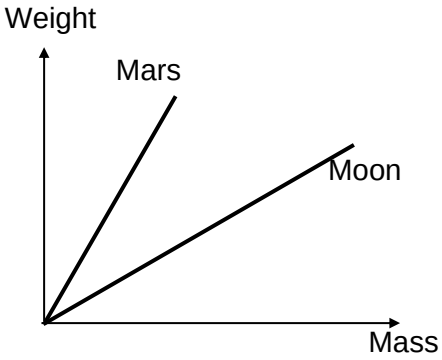
6 The gravitational field strength on the Moon and Mars are 1.6 N/kg and 3.6 N/kg respectively.

Which graph correctly shows the relationship between the weight and mass of a body on the Moon and Mars?

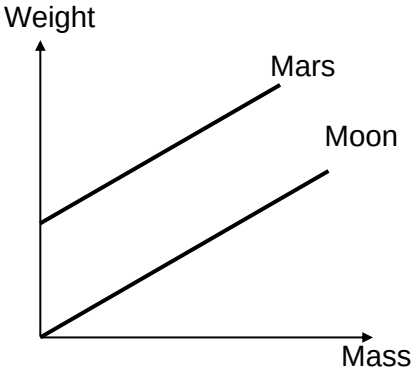
A



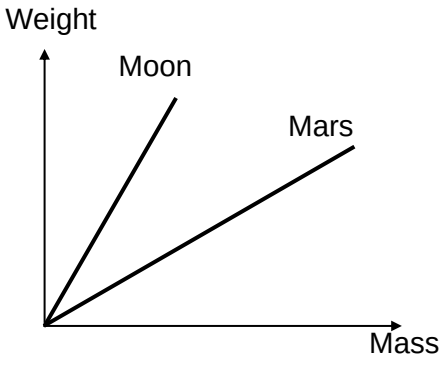
B



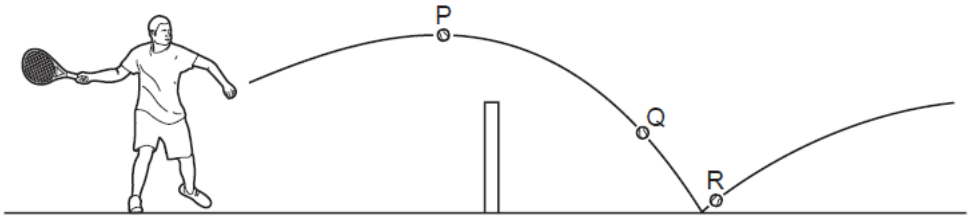
C



D



7 The diagram shows different positions of a tennis ball as it was hit over the net.

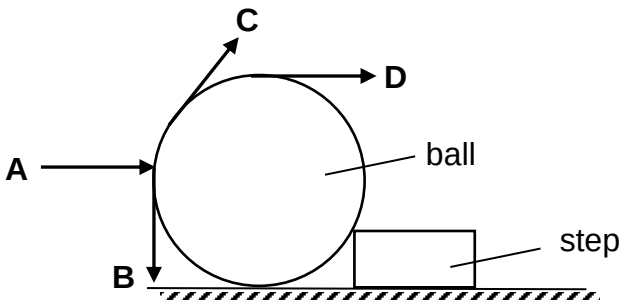


At which positions does the tennis ball experience acceleration?

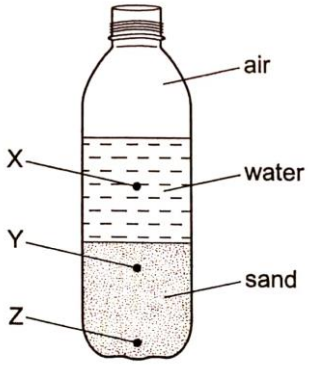
A P and Q only
B P and R only
C P, Q and R
D Q and R only

8 The diagram shows a ball being pushed up a step. A student would like to apply a minimum force to push the ball up the step.

Which force is the minimum force that can be applied to push the ball up the step?



9 The diagram below shows a bottle containing air, water and sand.

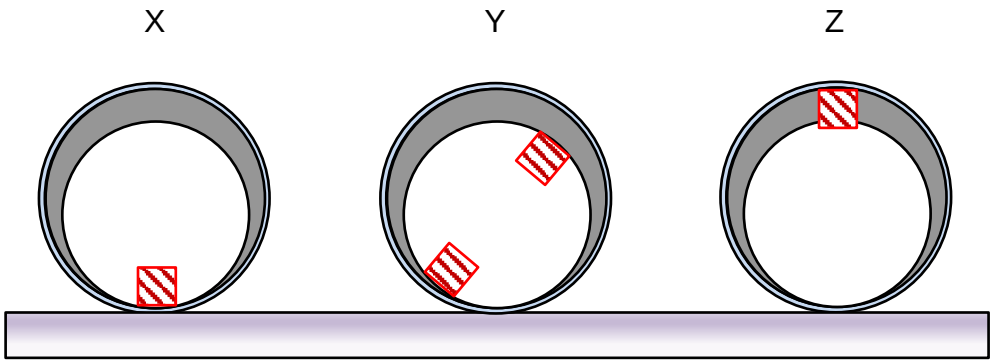


More sand is added to the bottle. This affects the centre of gravity of the bottle and its contents.

How might the centre of gravity be changed?

A from X towards Y
B from Y towards X
C from Z towards Y
D from Y towards Z

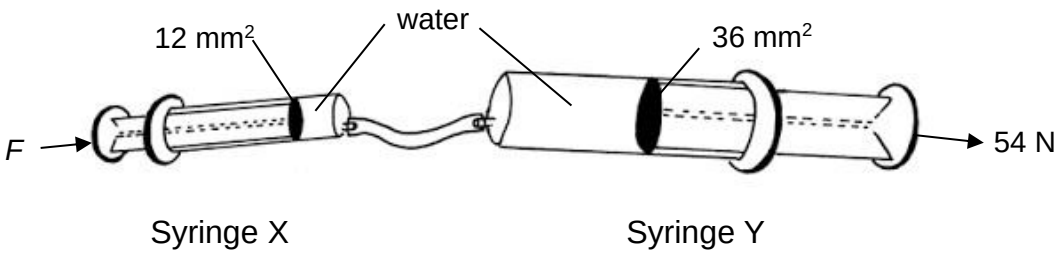
10 Three identical hollow pipes X, Y and Z have one or two identical weights attached to their inner surfaces as shown below.



Which row best describes the stability of the pipes?

	X	Y	Z
A	neutral equilibrium	unstable equilibrium	neutral equilibrium
B	neutral equilibrium	unstable equilibrium	stable equilibrium
C	stable equilibrium	neutral equilibrium	unstable equilibrium
D	stable equilibrium	unstable equilibrium	unstable equilibrium

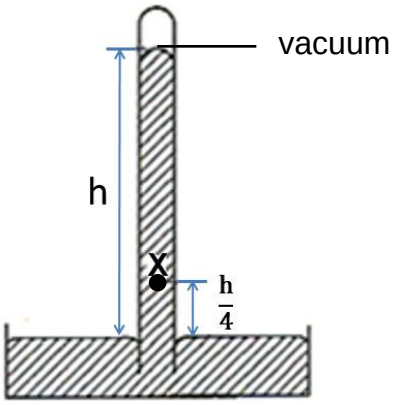
11 Syringes X and Y are filled with water and are connected by a tube. The cross-sectional areas of syringes X and Y are 12 mm^2 and 36 mm^2 respectively.



What is the input force F required to produce an output force of 54 N on syringe Y?

A 18 N
B 27 N
C 108 N
D 162 N

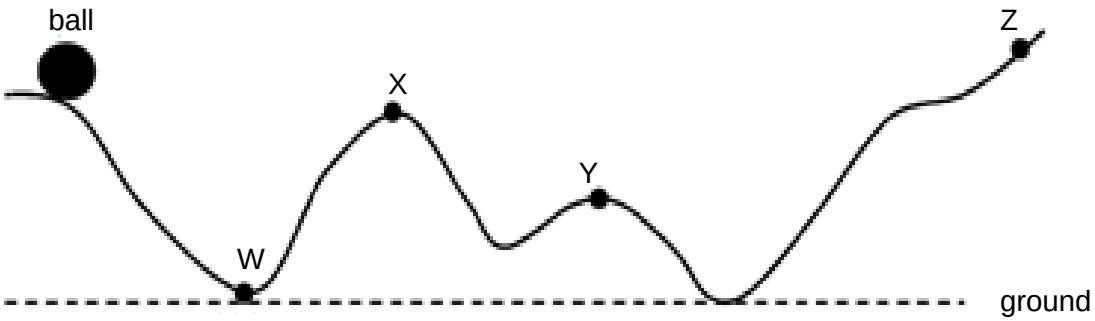
12 The height of mercury in a barometer is h when the atmospheric pressure is 100 000 Pa.



What is the pressure at X?

A 25 000 Pa
B 50 000 Pa
C 75 000 Pa
D 100 000 Pa

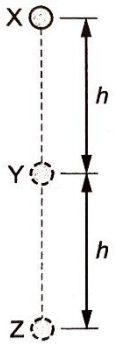
13 A ball is released from rest on a smooth surface as shown.



Taking air resistance to be negligible, which of the following is correct?

A The ball will move pass point Z.
B The kinetic energy of the ball at Y is greater than X.
C The kinetic energy of the ball at W is the lowest.
D The potential energy of the ball is smaller at X than Y.

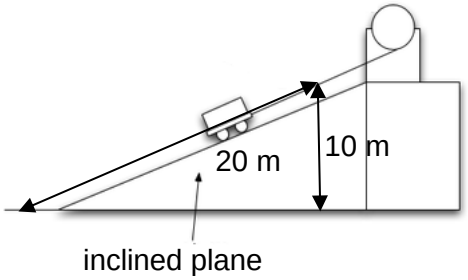
14 A ball is at rest at point X in a vacuum. The ball falls under gravity from X to Y to Z. Distances are shown in diagram.



What is the ratio of $\frac{kinetic\ energy\ of\ tha\ ball\ at\ Z}{kinetic\ energy\ of\ the\ ball\ at\ Y}$?

A $\sqrt{2}$ **B** 2 **C** $2\sqrt{2}$ **D** 4

15 A motor is used to pull a 2.0 kg toy car up an inclined plane. The toy car is pulled from the bottom to the top of the inclined plane in 5.0 s. The gravitational field strength is 10 N/kg.



The motor has an average power of 100 W. What is its efficiency?

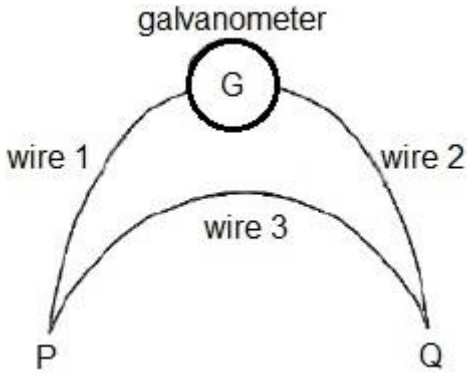
A 10% **B** 20% **C** 30% **D** 40%

16 The resistance of a piece of platinum wire in pure melting ice is 800 Ω. The resistance of the wire in steam is 910 Ω.

What would be the temperature when the wire has a resistance of 1000 Ω?

A 55 °C
B 110 °C
C 182 °C
D 220 °C

17 The diagram shows a thermocouple connected to a galvanometer. Two ends of the wires are placed in junctions P and Q respectively.



There is no deflection in the galvanometer.

Which of the following is **not** a possible reason for the observation?

A Both junctions P and Q have same temperature.
B The galvanometer is not sensitive enough to detect the current.
C Wire 1 and wire 2 are made of the same material.
D Wire 1 and wire 3 are made of the same material.

18 Daniel noticed that smoke particles contained in a glass jar were moving in a random manner.

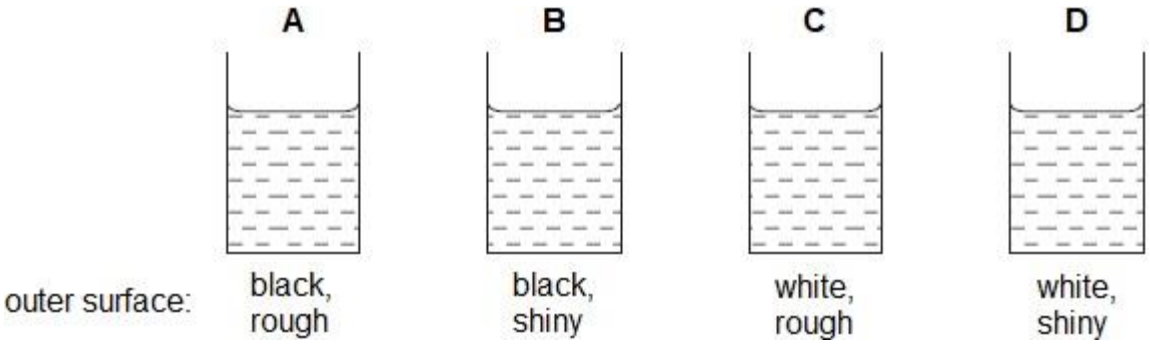
Which statement correctly explains the motion of smoke particles in the glass jar?

A Smoke particles are colliding with air particles which are moving in a random manner.
B Smoke particles are expanding when heated and become less dense.
C Smoke particles are moving faster and the frequency of collision increased.
D Smoke particles are vibrating about fixed positions more vigorously when heated.

19 Four metal cans are identical except for the colours and the textures of their outer surfaces.

100 cm^3 of water at 70 °C is poured into each can.

Which cools the most rapidly?



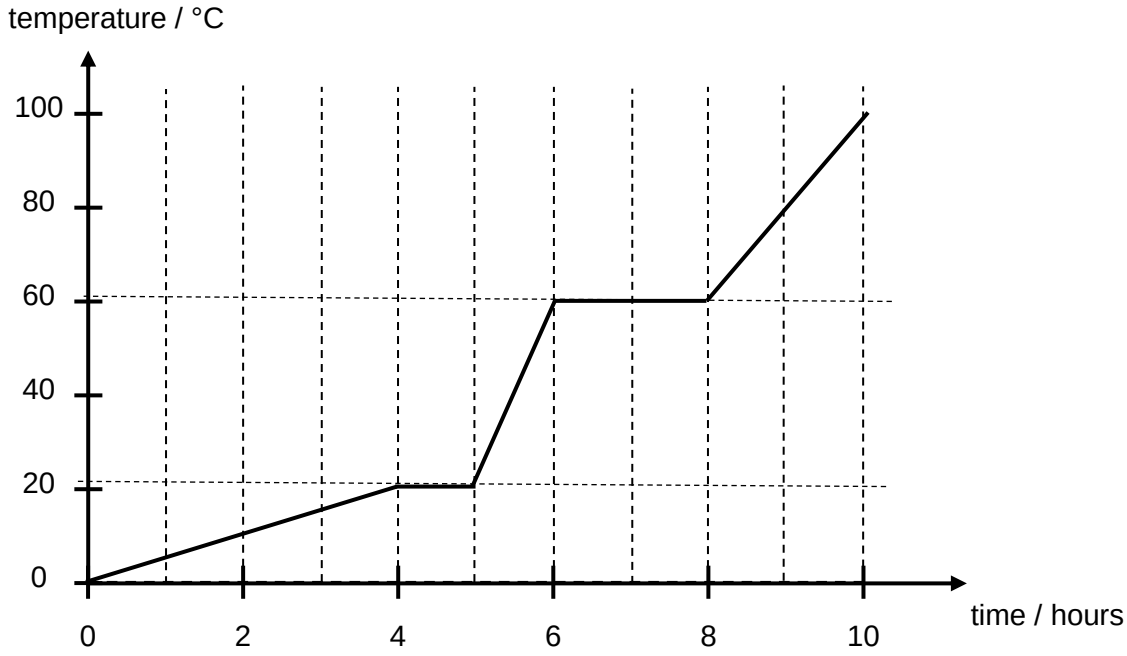
20 During condensation of steam to water, how does the internal kinetic energy and internal potential energy of the water molecules change?

	internal kinetic energy	internal potential energy
A	decreases	decreases
B	increases	decreases
C	unchanged	increases
D	unchanged	decreases

21 At which temperature, and where in a liquid, does evaporation occur?

	Temperature	Where in a liquid
A	any	point(s) of heating only
B	any	surface only
C	boiling point only	point(s) of heating only
D	boiling point only	surface only

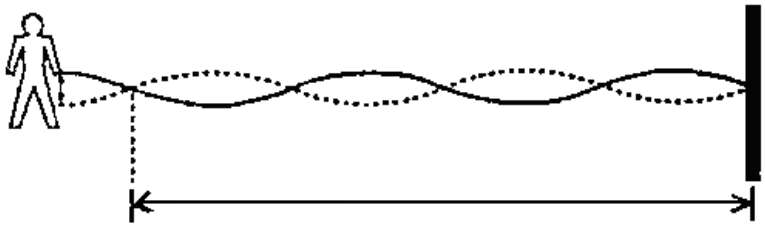
22 A sample of a material is heated at a constant rate from solid state until it reaches the gaseous state. A graph of temperature against time is shown below.



Which statement can be deduced from the graph?

A The heat capacity of the material increases with temperature.
B The specific heat capacity of the material is smallest when in the liquid state.
C The specific latent heat of fusion is larger than the specific heat capacity.
D The specific latent heat of fusion is twice the specific latent heat of vaporisation.

23 The diagram shows waves set up in a rope by a student moving the free end up and down at a steady rate.

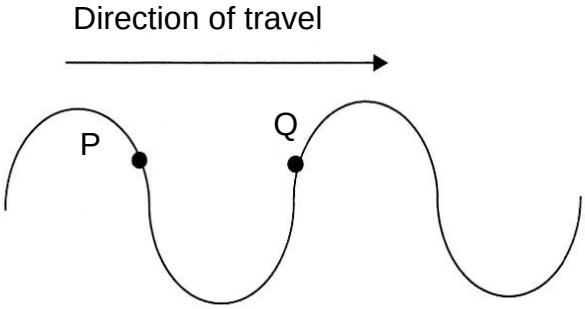


Free end 2.0 m Fixed end

What is the wavelength of the wave, and what will the wavelength be when the student doubles the frequency of the wave?

	Wavelength as shown	Wavelength when frequency doubled
A	0.50 m	1.00 m
B	0.50 m	0.50 m
C	1.00 m	1.00 m
D	1.00 m	0.50 m

24 Points P and Q are marked on a rope before it is set to oscillate.



At the particular instance shown below, what is the direction in which point P and point Q move?

	Point P	Point Q
A	down	down
B	down	up
C	up	down
D	up	up

25 Which statement about the use of each type of electromagnetic waves is correct?

A Microwaves can be used for cancer treatment.
B Radio waves can used for satellite communications.
C Gamma-rays can be used for luggage inspection at airports.
D X-rays can be used to check for cracks in metals.

- - - - - - - - - - End of Paper - - - - - - - - - -

Name | Reg. No | Class

MAYFLOWER SECONDARY SCHOOL

3EX

PHYSICS — 6091/02

Paper 2 Theory [75 Marks]

END OF YEAR EXAMINATION
October 2022

No Additional Materials are required.

2 hour 15 minutes
(with Paper 1)

Instructions to Candidates

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

Write in dark blue or black pen on both sides of the paper.

You may use a pencil for any diagrams or graphs.

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

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 12 has a choice of parts to answer.

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

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

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

Unless otherwise stated, take the gravitational field strength on earth *g* to be 10 N/kg.

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.

FOR EXAMINER'S USE		
Paper		**Marks**
Paper 1 (MCQ)		/ 25
Paper 2		
A		/ 45
B	**Q 10**	/ 10
	Q 11	/ 10
	Q 12	/ 10
Total		**/ 100**

This question paper consists of **18** printed pages.

Setter: Mr Johnson Tay

Vetter: Ms Mok Pei Jiun

[Turn over

Section A

Answer **all** the questions in this section.

1 Diagram shows a method to measure the acceleration of a vehicle. A series of eight electronic timers (A to H) are positioned at an equal distance of 20 m from each other along a straight road. A car, starting from rest, is driven along the road. All the timers are started when the car starts moving, and each timer is stopped when the front of the car passes it.

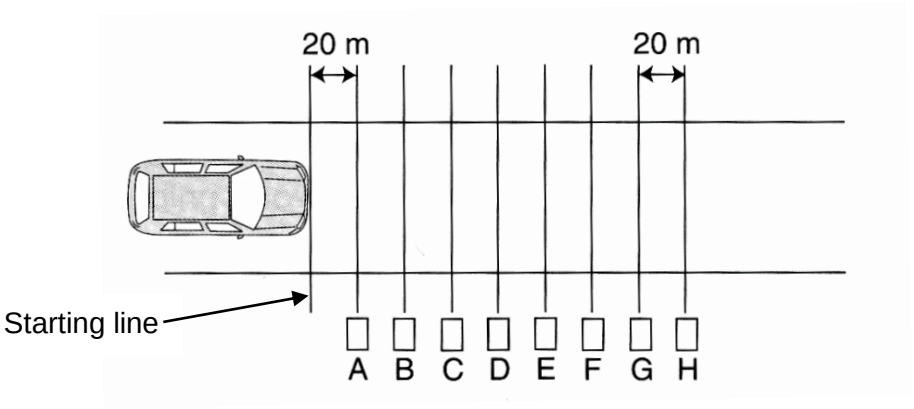


Table below shows the results for timers A to F.

Timer	A	B	C	D	E	F
Time (s)	4.3	6.0	7.4	8.5	9.5	10.5

(a) The car is accelerating uniformly for the first 100 m.

(i) Explain how the results show the car is accelerating in the first 100 m.

…..……

……..……[1]

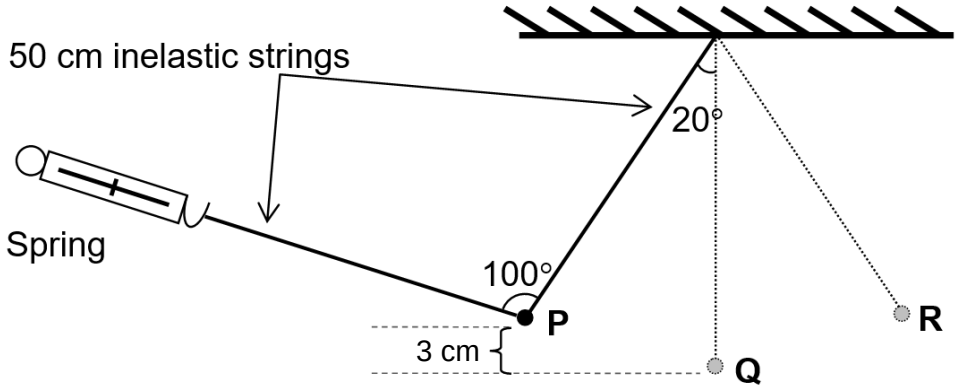
(ii) Calculate the average speed of the car for the first 100 m.

average speed = ... [2]

(b) Calculate the acceleration of the car for the first 100 m.

acceleration = ... [2]

2 Diagram shows a pendulum bob held stationery at P. The bob has a mass of 20 g and is tied to the ceiling and a spring balance by two 50 cm long inelastic strings as shown. If the bob was allowed to swing freely, it would pass through the positions Q and R which show the lowest and highest positions of the bob respectively. Assume there is no air resistance and the friction at the support is negligible.



(a) On the diagram above, draw and label an arrow to indicate the weight of the bob. [1]

(b) Given that the gravitational field strength is 10 N/kg, calculate the weight of the bob.

weight = ... [1]

(c) Given that the tension in the string tied to the ceiling is 0.2 N, draw a scale vector diagram to determine the force reading that is registered on the spring balance.

force = ... [4]

(d) A student wanted to conduct an experiment to measure the period of a pendulum bob. He set the bob to motion and started timing the moment he released the bob at P by detaching the spring. He counted one oscillation every oscillation every time the bob past P. He timed a total of two oscillations and found the average to obtain the period of the pendulum bob.

State one source of error in the experiment and how can it be improved.

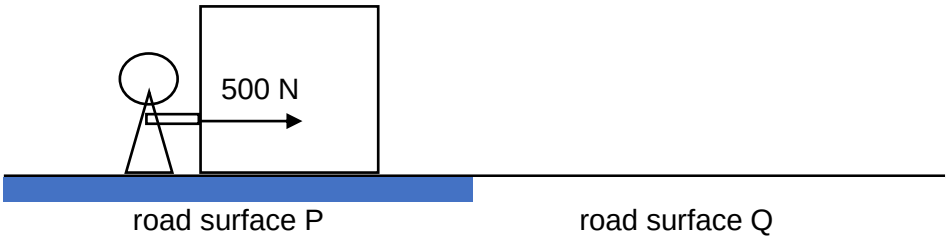
……

……

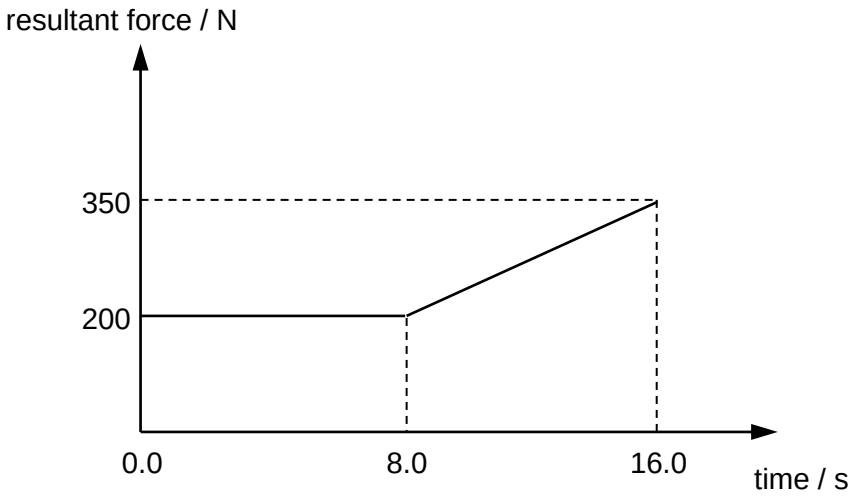
……

[1]

3 Diagram shows a man pushing a block across a road. After pushing for 8.0 s across road surface P, he enters a road surface Q. Throughout the entire journey, the man exerts a constant forward pushing force of 500 N. Assume that the air resistance is negligible.



The graph below shows how the resultant force acting on the block varies with time.



(a) Calculate the effective frictional force that acts against the motion of the block when it is on road surface P.

frictional force = ... [2]

(b) Describe, in terms of the condition of the road surface Q, why the resultant force increases from time t = 8.0 s to t = 16.0 s.

.....

.....

.....

[2]

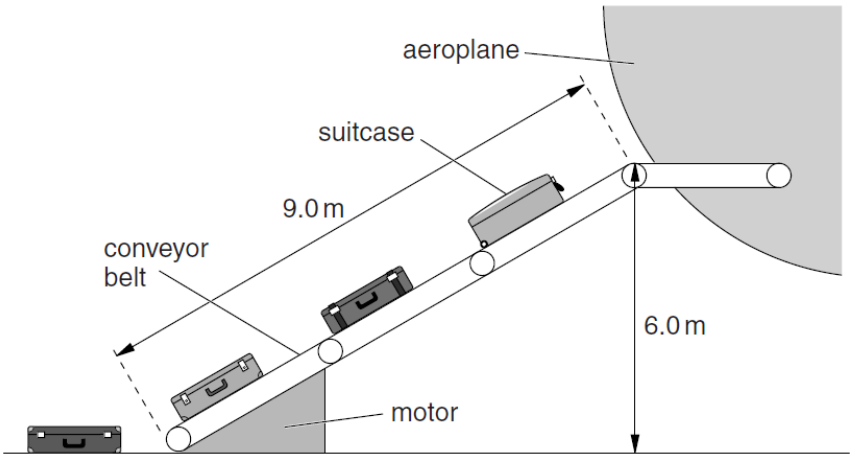
[Turn over

(c) The block has a mass of 100 kg.

Calculate the acceleration of the block at time t = 4.0 s.

acceleration = ... [2]

4 Diagram shows a conveyor belt carrying suitcases into an aeroplane.



An electric motor drives the conveyor belt.

A suitcase of mass 20 kg is lifted from the ground into the aeroplane.

(a) Explain what is meant by mass and by weight.

.....

.....

[1]

(b) The gravitational field strength g is 10 N/kg.

Calculate the increase in the gravitational potential energy of the suitcase.

increase in gravitational potential energy = ... [2]

(c) The suitcase takes 12 s to travel 9.0 m along the conveyor belt.

Calculate the kinetic energy of the suitcase.

kinetic energy = ... [2]

(d) The conveyor belt lifts 10 suitcases in 1 minute. Each suitcase has a mass of 20 kg.

(i) Calculate the power of the electric motor.

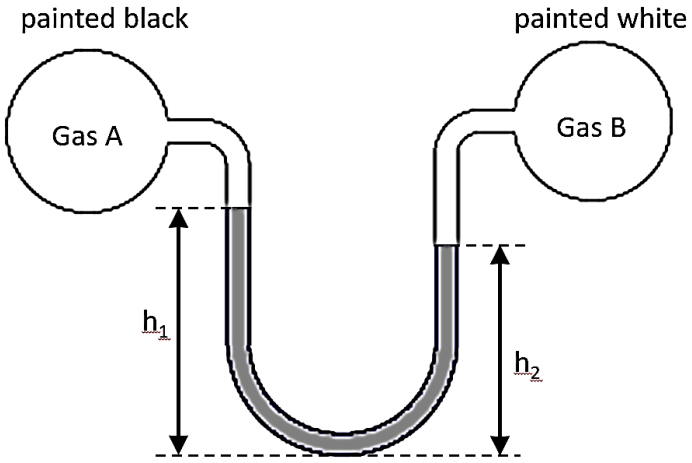
power = ... [2]

(ii) State the assumption you made when calculating the power of the electric motor in **(d)(i)**.

…..……

……..……[1]

5 Diagram below shows a mercury manometer with the left arm connected to gas container A painted in black and with the right arm connected to gas container B painted in white.



(a) Given that h_1 = 28.0 cm and h_2 = 20.0 cm and Gas A is at 772 mmHg, calculate the pressure of Gas B in mmHg.

pressure = ...mmHg [2]

(b) The entire setup is brought under strong sunlight.

Using ideas of transfer of thermal energy, state and explain how h_1 and h_2 would change.

……

……

……

……

[3]

(c) Using the kinetic particle theory, explain why mercury level and pressure of gas A and B are changed when manometer is placed under strong sunlight.

……

……

……

……

[3]

6 An unmarked mercury-in-glass thermometer is given to John. He is to calibrate the thermometer to measure a temperature range of 0 °C to 100 °C.

(a) State the thermometric property used in a mercury-in-glass thermometer.

……

[1]

(b) Describe the procedure John needs to carry out to correctly mark 0 °C on the mercury-in-glass thermometer.

……

……

……

……

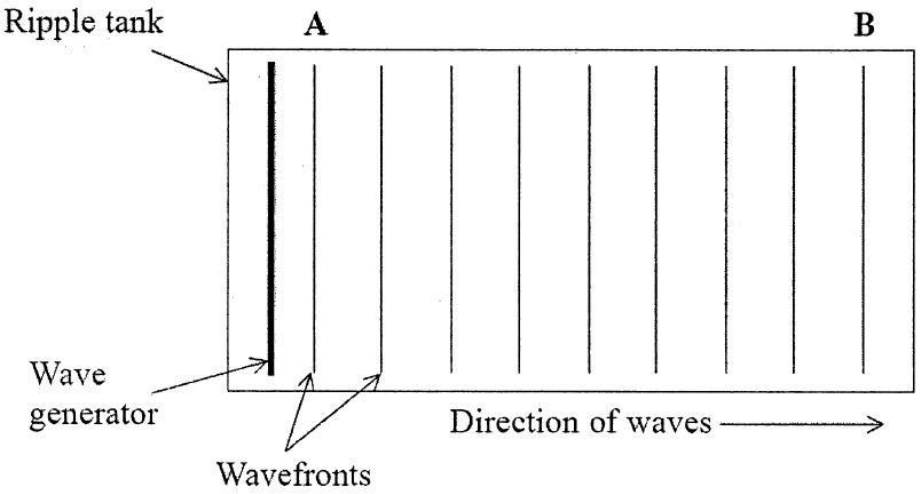
[2]

(c) The length of the mercury column is 4.0 cm in pure melting ice and 28.0 cm in steam.

Calculate the temperature for a mercury column length of 22.0 cm.

temperature = ... [2]

7 The full-scaled diagram below represent a water wave being produced in a ripple tank.



(a) By taking measurements and given that the speed of the waves in the ripple tank is 30 cm/s, calculate the frequency of these waves.

frequency = ... [2]

(b) The frequency of the wave generator is now increased.

State and explain how the speed of wave is changed, if any.

……

……

[1]

8 Microwaves are waves in the electromagnetic spectrum.

(a) State the name of a wave in one other part of the spectrum with a wavelength longer than microwave.

……

[1]

(b) Explain why the wave that has a wavelength longer than microwave has a frequency lower than microwave.

……

……

……

[2]

- - - - - End of Section A - - - - -

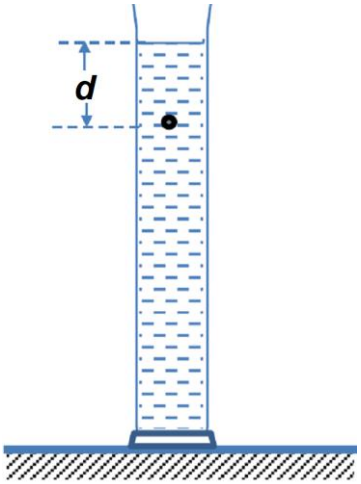
Section B

Answer **all** the questions in this section.

Answer only one of two alternative questions in **Question 11**.

9 Diagram shows a ball-bearing being dropped into a long tube containing liquid glue. The distance *d* travelled is measured at different times *t*. The liquid glue was replaced with water and the experiment was then repeated.

The results obtained in liquid glue and in water are shown in the table below.



***t* / s**	**liquid glue *d* / m**	**water *d* / m**
0.0	0.00	0.00
1.0	0.12	0.18
2.0	0.21	0.33
3.0	0.27	0.45
4.0	0.32	0.55
5.0	0.37	0.63
6.0	0.42	0.70
7.0	0.47	0.77
8.0	0.52	0.84

(a) Describe, in terms of speed, the motion of the ball-bearing in liquid glue.

……

……

……

[2]

(b) Using the data in the table, state

(i) a similarity between the distance *d* travelled for both glue and water,

……

……

[1]

(ii) a difference between the distance *d* travelled for both glue and water.

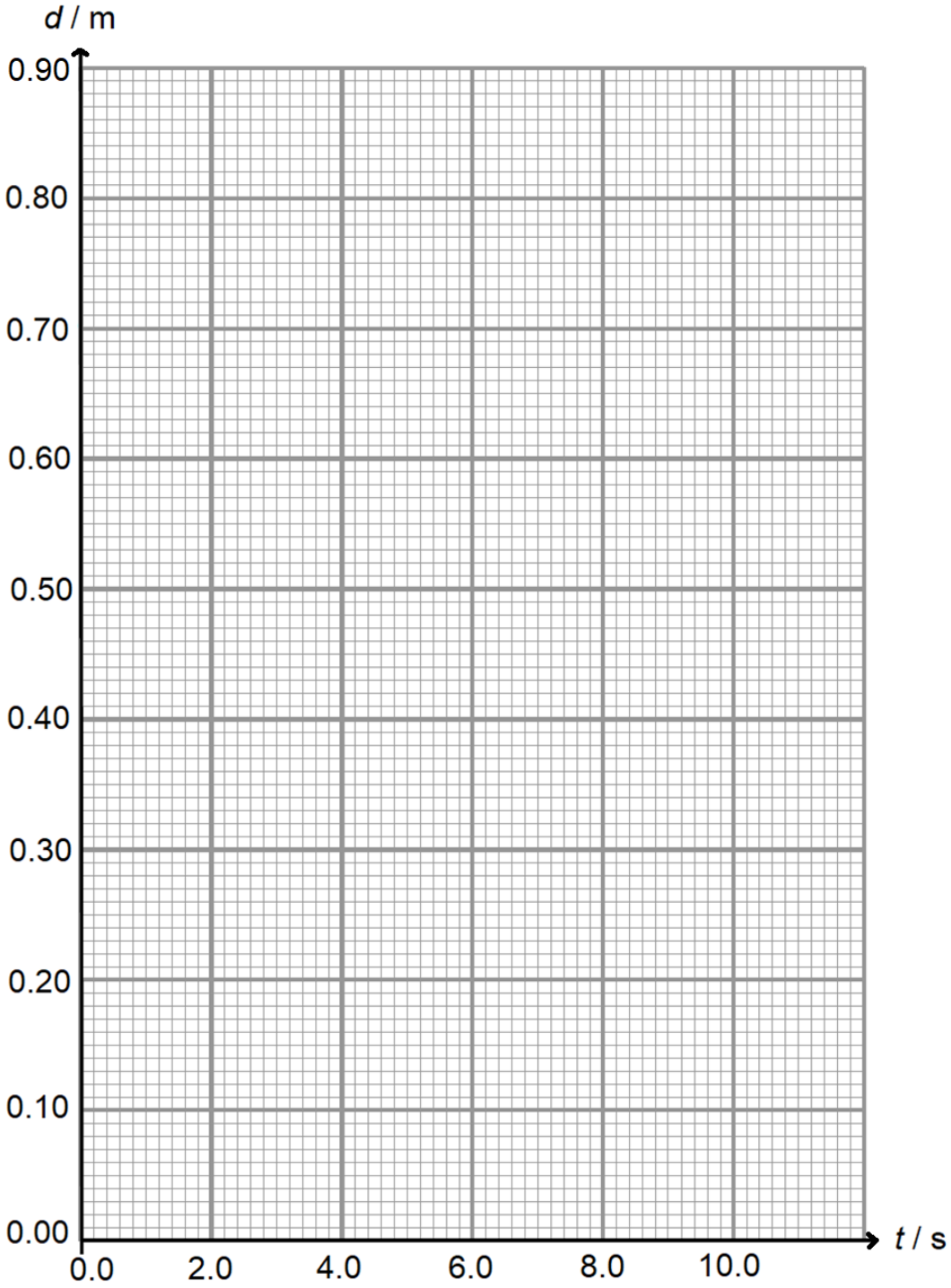
……

……

[1]

(c)

(i) On the grid provided, draw a graph of *d* against *t* for water.



[2]

(ii) Explain how the graph shows that the ball-bearing reaches terminal velocity.

……

……

[1]

(iii) Using the graph drawn, determine the terminal velocity of the ball-bearing in water.

terminal velocity = ... [1]

(d) Explain, by comparing the forces involved, why the time required for the ball-bearing to attain terminal velocity is different for both liquids.

.....

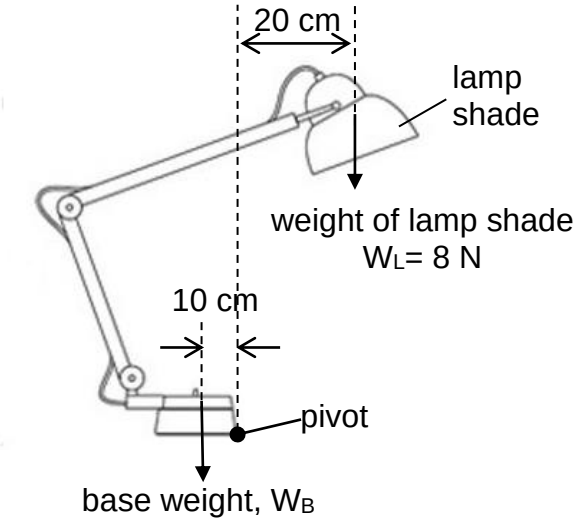
.....

.....

[2]

10 Diagram shows a desktop aluminium lamp. The base of the lamp is circular and has a radius of 10 cm. The weight (WL) of lamp shade is 8 N.

The dimensions of the lamp are as shown.



(a) Explain what is meant by *centre of gravity*.

.....

.....

[1]

(b) Calculate the minimum base weight (W_B) to prevent the lamp from toppling.

weight = ... [2]

(c) When the lamp is being tilted slightly, it returns to its original position.

State the type of equilibrium of the lamp and explain how the lamp returns to this state of equilibrium.

……

……

……

[2]

(d) Suggest and explain one way to increase the stability of the lamp.

……

……

……

[2]

(e) The table gives some information about two types of lamp.

	input electrical power / W	Efficiency / %
filament lamp	40	9
compact florescent lamp	10	40

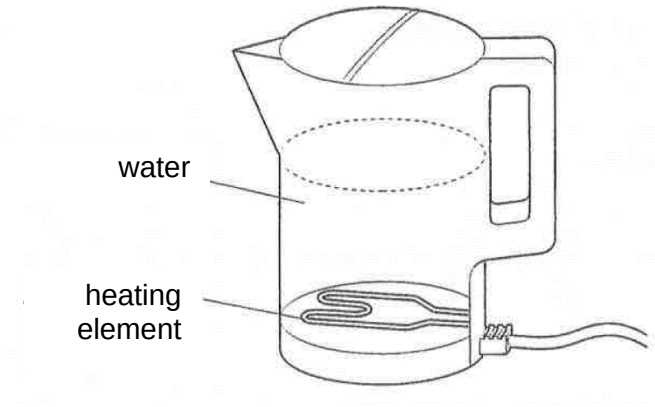
Determine which lamp produces a greater power output based on the efficiency of the lamp. Show your working.

[3]

Answer **one** of the alternative parts.

EITHER

11 Diagram shows an electric kettle



(a) Describe how the heating element heats up all the water inside the kettle.

……

……

……

[2]

(b) The specific latent heat of vaporisation of water is 2360 J/g.
The specific heat capacity of liquid water is 4.2 J/g.
The density of water is 1 g/cm^3.

Calculate the amount of thermal energy needed to boil off 1500 cm^3 of water with an initial temperature of 80 °C

thermal energy = ... [2]

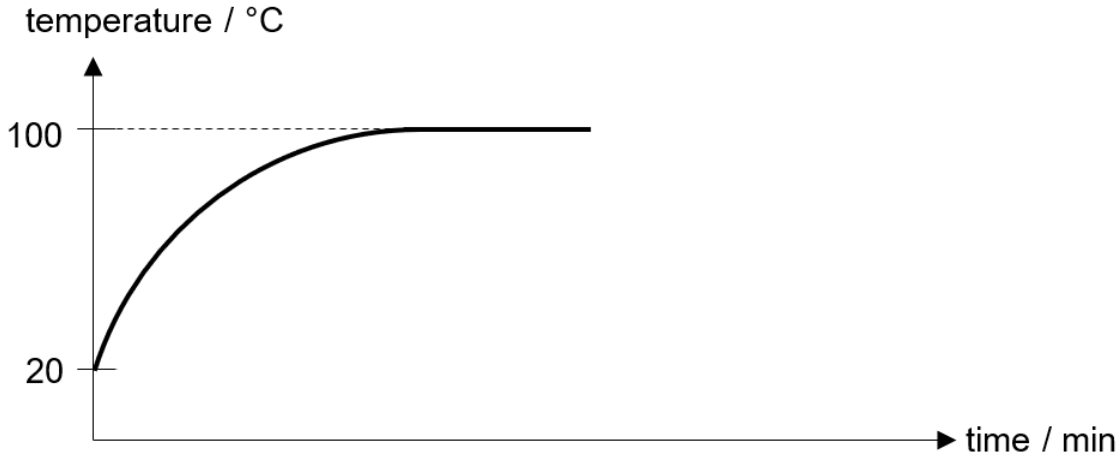
(c) Explain why steam is more dangerous than boiling water.

……

……

[1]

(d) The graph shows how the temperature of the water varies with time when the water is heated with the lid of the kettle closed.



(i) Explain, using internal energies, why the temperature of water remains constant at 100 °C even though heat is still supplied by the heating element.

……

……

……

……

……

[3]

(ii) On the graph above, sketch another line to show the new variation of temperature with time if the water is heated with the lid of the kettle opened.

[2]

OR

11 Diagram shows a diver salvaging items from a plane wreck below the surface of a lake. The density of the water in the lake is 1000 kg/m^3 and the atmospheric pressure at the surface is 1.0 x 10^5 Pa.

(a) The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

Calculate the air pressure in the balloon at 15 m below the surface of the lake.

pressure = ... [2]

(b) The air in the balloon occupies a volume of 0.048 m^3 at the pressure calculated in **(a)**. The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change.

(i) Calculate the volume occupied by the air in the balloon at atmospheric pressure when just fully emerged from the lake.

volume = ... [2]

(ii) The pressure of the air inside the balloon is less at the surface of the water than at a depth of 15 m.

Explain, in terms of the air molecules inside the balloon, why the pressure is less.

……

……

……

[2]

(c) When the diver releases the tray, the balloon accelerates upwards and reaches a constant speed before it arrives at the surface.

(i) Explain how the forces acting on the balloon cause it to behave in this way.

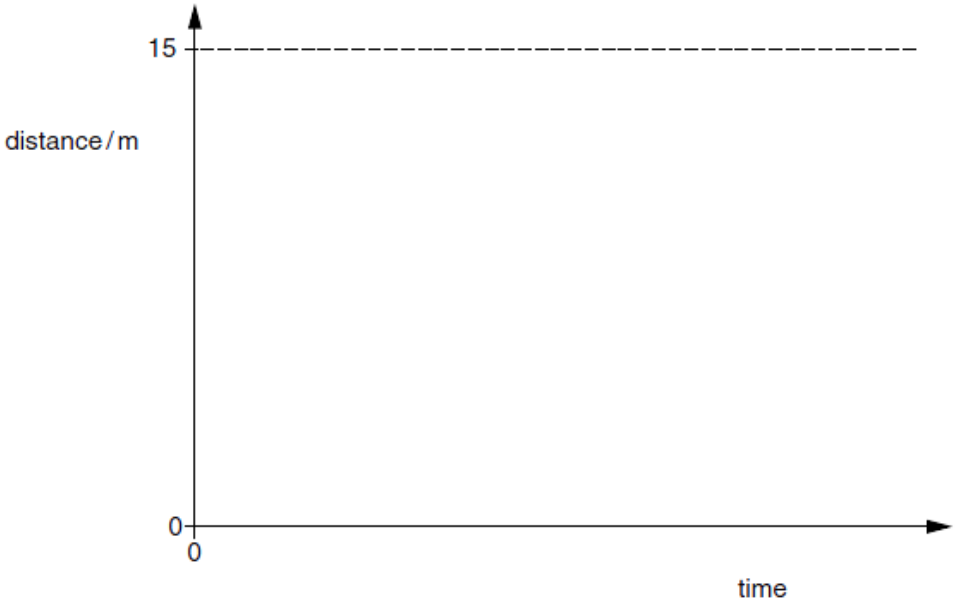
.....

.....

.....

[3]

(ii) Complete the graph by sketching the distance-time graph for the balloon as it travels 15 m to the surface.



[1]

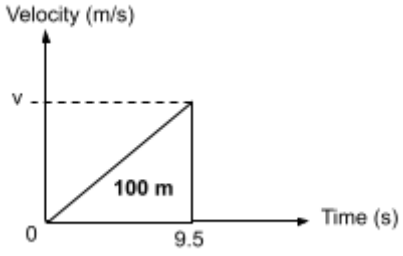
- - - - - End of Section B - - - - -

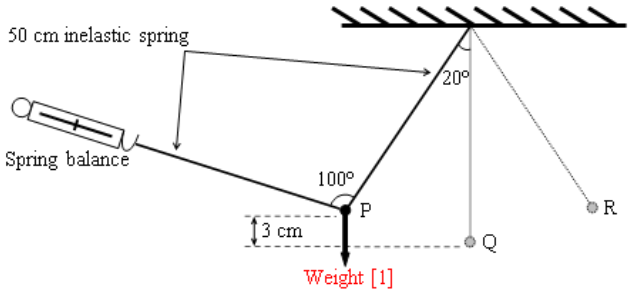
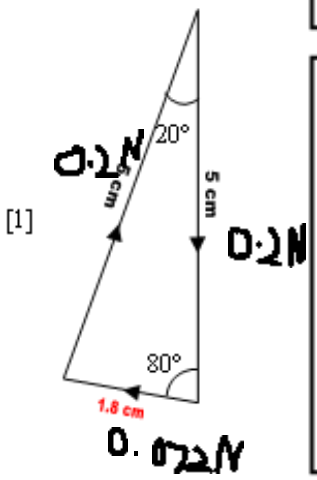
- End of Paper -

2022 Sec 3 Pure Physics 6091 EOY

1	2	3	4	5	6	7	8	9	10
B	A	C	ABCD	C	B	C	A	B	D
11	12	13	14	15	16	17	18	19	20
A	C	B	B	D	C	C	A	A	D
21	22	23	24	25					
B	B	D	C	D					

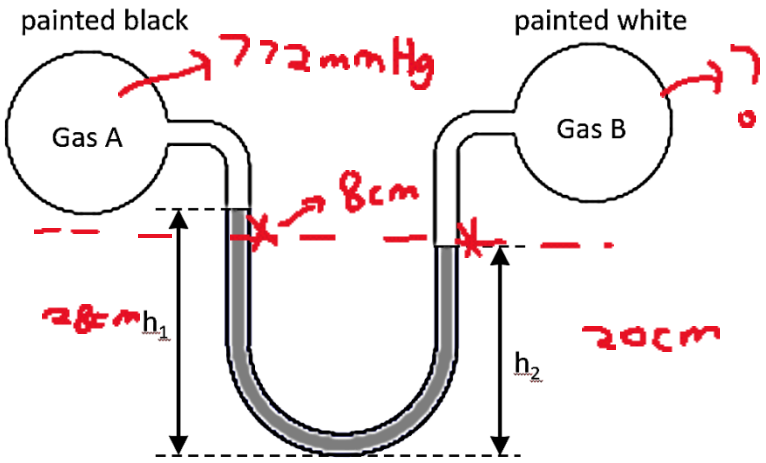
Selected MCQ Qn		
QN	ANS	Explanation
09	B	Adding sand raises the CG as it is adding a heavy substance over the existing sand, hence option B or C. Z cannot be the original CG as it is too low, with water above the sand. (cannot be C).
14	B	KE at Z = KE gain from X to Z = GPE loss from X to Z = mg(2h) KE at Y = KE gain from X to Y = GPE loss from X to Y = mgh KE at Z / KE at Y = 2mgh / mgh = 2

Section A		
The paper is designed to include basic recall question and critical level of understanding of concepts and application to get students ready for sec 4. There are questions that students MUST be able to do. Markers are allocating 1 mark for stating of formula to help students. Many students are sloppy in their answers – Not stating 3sf and SI unit in the final working. [Leniency given if correct 3sf and SI unit given in the answer line] Some of the questions are similar to the revision worksheet and from students' performance, it seems to suggest that some students may not done a good revision. For describe/explain question, even though students may know their content, their answers are not showing their mastery. Most of them are unclear in their answers – especially 5b, 5c and 6b. Please be mindful of handwriting.		
1 (a)(i)	The time taken to travel every 20 m is 4.3 s, 1.7 s, 1.4 s, 1.1 s and 1.0 s. Since the time taken decreases between each subsequent timer, the car is accelerating. Well done. Most students are able to see a decrease in timing.	1
(a)(ii)	average speed = total distance / total time = 100 / 9.5 = 10.5 m/s Well done. Most students are able to state the formula and use the correct data.	1 1
(b)	Area under V-T graph = displacement ½ × v × 9.5 = 100 v = 21.1 m/s a = (v – u)/t = (21.1 – 0)/9.5 = 2.22 m/s^2  This is the same type of question in the kinematic revision worksheet. Badly done.	1 for V-t statement or formula of acceleration 1

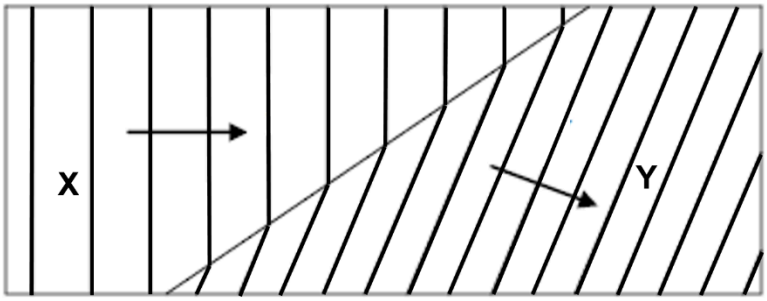
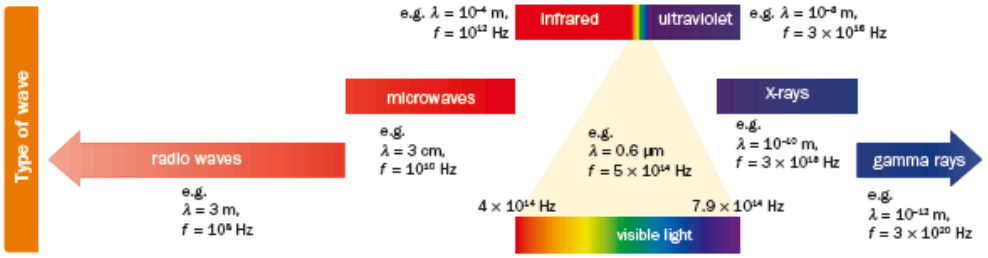
2(a)	 Students performed best for this question.	1
(b)	W = mg = 20/1000 x 10 = 0.200 N (3 sf) Basic question. No mark if no formula, 3sf and SI unit are given in the final working.	1
(c)	 [1] Scale used = 1 cm : 0.04 N [1] Weight of bob = 0.2 N [1] Force on string tied to spring balance = 1.8 × 0.04 = **0.072 N** [1] [Tolerance 10%] Accept answers from **0.0648 N to 0.0792 N** Correct direction of arrows of vector diagram [1] Most students didn't express final answer in 3 sf. There are students who were not able to apply basic angle concepts. Students are expected to know understanding that each vector represents force and not length, and hence to indicate the force of each vector. There are students who did not follow the orientation/direction of the vector too. Do note that this is a standard vector addition diagram.	4
(d)	Human reaction time delays timing and to reduce this error, student should increase the number of oscillations to 10 or 20	1

	OR By using Point P as a reference point, it is difficult to determine the starting and ending of stopwatch at the exact position of P. Q is the centre of the oscillation (equilibrium position) so the mass is moving past it at the fastest speed and there is the least uncertainty in starting and stopping the stopwatch A few students correctly stated human reaction time but it is wrong to just repeat the experiment to take average. Oscillation needs to increase	
3(a)	Resultant force = Pushing force – friction Friction = Pushing force – Resultant force Friction = 500 – 200 = 300 N Many students did not show their understanding of the concepts as no formula is stated.	1 1
(b)	The surface is less rough / smoother on Q than on P. The surface also gets smoother as the block moves further into Q. The question requires students to describe in terms of the condition of the road surface. As resultant force increases, it also means that the surface gets smoother as the block travel further into Q.	1 1
(c)	$F_{resultant}$ = ma 200 = 100a a = 2.00 m/s^2 Students are not giving their answers in 3sf and the correct SI units. It has been emphasized on a daily basis during lessons. Simple numbers are used in the attempt to improve performance. It is puzzling why so many students are not able to get this basic question correct. Common misconceptions: Apply acceleration formula, use 300 N as resultant force It is also not acceptable to not know the formula of F = ma. A few students recalled F = m/a, F = Ma (“mega acceleration”), SI unit of a is N/kg	1 1
4(a)	Mass is the amount of substance in a body while Weight is the gravitational force acting of a mass.	1

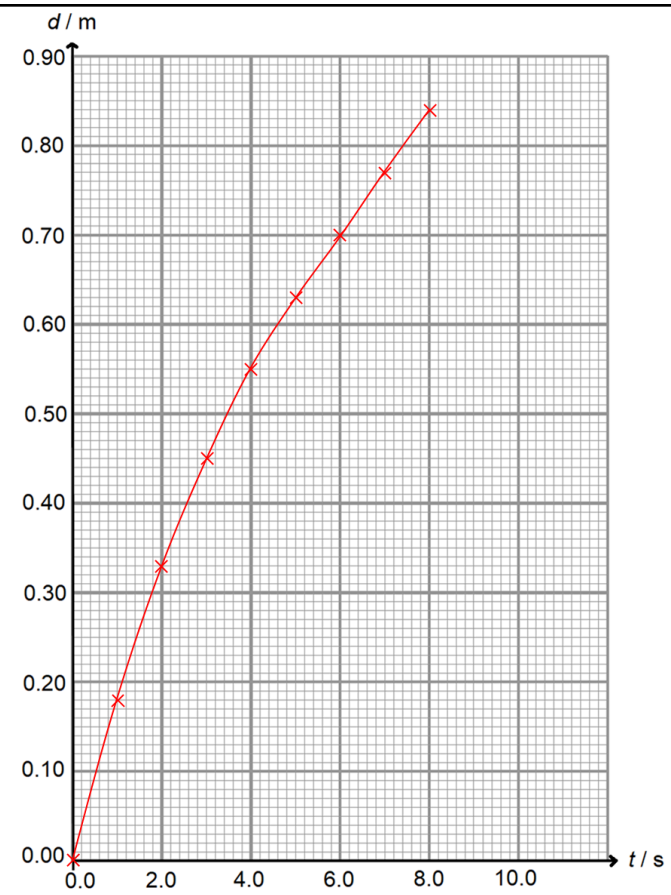
	Average performance. Question was set to improve the performance of students. This is a basic recall of definition which was learnt at lower sec. Major misconception from students – weight is gravitational field strength, weight is frictional force.	
(b)	mgh = 20x10x6 = 1200 J Well done. A few students left out SI unit at final step. A few have misconception that mgh is moment by showing incorrect SI unit – N m. A few thought energy is same as force and indicate incorrect SI unit – N.	1 1
(c)	Speed = 9/12 OR KE = ½ mv^2 = 0.5x20x$(9/12)^2$ = 5.63 J Students not expressing answers in 3sf. Shock to see students expressing in fraction.	1 1
(d)(i)	P = GPE gain / time = 10 x (1200) / 60 = 200 W Average performance. Students need to recognize that the suitcase is lifted up 6m and the motor supplying energy to lift 10 suitcases by up 6m. Each suitcase gains 1200 J when it is lifted 6m and motor takes 60 s to raise 10 of them.	1 1
(d)(ii)	The motor is 100% efficient. OR There is no energy lost to the surrounding. Badly done Question has stated that each suitcase has the same mass and hence, energy to lift each suitcase is the same cannot be accepted.	1
5(a)		

	 P_{gasA} + hpg = P_{gasB} P_{gasB} = 772 + (28-20) x10 need to convert cm to mm P_{gasB} = 852 mmHg Badly done. Lenient marking is given.	1 for hpg or 80 mm 1
(b)	Black is a better absorber of infrared radiation than white or absorb more infrared radiation. Hence Gas A gain more thermal energy than Gas B, resulting in a **larger** increase in pressure in Gas A than in Gas B. Hence h_1 will decrease and h_2 will increase. Students have misconception that black is a good conductor of heat. In this context, black is not emitting or radiating thermal energy, hence it cannot be a good radiator. Students are to take note the need to always state the property of black surface in the correct context. In this case, black is NOT a better emitter of infrared radiation. "Good absorber of heat" is not accepted. Some students also left out explaining pressure.	1 1 1
(c)	Gas molecules gain kinetic energy and move faster (at greater speeds) AND	1

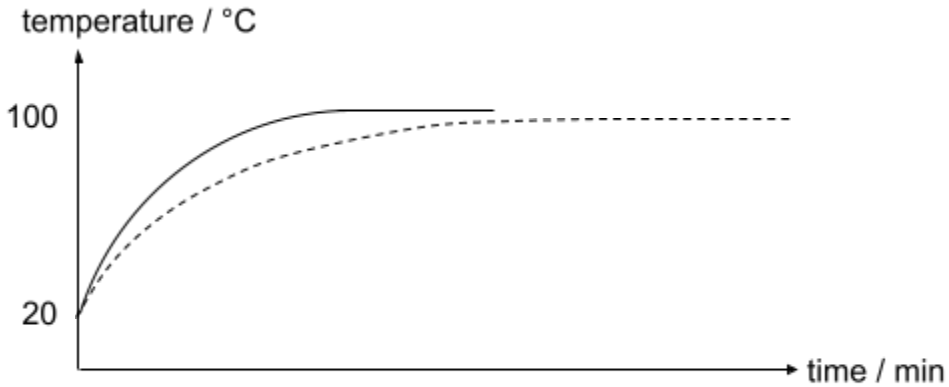
	Gas molecules collide with wall of container more frequently and more forcefully/vigorously. Since P = F/A, this increases the average force exerted on per unit area of the wall of container and hence pressure of the gas X increases. Many students did not read the question carefully ad use kinetic particle theory to answer this question. Many left out using P=F/A to explain why pressure is increased. Note Gas particle moves faster and not vibrate faster.	1 1
6(a)	Volume of a fixed mass of liquid Accept volume Many students did not understand the question.	1
(b)	place the bulb of the thermometer surrounded by pure melting ice. Wait until there is no visible movement of the mercury thread or mercury level remains steady Mark that point as $0^{o}C$. Many students did not indicate “pure melting ice”. Some students simply say to dip the thermometer into pure melting ice. It is important to state that the bulb of thermometer must be in the pure melting ice. Some students mentioned mercury stabilizing which is not clear. Better performing student talks about pure melting crushed ice. Tip of using this phase was given in the next question.	1 1
(c)	Formula $\frac{22 - 4}{28 - 4} \times 100 = 75.0\ ^{o}C$ A group of students repeatedly not giving SI unit in the final step. Many did not give the formula – please take note it is a 2m qn.	1 formula 1
7(a)	$f = v \div \lambda$ $= 30 \div 0.9$ (1 mark for formula OR 0.9 m AND not 9 cm) $= 33.3$ Hz Ok. There are students who didn’t know this formula. To obtain the wavelength, use a ruler to measure. Qn has stated that the diagram is fully scaled.	1 1

	W = f λ - unheard of Wave qn could have been done better. Setter was thinking if drawing of wave of the below qn should be included.  	
(b)	Since there is <u>no change to the medium</u>, and because speed is affected by the medium and not frequency, therefore there is <u>no change in speed.</u> Badly done. It was covered in lesson too. Basic fact that speed only changes when there is a change in medium and hence, as it is a 1 m qn, no mark is awarded if student is correct that there is no change of speed without correct explanation.	1
8(a)	Radio waves  It is set to help students to get 1 m easily. Students who failed to be awarded 1 m are likely those who didn't study. Eg of errors - visible light, infrared, UV ray, SOUND Wave	1
(b)	All EM waves have the same speed in vaccum, since **v= f λ**, a lower frequency will get a longer wavelength. Students will not be awarded any mark by repeating the qn that a longer wavelength has a lower frequency.	1 1

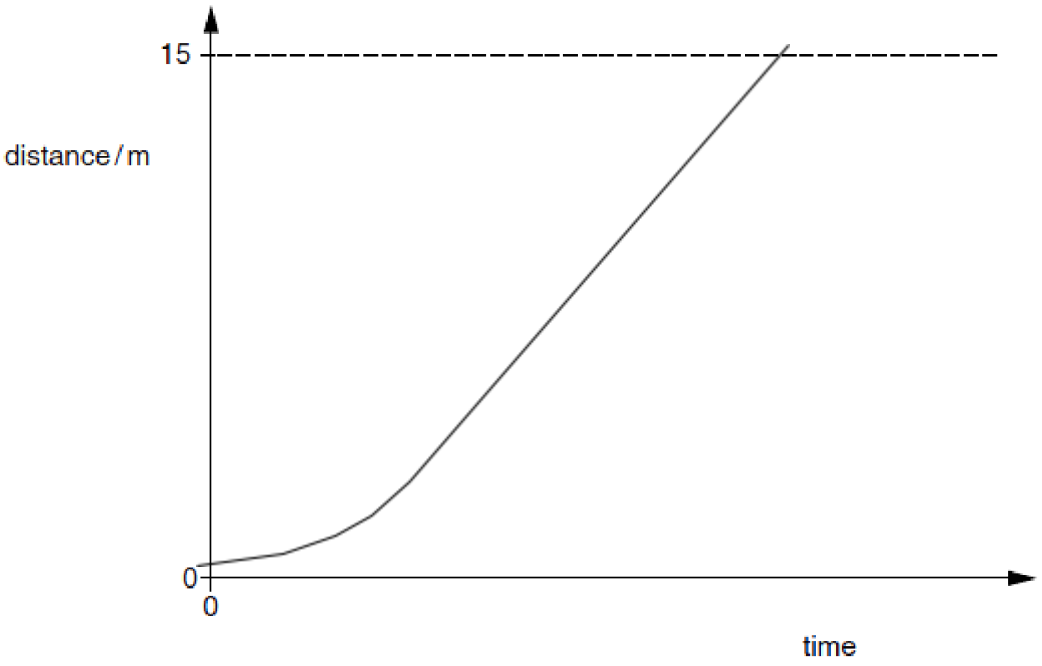
Section B		
9(a)	Decreasing speed from 0 s to 3 s then uniform/constant speed from 3 s to 8 s. (Must make reference to time) **Accept: Speed is decreasing at decreasing rate for first part.** **Common mistakes:** ● **Decreasing acceleration is mistaken as deceleration (for first part)** ● **Speed is increasing at decreasing rate (for first part)** ● **Speed is increasing at constant rate (for second part)**	1 1
9(b)(i)	There is an increase in distance moved per unit time for the first few seconds for both liquid glue and water. **Common mistakes:** ● **"the distance travelled was both decreasing" or "the distance travelled was both decreasing at decreasing rate" instead of "the distance travelled was both increasing at decreasing rate"**	1
9(b)(ii)	The distance moved for glue is smaller than that of water / time at which the increase in distance becomes constant is earlier for liquid glue than for water. **Common mistakes:** ● **"ball-bearing travelled greater distance in water than in glue" – must state time or else both would have travelled the same depth eventually** ● **Some students literally give the difference in value for distance…**	1
	Common mistakes: ● **Free-hand drawing leading to lines that are feathery and not smooth**	
9(c)(i)	Correct plots for graph Line for graph	1 1

	 **Common mistakes:** ● **Free-hand drawing leading to lines that are feathery and not smooth** ● **A single straight line is drawn instead of a curve in the first part joining smoothly to a straight line in the second part**	
9(c)(i)	Gradient of distance-time graph gives velocity and so terminal velocity can be observed as a straight line with constant positive gradient in the graph. ● **Do not just say it can be seen from a straight line.** ● **A vertical/horizontal/negative-gradient straight line here does not show a terminal velocity.**	1
9(c)(ii)	Terminal velocity for water = gradient of distance-time graph = (0.84 – 0.63) / (8.0 – 5.0) = 0.0700 m/s **Common mistakes:** ● **Omission of units at the end of working** ● **Absence of unit or wrong unit for final answer** ● **Answer not properly presented in 2sf or 3sf**	1
9(c)(iii)		1 1

	For the same speed, there is <u>larger in drag force / liquid resistance for liquid glue</u> than water. This allows the <u>drag force / liquid resistance for liquid glue to be equal to the weight of the ball-bearing</u> in a shorter amount of time. **Common mistakes:** ● **… is different because … is different… (What is the difference actually???)**	
10(b)	Taking pivot about pivot point, Sum of clockwise moments = Sum of anticlockwise moments (8)(20) = (W)(10) W = 16.0 N	1 1
(a)	Centre of gravity is <u>a point from which the weight of a body appear to act from</u> for all orientations of the body. **Accept: A point which the total weight of the body appears to be concentrated for all orientations of the body.** **Accept absence of orientation.**	1
(c)	Stable equilibrium When the lamp is tilted slightly, the <u>centre of gravity of the lamp rises and fall again</u> / <u>the line of action of the weight of the lamp lies within the base of the lamp / the weight produces restoring moment</u>	1 1
(d)	<u>Increase the base weight</u>. will <u>lower the centre of gravity</u> of the lamp. Or <u>Increase the base area</u> of the base. This will <u>increase the likelihood of the line of action of the weight of the lamp to fall within the base of the lamp when tilted slightly</u>. *Or any other possible suggestions with valid explanation.* **Common Mistakes:** ● **Instead of "line of action of weight falls within the base…" many students wrote wrongly "centre of gravity falls within the base…" OR "centre of gravity falls near the pivot…" OR "the pivot falls within the base…"** **Accept: "line of action of weight**	2 Or 2
(e)	Efficiency = output power / input power × 100 Output power = input power × efficiency/100 Output power of filament lamp = 40 ✎ 9/100 = 3.6 W Output power of fluorescent lamp = 10 ✎ 40/100 = 4 W fluorescent lamp produces higher output power **Common Mistakes:** ● **Wrong efficiency formula** ● **Wrong units – J instead of W**	1 1 1
Either 11(a)	The <u>heater element heats the water near it by conduction</u> causing it to expand.	1

	Heated, less dense water rises while cooler denser water sinks in replacement and gets heated by heater element, forming a convection current to heat all the water. **Common mistakes:** ● **"….. rises and …. sinks because of convection" instead of "….. rises and …. sinks, and the continuous movement created convection…."**	1
(b)	$m = \rho V = 1 g/cm^3 \times 1500 cm^3 = 1500 g$ Energy = energy needed to heat water from 80°C to 100 °C + energy needed to boil off the water $= mc\Delta\theta + ml_v$ $= (1 \times 1500/1000) 1500 \times 4.2 \times (100 - 80) + 1500 \times 2360$ $= 3.67 \times 10^6$ J	 1 1
(c)	Steam releases latent heat when it condenses (change from 100°C steam to 100°C water). This is **on top of** the thermal energy released by boiling water when in contact with any cooler surfaces. **Common Mistakes:** ● **Many describe steam as being able to flow freely and everywhere compared to water and so can cause more damage as if the steam can attack more people due to movement.**	1
(d)(i) **(ii)**	Since thermal energy is supplied to water molecules to **overcome the force of attraction between the water molecules and force of atmospheric pressure** This **energy supplied is NOT converted to internal kinetic energy** OR no change to average internal kinetic energy of the molecules. Therefore, there is no change in temperature during boiling. This energy is only **converted to internal potential energy** for breaking of inter-molecular bond OR during change in state  	1 1 1

	- Graph is below original line - Start from 20°C - ending must be also 100°C	 1 1
OR **11(a)**	Total pressure = hρg + P_{atm} = 15 x 1000 x 10 + 1.0 x 10^5 = <u>2.50 x 10^5 Pa</u> **Common mistakes:** ● **Instead of presenting answer as 2.50 x 10^5 Pa, students wrote 250000 Pa which is not 3sf.** ● **No proper equation is written before**	1 1
(b)(i)	$P_1V_1 = P_2V_2$, 2.5 x 10^5 x 0.048 = 1.0 x 10^5 x V_2 V_2 = <u>0.12 m^3</u> **Common mistakes:** ● **No equation written** ● **Wrong equation written**	1 1
(b)(ii)	The balloon has **<u>higher volume at the surface of water</u>** compared to when it was at 15m below surface, so the **<u>air molecules inside the balloon occupies a larger space and/or are spaced further apart</u>**. So air molecules in the balloon has **<u>lower frequency of collisions with the inner walls of the balloon</u>** and so as **<u>P=F/A</u>**, the **<u>average air pressure in the balloon is lower</u>**. **Common mistakes:** ● **No reference to particles or molecules** ● **Reference to outside pressure instead of inside pressure** ● **Inability to link between particle motion an behaviour to force to pressure**	1 1
(c)(i)	When the diver first releases the tray, the <u>unbalanced / net upward force</u> causes the balloon to accelerate upwards. As its speed increases, the <u>downwards water resistance / friction increases.</u> Eventually, when <u>downwards water resistance / friction becomes as much as the upwards buoyancy force</u>, <u>resultant force on balloon becomes zero</u> and so it continues to move up at constant speed. **Common mistakes:** ● **Inability to state the unbalance force that cause the upwards rise of balloon.** ● **Inability to refer to balance of forces and linking to acceleration and speed.** ● **Only description of motion with no relevance to deeper physics**	1 1 1

(c)(ii)		1