KENT RIDGE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2019

PHYSICS **6091/Part I**

Part I Multiple Choice

SECONDARY 3 EXPRESS

Thursday 3 October 2019 **2 hours**

Name: ____________________________ ( ) **Class: Sec** _______

Additional Materials

Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number clearly in the spaces provided at the top of this page.

Do not open this question paper until you are told to do so.

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet and in the spaces provided at the top of this page.

There are **thirty** 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.

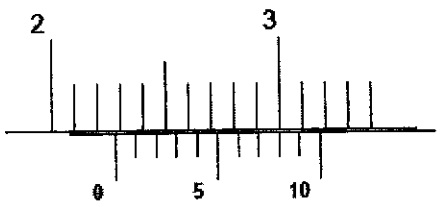
Read the instructions on the Answer Sheet very carefully.

Answers to Parts I and Parts II must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no more than **40 minutes** on **Part I**.
You may proceed to answer Part II as soon as you have completed Part I.
Any rough working should be done in this booklet.
The use of an approved scientific calculated is expected, where appropriate.

This question paper consists of 13 printed pages, including this page.

Setter: Ms Sally Chow **[Turn Over**

1 A student used a pair of Vernier calipers to measure the diameter of a wooden rod. The diagram shows an enlargement of the caliper scales.



What is the diameter?

A 0.30 cm
B 2.08 cm
C 2.28 cm
D 3.80 cm

2 A sheet of gold leaf has a thickness of 0.125 μm. A gold atom has a radius of 0.174 nm.

Approximately how many layers of atoms are there in the sheet?

A 4 **B** 7 **C** 400 **D** 700

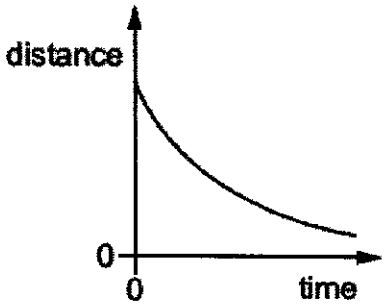
3 A pendulum is set in motion and timed. The time measured for 20 complete swings is 30 s.

What is the time for one complete swing of the pendulum?

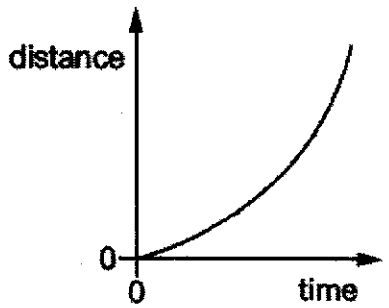
A 0.67 s **B** 0.75 s **C** 1.5 s **D** 3.0 s

4 Which distance-time graph represents the motion of an object moving with constant speed?

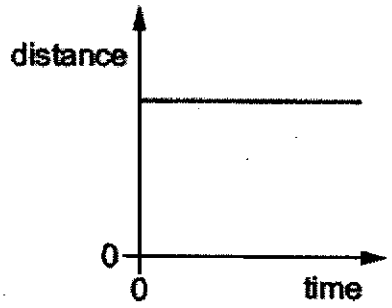
A



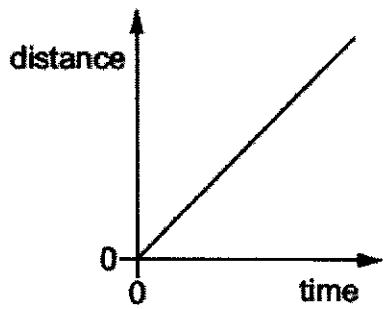
B



C

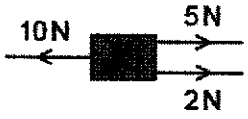


D



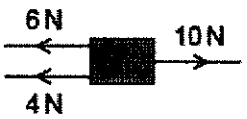
5 Which combination of forces produces a resultant force acting towards the right?

A



B

C



D

6 A force of 1600 N accelerates a car, of mass 800 kg, from rest.

What is the car's acceleration and its velocity after 4.0 s?

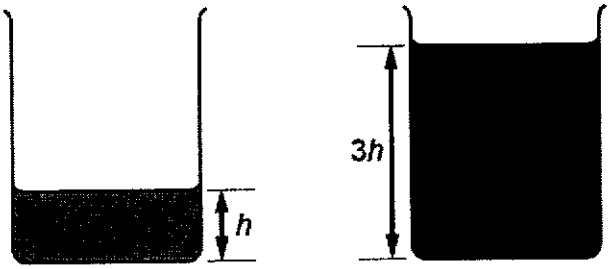
	acceleration / m s^{-2}	velocity / m s^{-1}
A	0.50	0.13
B	0.50	0.50
C	2.0	2.0
D	2.0	8.0

7 When a heavy coin falls a short distance towards the ground it does not reach terminal velocity.

Why is this?

A The coin has not hit the ground.
B The weight of the coin equals the air resistance.
C The weight of the coin increases as air resistance increases.
D The weight of the coin is always more than air resistance.

8 Two identical beakers contain the same mass of liquid. There is a different liquid in each beaker.



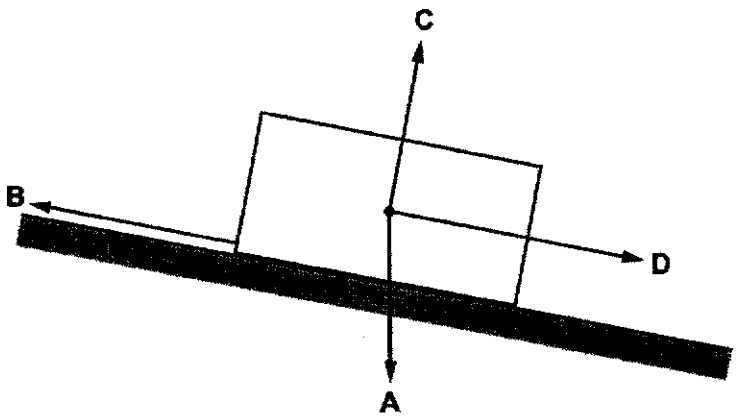
Liquid Q has a density of ρ.

What is the density of liquid P?

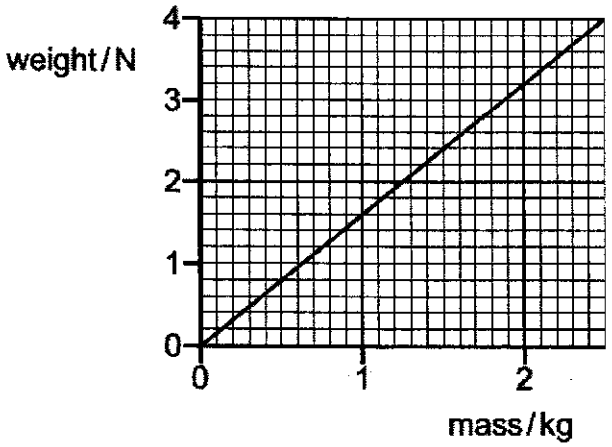
A $\frac{\rho}{3}$ **B** ρ **C** 3ρ **D** 9ρ

9 The diagram shows a block of wood resting on a sloping board.

Which arrow shows the direction of the gravitational force acting on the block?



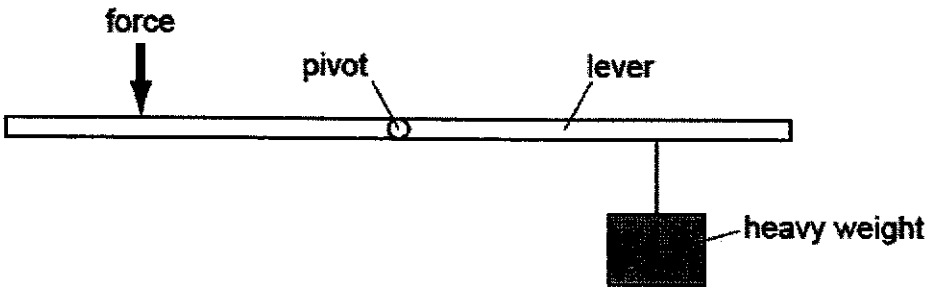
10 The graph shows the variation of mass with the weight of objects on a particular planet.



What is the value of the gravitational field strength of the planet?

A 0.63 N / kg **B** 1.6 N / kg **C** 3.2 N / kg **D** 9.8 N / kg

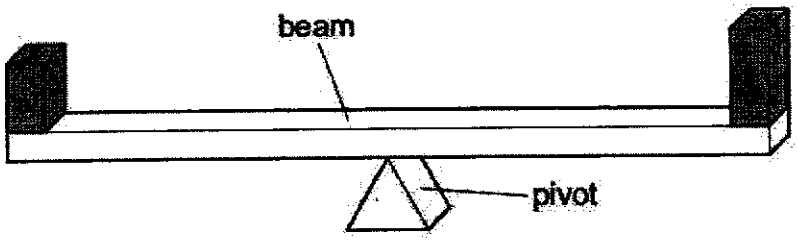
11 The diagram shows a force being applied to a lever to lift a heavy weight.



Which change would enable the heavy weight to be lifted with a smaller force?

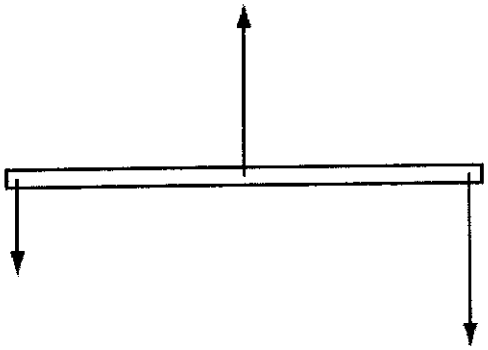
A Move the force to the right.
B Move the heavy weight to the right.
C Move the force to the left.
D Move the pivot to the left.

12 Two blocks are placed on a beam which balances on a pivot at its centre. The weight of the beam is negligible.

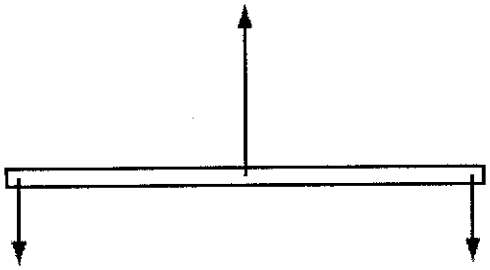


Which diagram shows the forces acting on the beam?
(The length of each arrow represents the size of a force.)

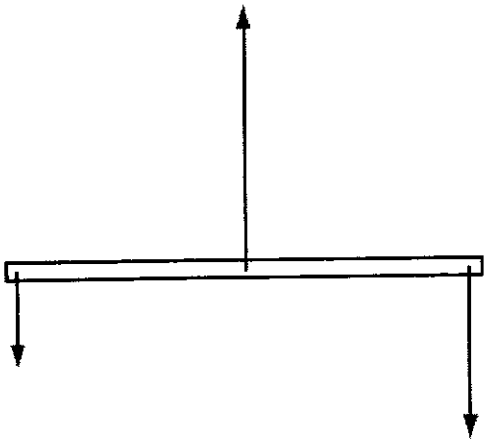
A



B



C



D

13 What affects the stability of an object?

A only its base area and the location of its centre of mass
B only its weight and its base area
C only the location of its centre of mass
D only its weight

14 In a hydroelectric power station, water from a reservoir falls down a long pipe before entering the turbines. The turbines then turn the generator.

What is the overall energy conversion?

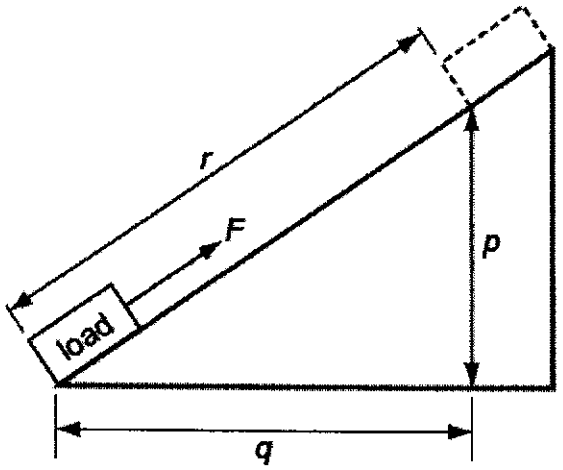
A electrical energy into kinetic energy
B electrical energy into potential energy
C kinetic energy into chemical energy
D potential energy into electrical energy

15 A man is running in a straight line.

What is an approximate value of his kinetic energy?

A 10 J **B** 100 J **C** 1000 J **D** 10 000 J

16 A force *F* moves a load from the bottom of a slope to the top.

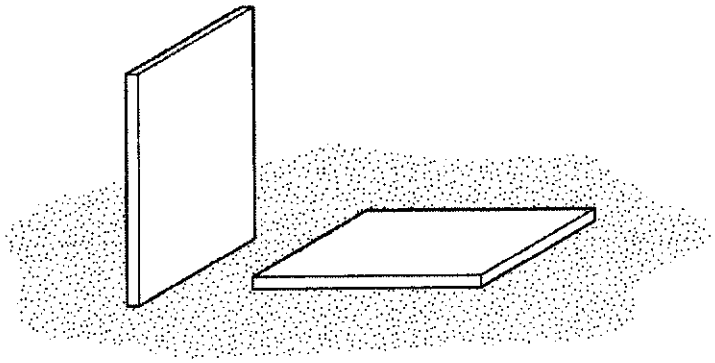


The work done by the force depends on a distance.

What is this distance?

A *p* **B** *q* **C** *r* **D** *p* + *q*

17 A builder leaves two identical, heavy, stone tiles resting on soft earth. One is vertical and other is horizontal.

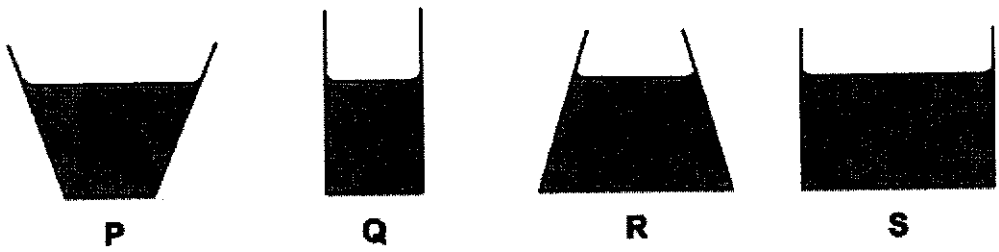


After a few hours, the vertical tile has started to sink into the soft earth, but the horizontal one has not.

Which row correctly compares the forces and the pressures that the tiles exert on the earth?

	forces	pressures
A	different	different
B	different	same
C	same	different
D	same	same

18 The diagrams show, to the same scale, the vertical sections of a set of circular vessels. Each vessel contains the same depth of water.



Which of the following statements is correct?

A The water exerts the greatest pressure on the base of vessel **P**.
B The water exerts the greatest pressure on the base of vessel **S**.
C The water exerts the same force on the base of each vessel.
D The water exerts the same pressure on the base of each vessel.

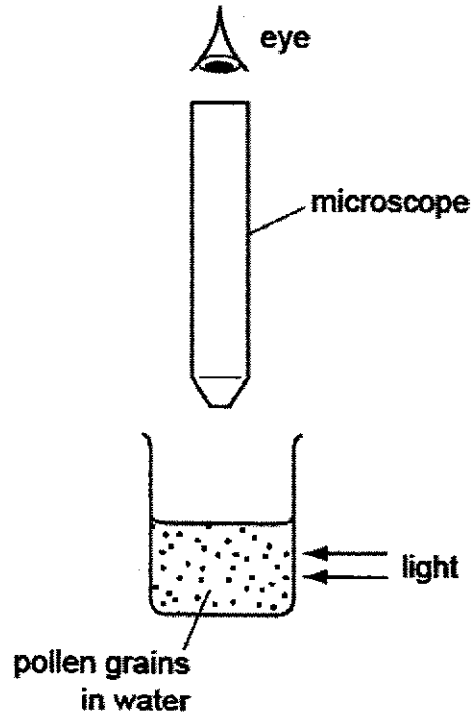
19 A giant squid of length 20.0 m is vertical in seawater, with the top of the squid at a depth of 8.00 m. The density of seawater is 1050 kg m^{-3}.

What is the difference in pressure between the top and the bottom of the squid?

A 82 000 Pa
B 206 000 Pa
C 288 000 Pa
D 389 000 Pa

20 Very small pollen grains are suspended in water. A bright light shines from the side.

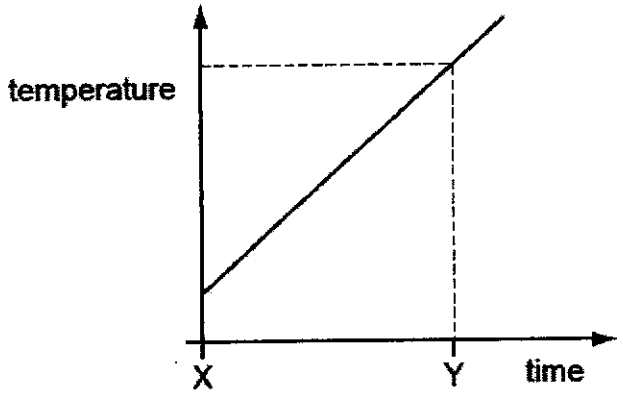
Looking through a microscope, small specks of light are seen to be moving in a random, jerky manner.



What are the moving specks of light?

A pollen grains being hit by other pollen grains
B pollen grains being hit by water molecules
C water molecules being hit by other water molecules
D water molecules being hit by pollen grains

21 A gas storage tank has a fixed volume. The graph shows how the temperature of the gas in the tank varies with time.



At time Y, the gas molecules are

A closer together than at time X.
B hitting the sides of the tank harder than at time X.
C larger in size than at time X.
D moving more slowly than at time X.

22 At a constant temperature, a solid has a fixed shape and a fixed volume.

Which row describes the shape and the volume of a liquid at constant temperature?

	shape	volume
A	fixed	fixed
B	fixed	no fixed
C	not fixed	fixed
D	not fixed	not fixed

23 Which statement about copper explains why it is a better conductor of heat than glass?

A Atomic vibration is passed on to neighbouring copper atoms quickly.
B Atoms move through the copper and pass on kinetic energy.
C There are density changes within the copper.
D There are free electrons in the copper.

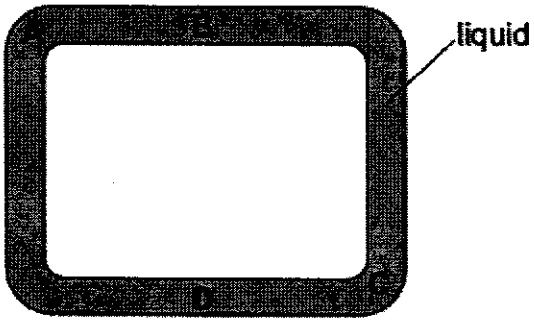
24 After a sheep has its wool cut off, it is harder for it to stay warm when the air temperature falls.

How does the wool help the sheep to stay warm?

A Air can circulate between the wool fibres and heat up the skin by convection.
B Air trapped by the wool fibres reduces heat losses from the skin by convection.
C The wool fibres are curly so it takes longer for heat to be conducted away from the skin.
D The wool fibres conduct heat to the skin from the air outside.

25 A heating element is positioned in a narrow sealed tube of liquid.

What would be the best place to position the heating element in order to obtain the best circulation of the liquid through the tube?



26 The length of mercury in the bore of a thermometer is 5.0 cm at 0 °C and 11.0 cm at 60 °C.

What is the length in the bore when the temperature is –10 °C?

A 1.0 cm **B** 4.0 cm **C** 6.0 cm **D** 10.0 cm

27 In an experiment, a thermometer is placed in a test-tube of hot liquid. The temperature of the liquid is recorded every half minute. The table shows the results.

time / minutes	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
temperature / °C	73	65	59	55	55	55	51	48	45	42	40	38	36	35	34	33

What is the melting point of the substance?

A 73 °C **B** 55 °C **C** 33 °C **D** 0 °C

28 Ice is taken from a freezer and left in a room. The ice melts and eventually the water reaches room temperature.

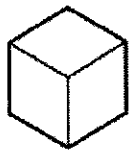
Which energy transfers take place?

	energy transfer **during** melting	energy transfer **after** melting
A	from ice to room	from water to room
B	from ice to room	from room to water
C	from room to ice	from room to water
D	from room to ice	from water to room

29 Four blocks, made from different materials, are each heated so that they have the same increase in internal energy.

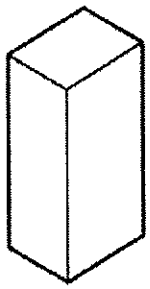
Which block has the smallest thermal capacity?

A



emperature rise = 3 °C

B

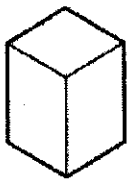


temperature rise = 6 °C

C

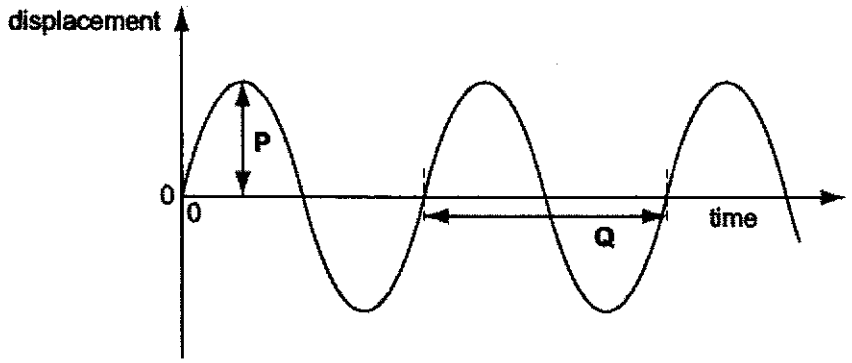
temperature rise = 9 °C

D



temperature rise = 12 °C

30 The diagram shows a graph of wave motion.



Which quantities are shown by distances **P** and **Q**?

	P	Q
A	amplitude	period
B	amplitude	wavelength
C	half the amplitude	period
D	half the amplitude	wavelength

End of Paper

KENT RIDGE SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2019

PHYSICS **6091/Part II**

Part II Theory

SECONDARY 3 EXPRESS

Thursday 3 October 2019 **2 hours**

Name: ________________________( ) **Class: Sec** _______

READ THESE INSTRUCTIONS FIRST

Do not open this question paper until you are told to do so.

Write your name, class and index number in the spaces provided at the top of this page.
Write in dark blue or black ink.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 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.

FOR EXAMINER'S USE	
Part I	/ 30
Part II Section A [50 marks]	/ 50
Part II Section B [20 marks]	/ 20
TOTAL	/ 100

You are advised to spend no longer than 40 minutes on Part I.
You may proceed to answer Part II as soon as you have completed Part I.

At the end of the examination hand in your answers to Part I and Part II separately.
The number of marks is given in brackets [ ] at the end of each question or part of question.

This question paper consists of 20 printed pages, including this page.

Setter: Ms Sally Chow **[Turn Over**

Section A

Answer **all** questions in this section.

1 **(a)** A pipe drips water into an empty glass jar as shown in Fig. 1.1. A student plans to take measurements to find out how fast the water is rising up the jar. [3]

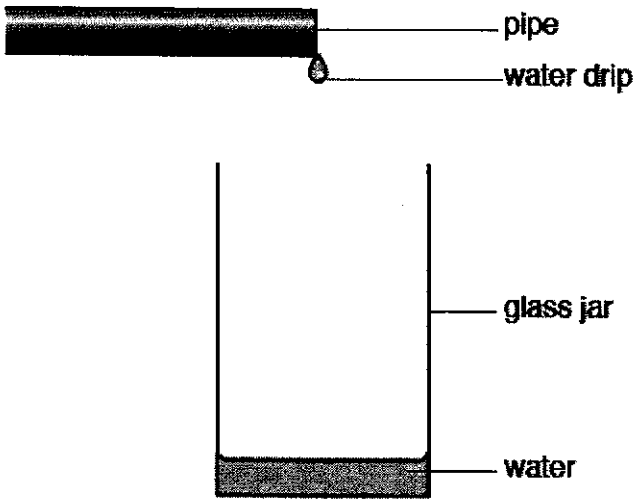


Fig. 1.1.

Describe what measurements are taken and how they are used to determine the average rate at which the water rises up the jar.

.....

.....

.....

.....

.....

.....

.....

.....

(b) The student records her observations in a table. She then plots a graph using the axes shown in Fig. 1.2.

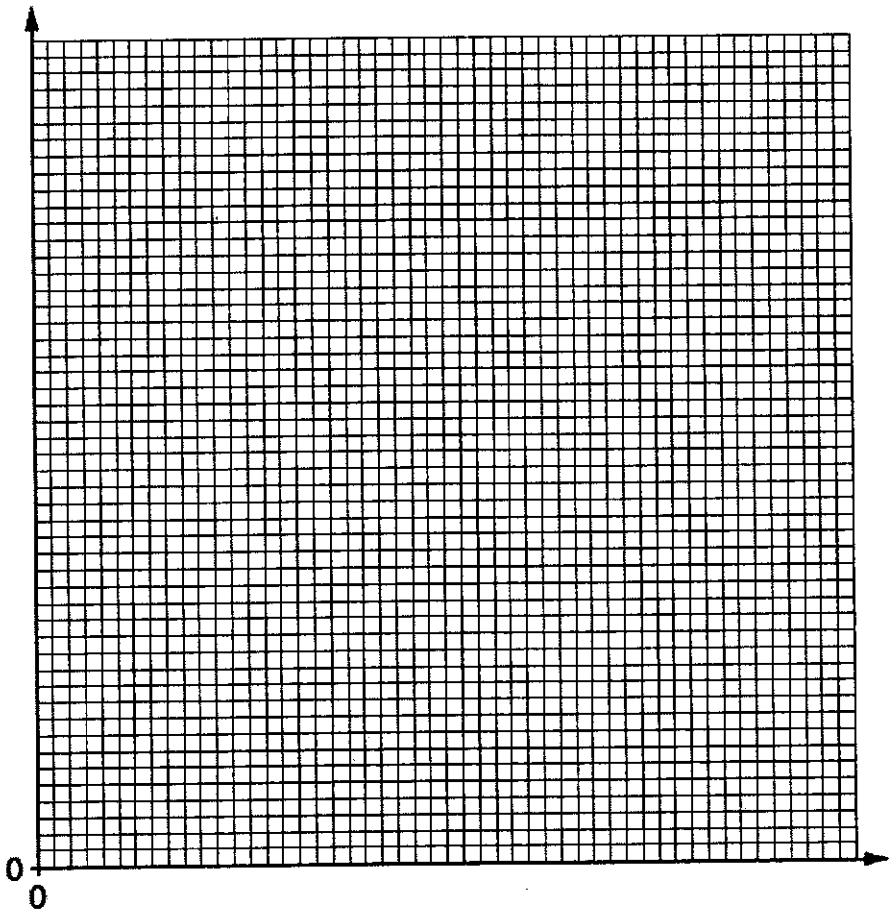


Fig. 1.2

(i) On Fig. 1.2, label both axes with a suitable physical quantity and unit. [1]

(ii) The water rises up the jar at a constant rate. [1]
Sketch the graph on Fig. 1.2 obtained by the student. Start the graph from when the jar is empty.

2 A car of 800 kg moves in a straight line along a horizontal road. The variation with time t of the velocity v of the car for part of its journey is shown in Fig. 2.1.

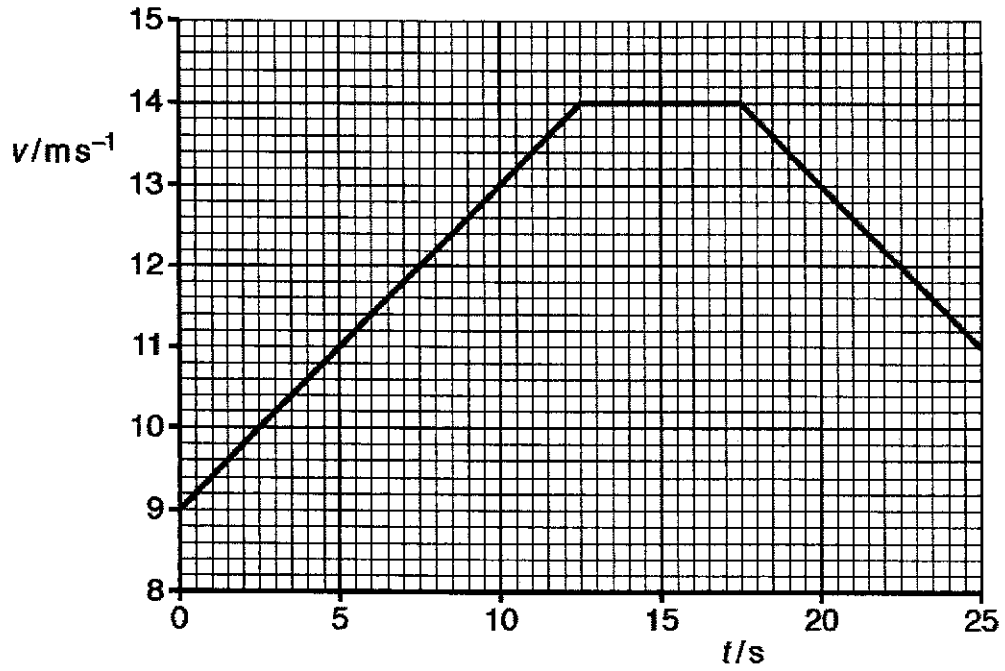


Fig. 2.1

(a) Describe the motion of the car from time $t = 0$ to $t = 25$s. [3]

.....

.....

.....

.....

.....

.....

.....

.....

(b) During part of the journey, Newton's first law describes the motion of the car. Explain using ideas about forces, what happens during this part of the journey. [2]

.....

.....

.....

.....

.....

(c) **(i)** Calculate the distance travelled by the car from time $t = 0$ to $t = 10$s. [2]

distance = ...

(ii) Hence determine the average speed of the car in the first 10 s. [1]

speed = ...

3 A ring supported by two strings that hang from a rod is shown in Fig. 3.1. The ring hangs at rest.

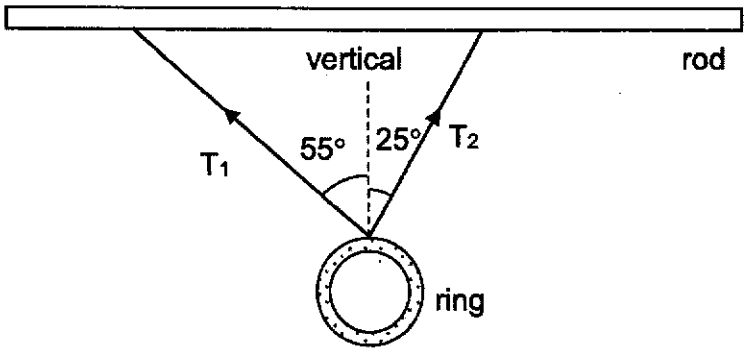


Fig. 3.1

The ring has a weight of 5.0 N.

(a) State the size of the final upward resultant force exerted by the combined tensions of T_1 and T_2. [1]

force = ...

(b) In the space below, use a labelled vector diagram to determine the size of the two tensions T_1 and T_2, in the strings. [3]

T_1 = ...

T_2 = ...

4 A cylindrical disc of mass 200 g has a circular cross-sectional area *A*, as shown in Fig. 4.1.

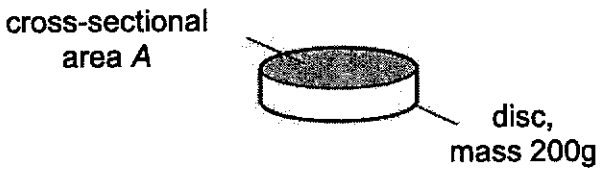


Fig. 4.1

The disc is on horizontal ground, as shown in Fig. 4.2. A force of magnitude 8.5 N acts on the disc horizontally. The disc moves at a constant speed of 0.40 m s^{-1} along the ground. Take the gravitational field strength as 10 N / kg.

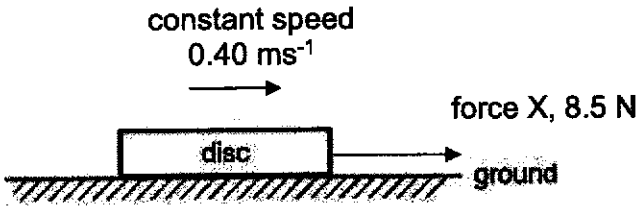


Fig. 4.2

(a) The weight of the disc exerts a pressure on the ground of 2700 Pa. [2]

Calculate the cross-sectional area *A* of the disc.

cross-sectional area *A* = ...

(b) Calculate the rate of doing work on the disc by the force X. [2]

rate of doing work = ...

(c) Newton's third law describes how forces exist in pairs. One such pair of forces is the weight of the disc and another force Y. State:

(i) the direction of force Y [1]

.....

(ii) the name of the body on which force Y acts. [1]

.....

5 Fig. 5.1 shows some gas trapped in a metal cylinder by a piston.

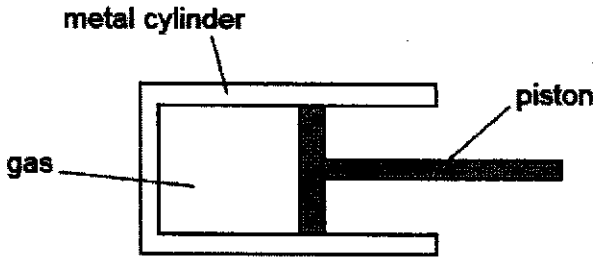


Fig. 5.1

(a) The position of the piston is fixed. The cylinder is moved from a cold room to a warm room. [2]

Explain, in terms of molecules, what happens to the pressure of the gas in the cylinder.

.....

.....

.....

.....

.....

(b) The piston is now released. It moves to the right and finally stops. Explain why. [2]

.....

.....

.....

.....

.....

6 All thermometers use the value of a physical property to measure temperature.

(a) **(i)** State what makes a physical property suitable for the measurement of temperature. [1]

.....

(ii) State one property that is used for the measurement of temperature. [1]

.....

(b) When a liquid-in-glass thermometer is calibrated, two fixed points are used.

(i) Describe how to check that the lower fixed point is marked correctly on the liquid-in-glass thermometer. [2]

.....

.....

.....

.....

.....

(ii) Explain how the fixed points are used when calibrating a thermometer. [2]

.....

.....

.....

.....

.....

.....

.....

7 Fig. 7.1 shows three simple mercury barometers.

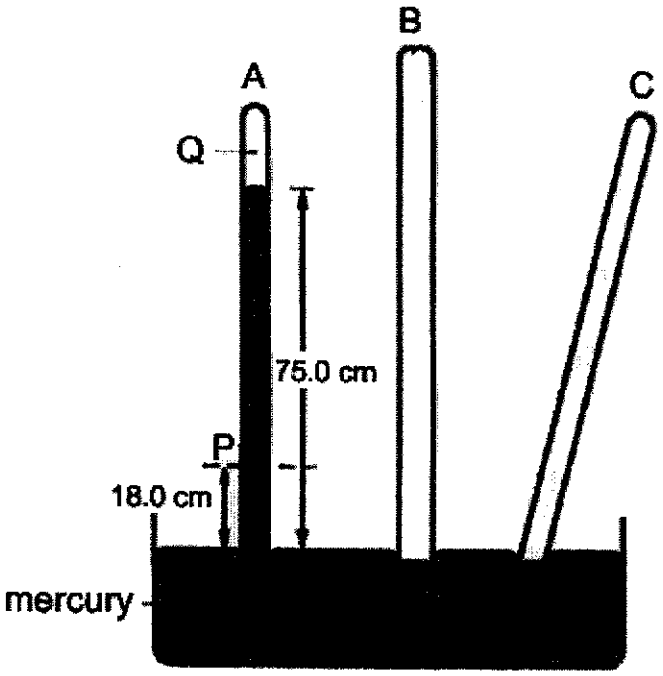


Fig. 7.1

(a) Determine, in cm mercury, [2]

(i) the atmospheric pressure, and

pressure = ... cm Hg

(ii) the pressure at point P.

pressure = ... cm Hg

(b) The barometer tube B is longer and wider. [2]

Barometer tube C is identical to A but is slightly tilted.

By drawing in Fig 7.1, show clearly the mercury levels in **both** tubes B and C in comparison with the mercury level in tube A.

8 A student compares the efficiency of two electric water heaters in the kitchen. Each heater consists of a tank to contain the water and an electrical heating element to heat the water.

The two tanks are different, but each tank contains the same amount of water and is heated by the same type of electrical heating element.

Fig. 8.1 shows part of the tank from the heater that is less efficient, and Fig. 8.2 shows the heater that is more efficient.

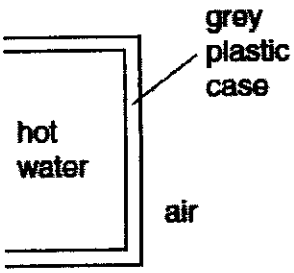


Fig. 8.1

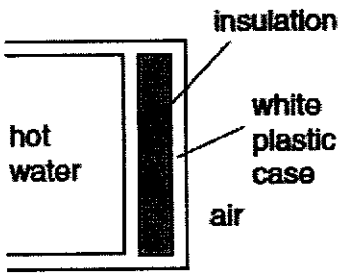


Fig. 8.2

(a) **(i)** Explain how the more efficient heater in Fig. 8.2 reduces energy lost by conduction, convection and radiation. [3]

.....

.....

.....

.....

.....

.....

.....

(ii) State one advantage of using an efficient water heater in a kitchen. [1]

.....

.....

.....

(b) When one heater is switched on, 20 kg of cold water at 20 °C is heated to 58 °C in 15 minutes. The specific heat capacity of water is 4200 J / (kg °C). Calculate the increase in energy of the water in 15 minutes. [3]

energy = ...

9 Fig. 9.1 shows the wavefronts of a water wave in shallow water in a ripple tank.

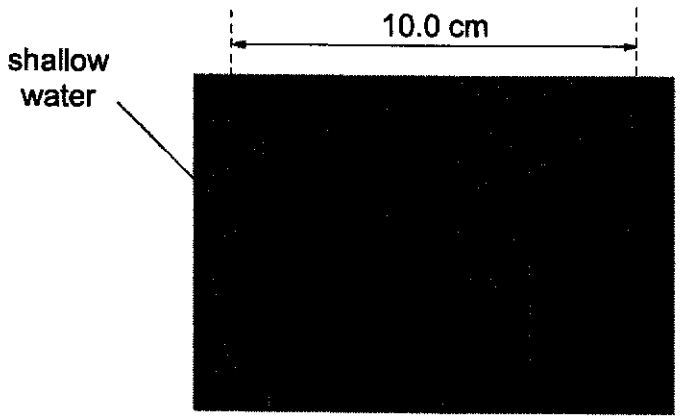


Fig. 9.1

The frequency of the water in shallow water is 3.0 Hz.

(a) State what is meant by a wavefront. [1]

.....

.....

(b) **(i)** Determine the wavelength of the water in shallow water. [1]

wavelength = ...

(ii) Calculate the speed of the wave in shallow water. [2]

speed = ...

(c) Water wave is a transverse wave. The direction of vibration is perpendicular to the direction of transfer of the energy. [2]

Complete the table of Fig. 9.2 to show the direction of vibration and the type of wave associated with sound wave and light wave.

wave	direction of vibration	type of wave
water	perpendicular to the direction of transfer of energy	transverse
sound		
light		

Fig. 9.2

Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 11.**

10 A bungee jumper falls from a bridge above a river as shown in Fig. 10.1.

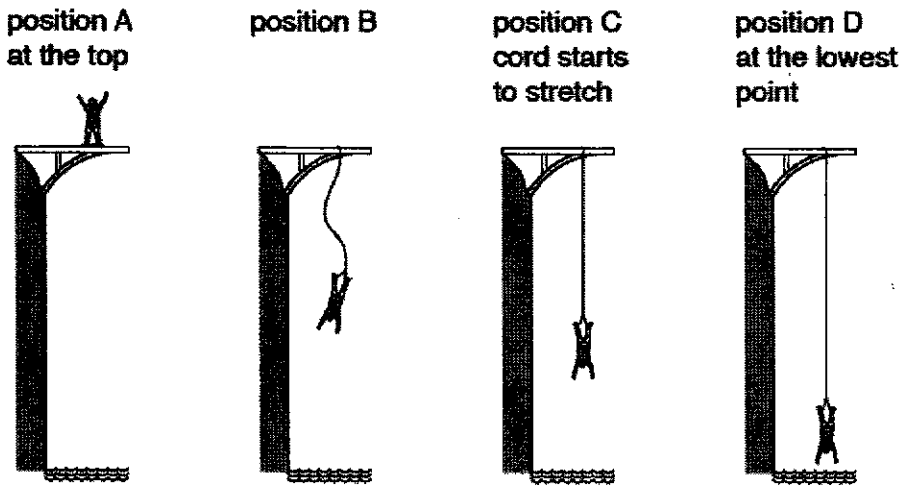


Fig. 10.1 (not to scale)

The man starts from position A in Fig. 10.1. The elastic cord starts to stretch at position C and he stops for the first time at position D. He continues to rise and fall.

Fig. 10.2 shows how the velocity of the man varies with time *t*.

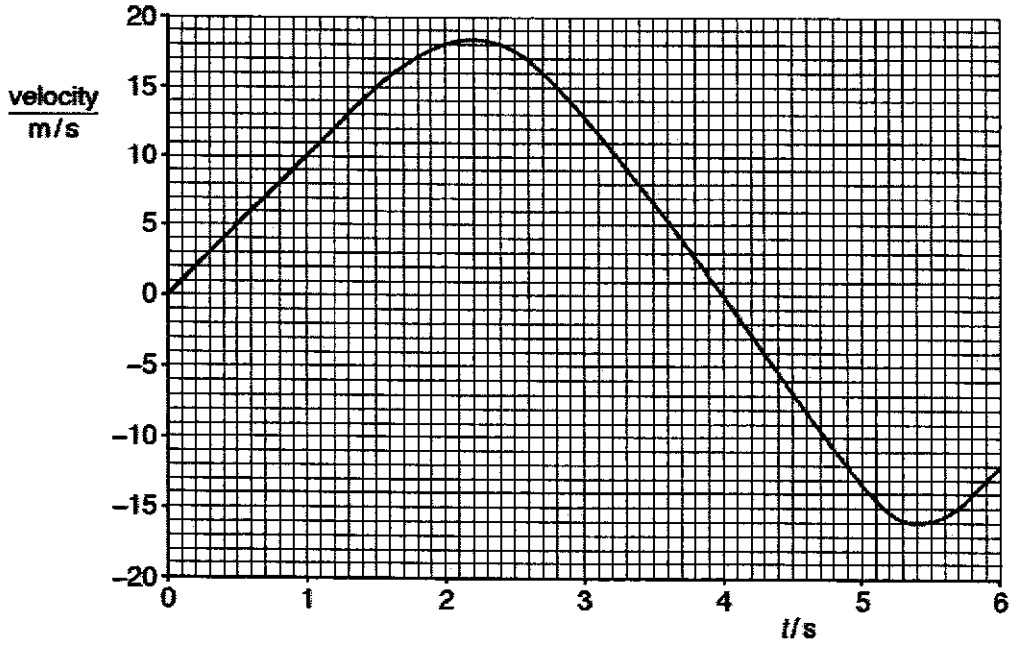


Fig. 10.2

(a) Velocity is a vector quantity. Is speed a vector quantity? Explain your answer. [1]

.....

.....

(b) **(i)** State how acceleration is found from a velocity-time graph. [1]

.....

.....

(ii) In the first 1.4 s, the acceleration is uniform. Using values from Fig. 10.2, determine the acceleration of the man in the first 1.4 s. [2]

acceleration = ...

(c) From Fig. 10.2, state the value of t when the man is in position D. [1]

.....

(d) Fig. 10.3 shows the values for the gravitational potential energy of the man, the kinetic energy of the man and the elastic potential energy in the cord at A, C and D.

You may ignore the effect of air resistance in this question.

	gravitational potential energy / J	kinetic energy / J	elastic potential energy / J
position A	20 000	0	0
position C	15 000		0
position D	0	0	

Fig. 10.3

(i) Complete Fig. 10.3 to show the kinetic energy of the man at C and the elastic potential energy in the cord at D. [2]

(ii) In reality, explain why your answer to **(d)(i)** is only an estimate. [1]

.....

.....

(iii) The man has a mass of 50 kg. [2]

The gravitational field strength g is 10 N / kg.

Using values from Fig. 10.3, calculate the vertical distance between C and D.

distance = ...

11 EITHER

A bucket of water is pulled out of a well using a rope. Fig. 11.1 shows the rope winding on to a cylinder as the handle is turned.

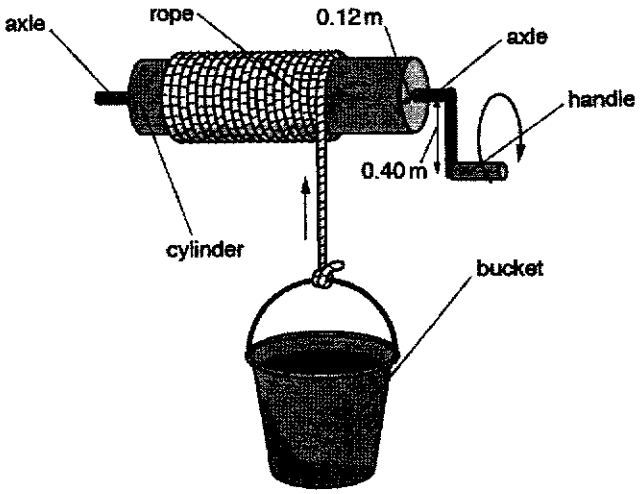


Fig. 11.1

The empty bucket has a mass of 1500 g.

(a) When the bucket is full, it contains 2.3×10^{-2} m^3 of water.

The gravitational field strength g is equal to 10 N / kg.

(i) State what is meant by *gravitational field strength.* [1]

.....

.....

(ii) The density of water is 1000 kg / m^3. [3]

Determine the total weight of the bucket and the water.

weight = ...

(b) The radius of the cylinder is 0.12 m and the handle is 0.40 m from the axle of the cylinder. The weight of the bucket and the water produce a moment that acts on the cylinder.

(i) Calculate this moment. [2]

moment = ...

(ii) Calculate the minimum force on the handle that balances this moment. [1]

force = ...

(c) The rope system is replaced by a motor. The motor is used to lift a combined weight of 20 N of bucket and water through 5.0 m.

The total amount of electrical energy used by the motor is 180 J.

(i) Calculate the work done by the motor. [2]

work done = ...

(ii) Calculate the efficiency of the motor. [1]

efficiency = ...

11 OR

A beaker is filled with water and placed on a hot-plate to boil, as shown in Fig. 11.2. The hot-plate is on top of a balance, which measures the mass of water in the beaker.

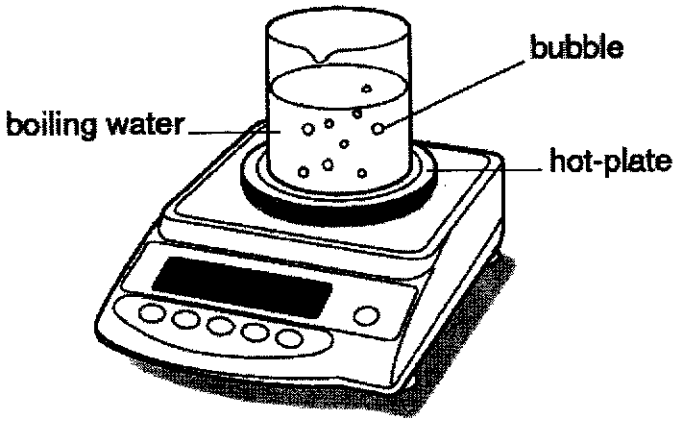


Fig. 11.2

The liquid boils for a long time. There are bubbles within the boiling water.

(a) **(i)** State what is meant by *boiling*. [1]

.....

.....

.....

(ii) State what is inside each bubble. [1]

.....

(b) The experiment starts after the water is boiling steadily. The mass of the water is measured at the start of the experiment and at the end of the experiment.

Data relevant to the experiment is given in the box.

Change in mass of water in the beaker: 20 g Power rating of hot-plate: 0.450 kW Duration of the experiment: 2.0 minutes Energy lost from the hot-plate and beaker to the atmosphere: 8000 J

(i) Calculate the energy supplied by the hot-plate [2]

energy = ...

(ii) Calculate the efficiency of the hot-plate. [1]

efficiency = ...

(iii) Calculate the specific latent heat of vaporisation of water. [2]

specific latent heat = ...

(c) (i) The beaker of water is taken off the hot-plate. The boiling stops but evaporation still continues and the water cools. [2]

Explain, using ideas about molecules, how evaporation causes cooling.

.....

.....

.....

.....

.....

.....

(ii) Suggest and explain how the rate of evaporation can be reduced. [1]

.....

.....

.....

End of Paper

Mark Scheme

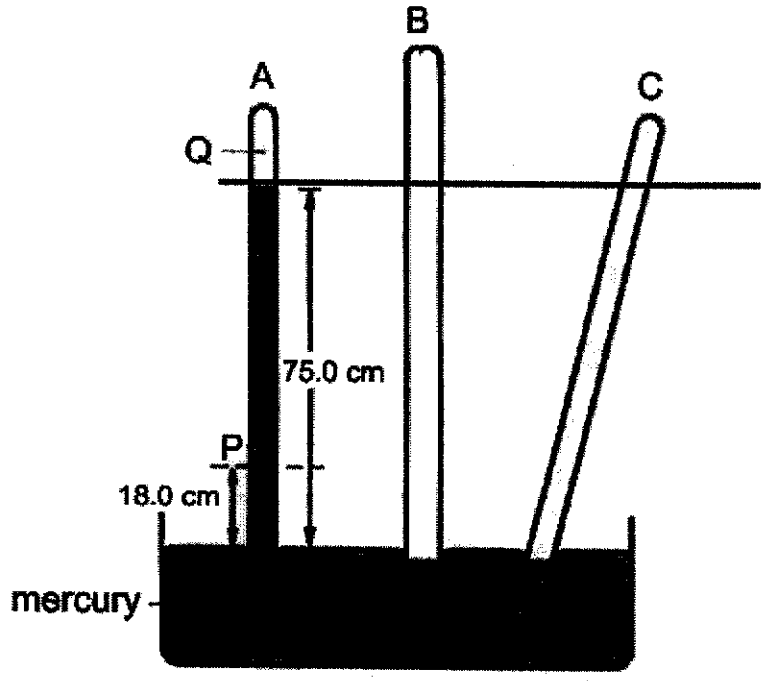
Part I (30 marks)

1	C	**11**	C	**21**	B
2	C	**12**	B	**22**	C
3	C	**13**	A	**23**	D
4	D	**14**	D	**24**	B
5	B	**15**	C	**25**	C
6	D	**16**	C	**26**	B
7	D	**17**	C	**27**	B
8	C	**18**	D	**28**	C
9	A	**19**	B	**29**	D
10	B	**20**	B	**30**	A

Part II
Section A (50 marks)

Qn		Answers		Marks
1	(a)	**Apparatus:** ruler **and** stopwatch **Method / Measurements:** Place the ruler in the empty jar with the zero marking (of ruler) aligned with the base of the jar. Let the pipe drip water into the jar and start the stopwatch. Record the depth of the water every minute for 10 minutes. **Results:** To determine the average rate at which the water rises, use the formula Average rate = total depth / total time		B1 B1 B1
	(b)	(i)	Vertical axis: depth of water / cm Horizontal axis: time / minutes *solidus notation only* [*Allow ecf e.g. volume / cm^3*]	B1
		(ii)	Upward sloping straight line passing through the origin.	B1
2	(a)	From t = 0 to t = 12.5 s, the velocity of the car increases from 9 m / s to 14 m / s at a **constant rate**. From t = 12.5 s to t = 17.5 s, the velocity of the car remains constant at 14 m /s. From t = 17.5 s to t = 25 s, the velocity of the car decreases from 14 m / s to 11 m / s at a **constant rate**. [*Must state time interval and velocity values of the car*]		B1 B1 B1 *Apply unit penalty if units are wrong*

	(b)	The velocity of the car remains constant. The **resultant force** acting on the car is **zero.** Since **F = ma**, the **car does not accelerate / moves with constant velocity.**		B1 B1
	(c)	(i)	Distance travelled = area under velocity-time graph = 0.5 x (9+13) x 10 = 110 m	C1 M1 A1
		(ii)	Average speed of the car = **total** distance / **total** time = 110 / 10 = 11 m / s	allow ecf A1
				8
3	(a)	Force = 5.0 N (c.a.o)		A1
	(b)	Appropriate Scale e.g. 1 cm represent 0.5 N Correct diagram T_1 = 2.2 N ± 0.2 N T_2 = 3.9 N ± 0.4 N		B1 B1 A1
				4
4	(a)	W = mg = 200 / 1000 * 10 = 2.0 N Pressure = force / area 2700 = 2.0 / area Area = 0.00074 m^2		C1 M1 Or C1 Or M1 A1
	(b)	Rate of doing work / power = work done / time = 8.5 x 0.40 = 3.4 W		C1 M1 A1
	(c)	(i)	upwards	B1
		(ii)	the Earth *[Reject: ground]*	B1
				8
5	(a)	Pressure increases As the temperature increases, the molecules (of gas) **move faster** / their **kinetic energy increases** The molecules **collide with the walls more frequently** and with **greater force.** The molecules exert a greater force on the walls. Since pressure = force / area, **pressure increases.**		C1 B1 B1
	(b)	Volume of gas increases **and** pressure of gas falls Initially there is larger pressure inside the piston than the atmospheric pressure / pressure outside the cylinder OR Piston stops when the pressure of the gas is equal to the atmospheric pressure / pressure outside the cylinder		B1 B1
				4

6	(a)	(i)	It varies uniformly / linearly (and continuously) with temperature.	B1
		(ii)	Resistance (of wire) / Volume (of liquid) / electromotive force Accept other suitable answers.	B1
	(b)	(i)	Insert the **bulb** of the thermometer into **pure ice shavings.** Ensuring that the bulb is covered by the shavings. Allow the liquid column to **stabalise**. When it stops changing in length, read the thermometer reading. **If it is marked correctly, the reading should be at 0 °C.** *[Allow ice at 0 °C, Reject ice cubes]*	B1 B1
		(ii)	Select two suitable fixed points: **ice point (0 °C)** and **steam point (100 °C)** **Divide** the **physical property** e.g. length, between the fixed points into a suitable number of **equal parts** e.g. 100 to obtain the scale.	B1 B1
				6
7	(a)	(i)	75.0 cmHg	B1
		(ii)	75.0 – 18.0 = 57.0 cmHg	B1
	(b)		 Both vertical heights in tubes B and C are the same (75.0 cm)	B1 B1
				4
8	(a)	(i)	The more efficient heater reduces heat loss through conduction as the **insulation is a poor conductor of heat.** The **air outside the surface of the heater was cooler** and so **less convection of the air** takes place. The **white surface** is a **poor emitter of radiation.** *[Reject: Radiation was reflected backwards from the hot water by the white surface.]*	B1 B1 B1

		(ii)	A more effective water heater in a kitchen allows the same amount of **water to be heated in a shorter time** *[Reject saves time.]*	B1
	(b)		Q = mc(change in temperature) Q = 20 x 4200 x (58 – 20) = 319 0000 J	C1 M1 M1 (change in temperature) A1
				4
9	(a)		A wavefront is an imaginery line that joins all points in phase.	B1
	(b)	(i)	Wavelength = 10.0 / 4 = 2.5 cm	B1
		(ii)	Speed = wavelength x frequency = 2.5 x 3.0 = 7.5 cm / s	C1 M1 A1
	(c)			

wave	direction of vibration	type of wave
water	perpendicular to the direction of transfer of energy	transverse
sound	**parallel to the direction of transfer of energy**	**longitudinal**
light	**perpendicular to the direction of transfer of energy**	**transverse**

B1

B1

Any 2 correct, 1 mark. Spelling of key words e.g. longitudinal must be correct.

6

Part II
Section B (20 marks)

10	(a)		**Speed is not a vector quantity / is a scalar quantity.** **It has only magnitude and no direction.**	B1
	(b)	(i)	Acceleration is found using the gradient of a velocity-time graph.	B1
		(ii)	Acceleration = change in velocity / time = (14 – 0) / 1.4 = 10 m / s^2 Alternative C1: Value seen for v and corresponding value of t	M1 A1
	(c)		4.0 s (Allow 4 s)	B1

	(d)	(i)	Kinetic energy = 5000 (J) Elastic potential energy = 20 000 (J)	B1 B1
		(ii)	In reality some **work is done to overcome air resistance.** The gain in KE is lower. *[Reject: Energy is converted to other forms of energy such as heat and sound energy.* *Remark: Energy loss must be attributed.]*	B1
		(iii)	GPE = mgh 15000 = 50 x 10 x h h = 30 m	C1 M1 A1
				10
11 E	(a)	(i)	Gravitational field strength is the gravitational force acting per unit mass.	B1
		(ii)	Density = mass / volume 1000 = mass / 2.3×10^{-2} mass = 23 kg Total mass = 23 + (1500 / 1000) = 24.5 kg Weight = mg = 24.5 x 10 = 245 N	C1 M1 Or M1 A1
	(b)	(i)	Moment = force x perpendicular distance = 245 x 0.12 = 29.4 Nm	C1 M1 A1
		(ii)	By principle of moments, for an object in equlibrium, Sum of clockwise moments = sum of anti-clockwise moments 29.4 = F x 0.40 F = 73.5 N	C1 M1 A1
	(c)	(i)	Work done = force x distance moved in the direction of force = 20 x 5.0 = 100 J	C1 M1 A1
		(ii)	Efficiecy = useful energy / total energy input x 100 = 100 / 180 x 100 = 55.5 %	 A1
				10
11 O	(a)	(i)	Boiling is the process where the energy absorbed by a substance changes it from liquid state to gaseous state without a change in temperature.	B1
		(ii)	Steam Or (water) vapour Or water in gaseous form	B1
	(b)	(i)	E = Pt = 0.450 x 1000 x (2.0 x 60) = 54000 J	C1 M1 A1
		(ii)	Efficiecy = useful energy / total energy input x 100 = (54000 – 8000) / 54000 x 100 = 85.2 %	 A1
		(iii)	Energy supplied to water = 54000 – 8000 = 46000 J Energy = ml_v	M1 C1

			46000 = 20 x l_v l_v = 2300 J / g	Or M1 A1
	(c)	(i)	During evaporation, the fast moving / energetic molecules escape / break bonds / become gas Less energetic molecules or reducing average kinetic energy of remaining molecules.	B1 B1
		(ii)	Reduce the exposed surface area.	B1
				10