NEW TOWN SECONDARY SCHOOL
Final Examination
Secondary 3 Express

NAME

CLASS

INDEX NUMBER

Science (Physics)
Paper 1

5076/01
6 October 2021
0800 - 0900
1 hour

Additional Materials: OTAS Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and index number on the OTAS Sheet in the spaces provided.

There are **twenty** 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 OTAS Sheet.

Read the instructions on the OTAS 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.
The use of an approved scientific calculator is expected, where appropriate.

You are advised not to spend more than 30 minutes on this paper.

This document consists of 8 printed pages.

Setter: Ms Wee Shu Ying

Physics Section (20 marks)

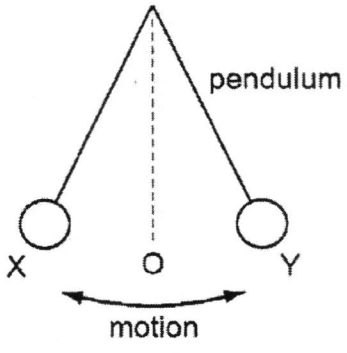
Answer **all** the questions on the OTAS sheet provided.
Shade your answers clearly with a 2B pencil.

1 A car accelerates at 5.0 m/s^2 along a straight, horizontal road and reaches a velocity of 20 m/s in a time of 4.0 s. During this time, its total displacement is 40 m.

Which quantity is a scalar?

A a displacement of 40 m
B a time of 4.0 s
C a velocity of 20 m/s
D an acceleration of 5.0 m/s^2

2 The diagram shows a simple pendulum. It swings between X and Y.



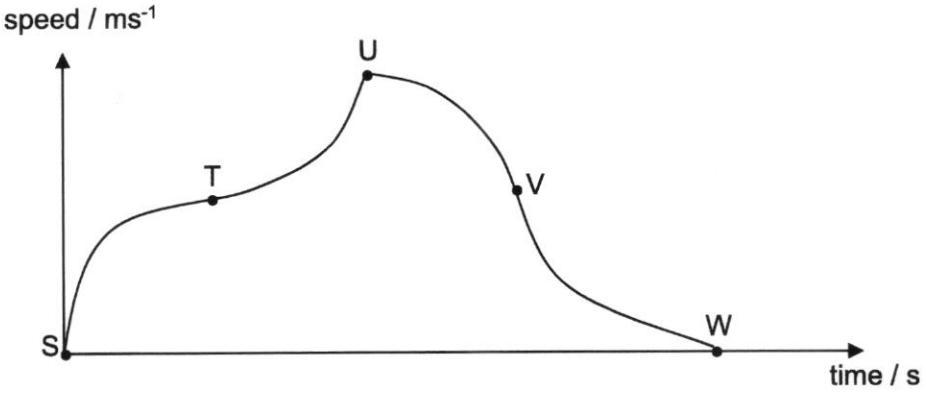
Which sequence should be timed to measure the period of the pendulum?

A X → O
B X → Y
C X → Y → O
D X → Y → X

3 Which statement about a moving object is correct?

A When an object is accelerating, the resultant force acting on it must equal zero.
B When an object is moving, there must be a resultant force acting on it.
C When an object is moving at a steady speed, the air resistance acting on it must equal zero.
D When an object is moving at a steady speed, the resultant force acting on it must equal zero.

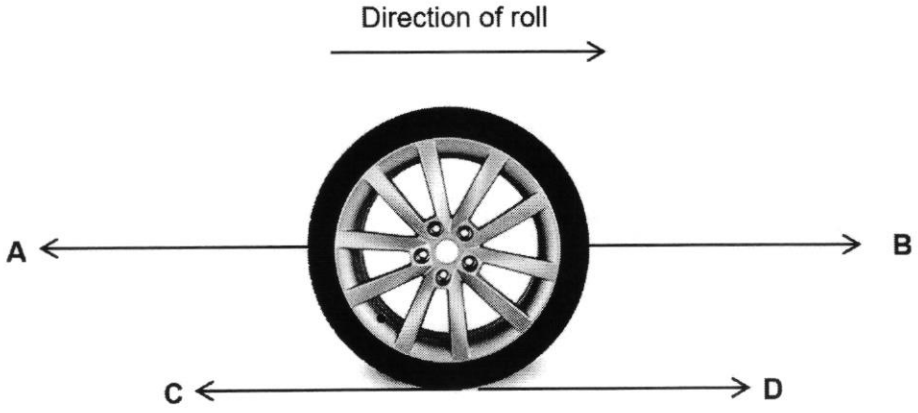
4 The figure shows the speed-time of an object.



Which region shows the object undergoing increasing acceleration?

A ST
B TU
C UV
D VW

5 The figure below shows a tyre being rolled towards the **right** on a rough ground. Which arrow correctly represents the friction acting on the tyre?



6 Under free fall, both a book and a leaf would take the same time to fall through the same height in vacuum.

Which statement best explains the observation?

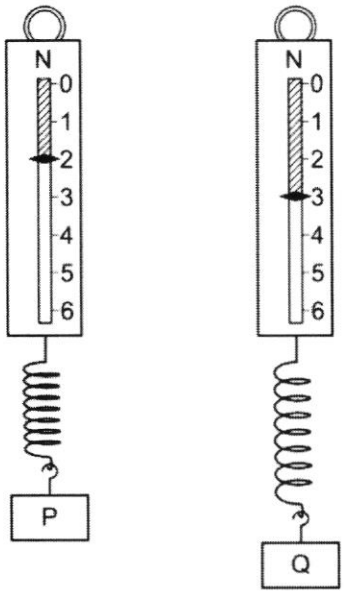
A Both the book and the leaf are of the same mass.
B Both the book and the leaf are of the same volume.
C Both the book and the leaf fall at the same constant acceleration.
D Both the book and the leaf fall at the same constant speed.

7 In which of the following positions will a boy exert the greatest pressure on the ground?

A The boy does a handstand on one of his hands.
B The boy lies flat on his back.
C The boy sits cross-legged on the floor.
D The boy stands on both legs.

8 P and Q have identical length, breadth and height.

They hang on identical spring balances at the same location.



What can be deduced about P and Q?

A Both P and Q have equal densities.
B P and Q have different masses and weights.
C P and Q have different masses but same weights.
D P and Q have same masses but different weights.

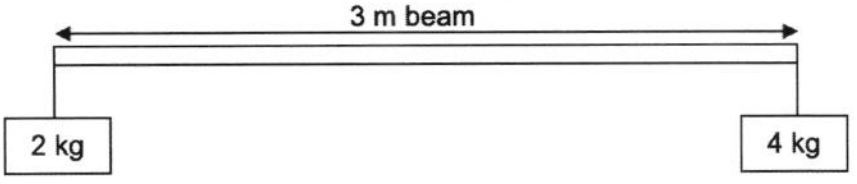
9 An object that has a mass of 15 kg on the Earth is taken to the Moon.
The gravitational field strength on the Earth is 10 N/kg and on Moon is 1.6 N/kg.
What are the mass and the weight of the object on the Moon?

	mass/ kg	weight/ N
A	15	24
B	15	150
C	24	15
D	150	24

10 Which of the following statements **does not** illustrate the effect of inertia?

A If a bus accelerates suddenly from rest, a person sitting in the bus tends to jerk backwards.
B If a pile of coins is placed on a table, the bottom one can be flicked away without disturbing the others.
C It is difficult to stop a shopping trolley full of things when it is moving.
D It is easier to slide a heavy box up an incline to a certain height than to lift it vertically to the same height.

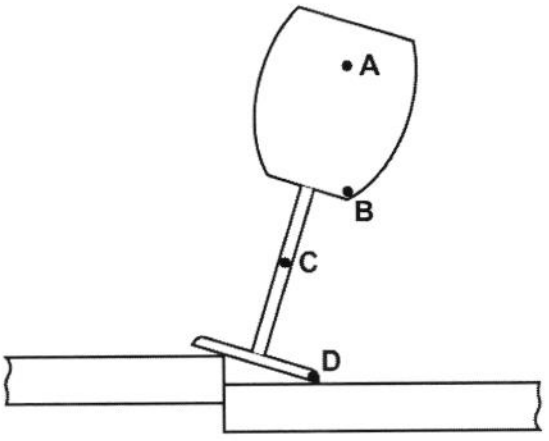
11 A uniform beam of negligible weight is 3 m long. A 2 kg mass and a 4 kg mass are suspended at opposite ends of the beam. The beam is supported by a pivot and is in equilibrium.



Where is the location of the pivot?

A 1 m to the right of the 2 kg mass
B 1.5 m to the right of the 2 kg mass
C 2 m to the right of the 2 kg mass
D 2.5 m to the right of the 2 kg mass

12 An empty glass is placed on a joint between two tables as shown.
The glass remains stable. Which point is the center of gravity of the glass?



13 Student **X** held a sack of rice on top of his head for 30 minutes. Student **Y** held another sack of rice half as heavy as Student **X**'s on top of his head for 1 hour.

Which statement best describes the above situation?

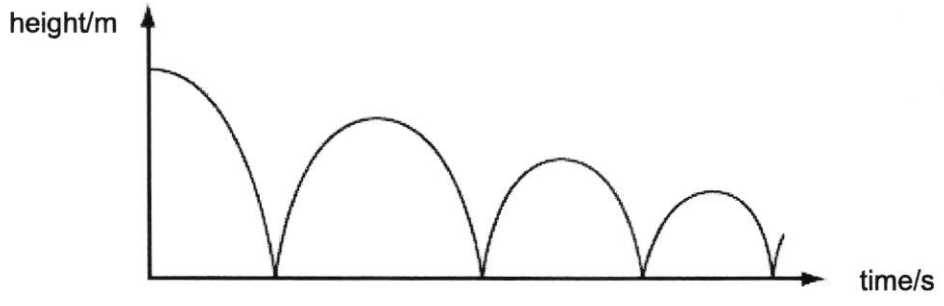
A Both of them did not do any work.
B Student **X** did more work.
C Student **Y** did more work.
D Student **X** did the same amount of work as Student **Y**.

14 Jacob does 10 J of work each time he lifts a weight. In two minutes, the average power is 20 W.

How many times is the weight lifted in two minutes?

A 1
B 4
C 60
D 240

15 The graph shows how the height above the ground of a bouncing ball changes with time.



Which statement explains why the height of each peak decreases with time?

A All the kinetic energy is converted to potential energy at each bounce.
B Some kinetic energy is destroyed after each bounce.
C The ball loses its total energy after each bounce.
D The ball loses some of its energy on impact with the floor.

16 3.0 kg of ice at 0 °C is floating on 6.0 kg of water at 0 °C.

Which of the following statements is correct?

A There is net heat flow from the ice to the water.
B There is net heat flow from the water to the ice.
C There is no net heat flow between ice and water.
D There is no heat flow from the water to the ice.

17 A substance consists of molecules that are close together and moving past each other randomly. The average speed of the molecules is gradually increasing.

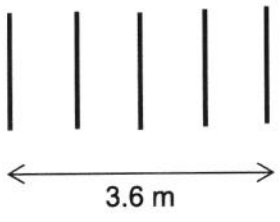
What statement best describes the substance?

A The substance is a liquid and is being heated.
B The substance is a liquid and is boiling.
C The substance is a solid and is being heated.
D The substance is a solid and is melting.

18 A liquid boils and turns into a gas at a fixed temperature.
Which statement is correct?

A The molecules expand.
B The molecules lose energy.
C The molecules move faster.
D The molecules move further apart.

19 A wave moving at 2 m/s covers a distance of 3.6 m with 5 wavefronts.



What is the wavelength of the wave?

A 0.36 m **B** 0.72 m **C** 0.9 m **D** 1.8 m

20 X-rays are one type of electromagnetic radiation.

Which of the following is correct for X-rays?

	type of wave	speed of wave in vacuum /ms^{-1}
A	longitudinal	330
B	longitudinal	3×10^8
C	transverse	330
D	transverse	3×10^8

End of Paper

NEW TOWN SECONDARY SCHOOL
Final Examination
Secondary 3 Express

NAME

CLASS

INDEX NUMBER

Science (Physics)
Paper 2

5076/02
5 October 2021
0800 - 0915
1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name 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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A (45 marks)
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B (20 marks)
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.

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.

Setter: Ms Wee Shu Ying

Section A (45 marks)

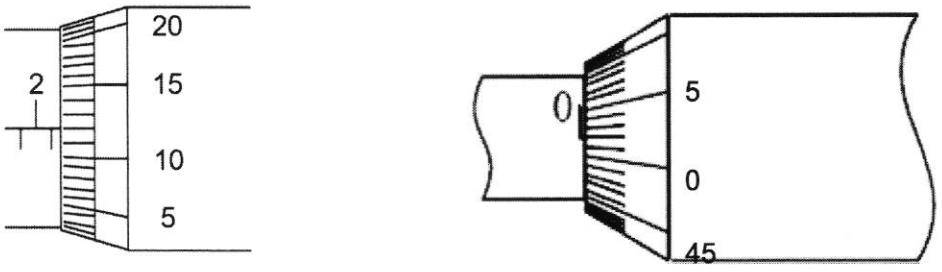
Answer **all** the questions in the spaces provided.

1 Complete the table. Write the missing prefixes, symbols and values.

prefix	symbol	value
kilo	k	10^3
milli		
		10^6
	μ	

[3]

2 A micrometer screw gauge was used to measure the diameter of a pencil. The readings obtained are shown in Fig 2.1.



Observed reading Zero error

Fig 2.1

Use Fig 2.1 to complete Table 2.1

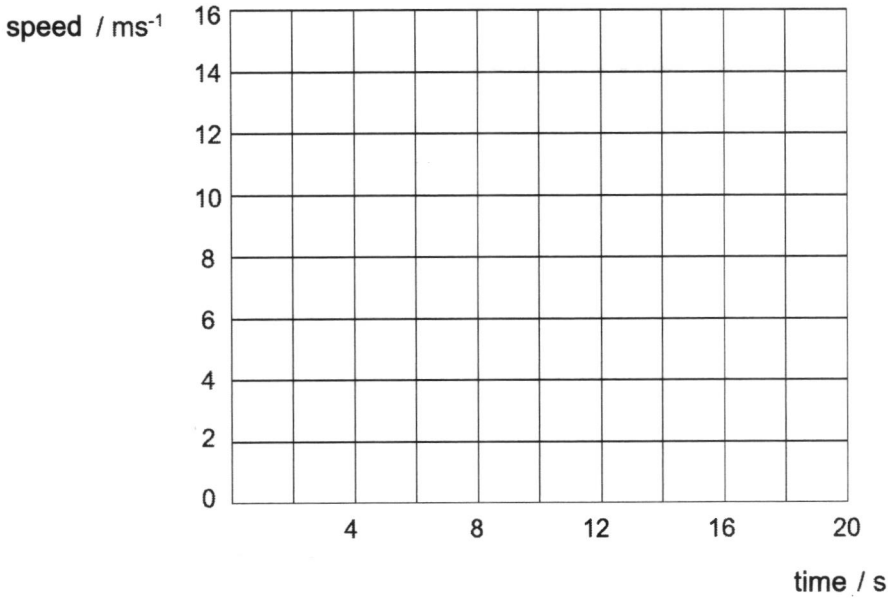
Observed reading	mm
Zero error	mm
Actual diameter (after correcting zero error)	mm

[3]

Table 2.1

3 A lorry moves off from a traffic light on a straight level road.
It has a uniform acceleration of 2.0 m/s^2 for 5 seconds, followed by a constant speed for next 5 seconds.
A constant braking force is then applied to bring it to rest in a further 8 seconds.

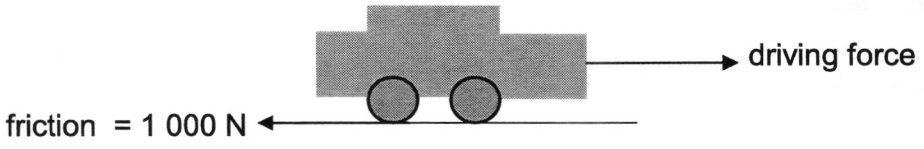
Draw a speed-time graph for the motion of the lorry on Fig 3.1.



[3]

Fig 3.1

4 A car of mass 1 500 kg accelerates from rest to 20 m/s in 5.0 s.
A frictional force of 1 000 N acts on the car.



(a) Calculate the resultant force that acts on the car.

resultant force = ... N [2]

(b) Hence, calculate the driving force that acts on the car.

driving force = ... N [1]

(c) If the car is moving at a constant speed of 20 m/s, what can you conclude about the magnitude of the driving force and the frictional force?

.....

..... [1]

5 Fig. 5.1 shows the forces exerted on a tree by two tractors in an attempt to pull it out of the ground.

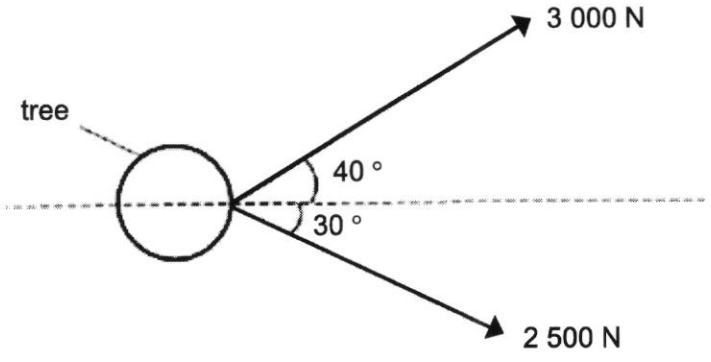


Fig. 5.1

In the space below, draw a scale diagram to determine the magnitude of the resultant force exerted on the tree by the two tractors. State the scale used.

Scale: 1 cm represents ..... N

resultant force = ... N [4]

6 Fig. 6.1 shows part of a non-uniform tube filled with an incompressible liquid.

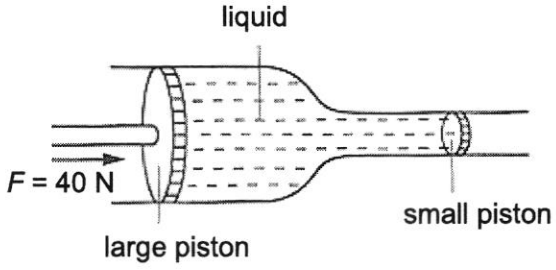


Fig. 6.1

The wider end is fitted with a large piston of cross-sectional area 10 cm^2 and the narrower end is fitted with a small piston of cross-sectional area 2 cm^2.

A force F of 40 N is exerted on the large piston.

(a) Calculate the pressure acting on the large piston.

pressure = ... N/cm^2 [2]

(b) The pressure transmitted within the liquid is the same throughout.
Calculate the force acting on the small piston.

force = ... N [1]

(c) If the large piston is moved through a distance of 3.0 cm, calculate the distance moved by the small piston.

distance = ... m [2]

7 An alloy is made by mixing 480 g of iron and 900 g of cobalt. The volume of the metals remains unchanged after mixing.

Density of iron: 8.0 g/cm^3
Density of cobalt: 9.0 g/cm^3

(a) What is the total volume of iron and cobalt used?

total volume = ...cm^3 [2]

(b) What is the density of the alloy?

density = ...g/cm^3 [2]

8 A girl of weight 550 N is playing on a see-saw with her brother.
Fig 8.1 shows her brother of weight **W** sitting 1.1 m to the right of the balance point.

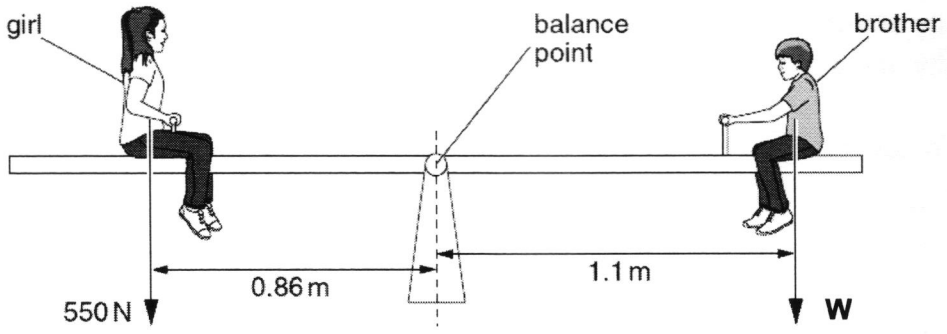


Fig 8.1

The see-saw is balanced when the girl sits 0.86 m to the left of the balance point.

(a) Calculate **W**.

W = ...N [2]

(b) The girl and her brother slide by **equal** distances along the see-saw away from the balance point. The see-saw tilts anti-clockwise.
Explain why this happens.

.....

.....

..... [2]

9 Fig 9.1 shows a crane working on a building site.

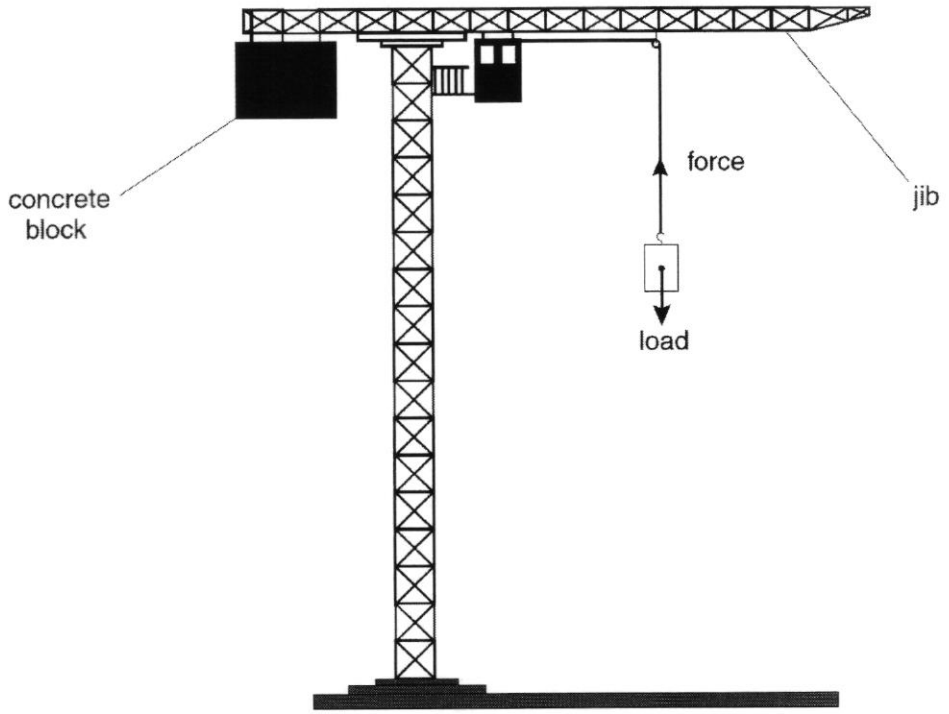


Fig 9.1

The crane uses a motor to lift a load from the ground to a height of 30 m in 90 s.

Given that the load has a mass of 1 500 kg and the gravitational field strength is 10 N/kg, calculate

(a) the weight of the load,

weight = ...N [1]

(b) the gain in gravitational potential energy of the load,

gain in gravitational potential energy = ...J [2]

(c) the minimum power of the crane's motor to lift the load.

power = ...W [2]

10 **(a)** Fig. 10.1 shows water being heated in a metal pot at a campfire. The pot has a silvery and shiny external surface.

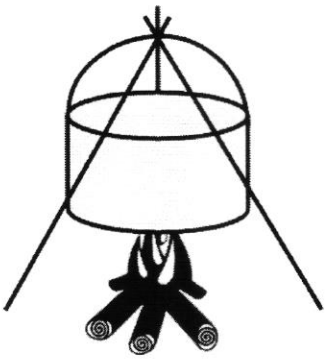


Fig. 10.1

(i) State the main process where thermal energy is transferred from the bottom of the pot to the water inside the pot.

..... [1]

(ii) Describe the process in which thermal energy is being transferred throughout the water in the pot.

.....

.....

.....

..... [2]

(iii) Suggest one modification to the pot so that the water inside the pot can heat up faster.

.....

..... [1]

(b) Explain why the density of a gas is lower than that of a solid.

.....

.....

..... [2]

(c) A nurse places a damp cloth on the forehead of a sick patient. As water evaporates, the patient's forehead is cooled.
Explain, in terms of kinetic theory, how the cooling effect is produced.

.....

.....

..... [2]

11 Fig. 11.1 shows how the temperature of a substance varies with time.

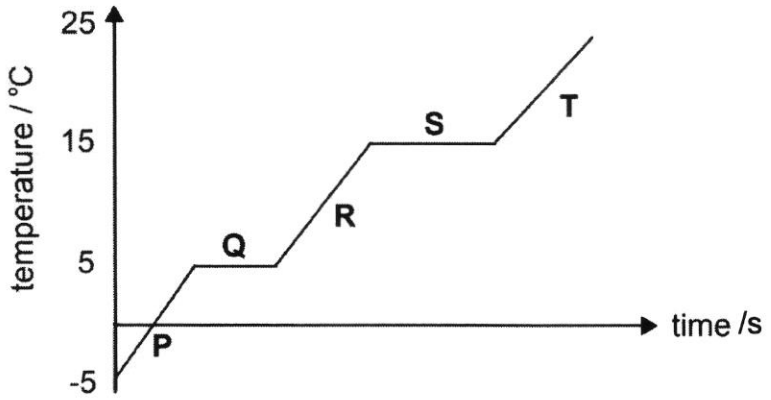


Fig. 11.1

Complete Table 11.2 by writing either **true** or **false** for each of the given statement.

statement	**true / false**
The substance is not gaining energy at **Q** and **S**.	
The average internal energy of the substance is increasing at **T**.	
The average internal kinetic energy of the substance is lower at **P** than at **R**.	
The substance is changing state at **R**.	

[2]

Section B (20 marks)

Answer any **two** questions in this section.
Write your answers in the spaces provided.

12 Fig. 12.1 shows a distance - time graph of a car that starts from rest.
The car moves along a straight line.

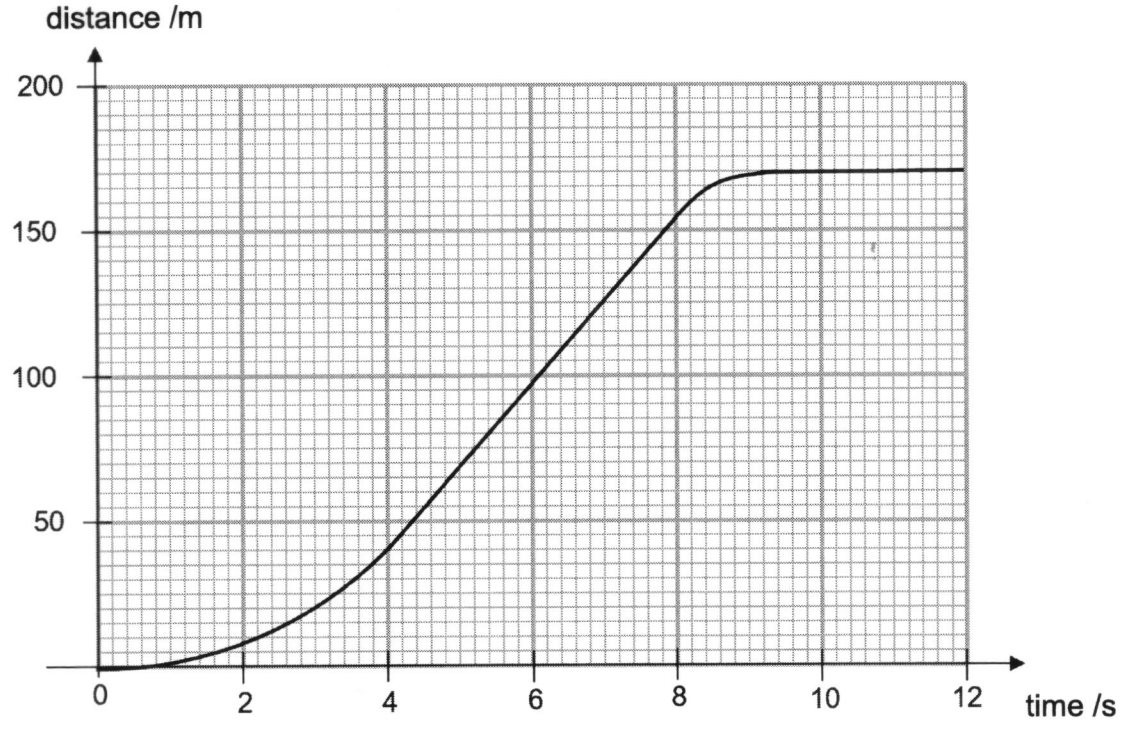


Fig. 12.1

(a) Describe the motion of the car for the time intervals

(i) t = 0 to t = 4 s

.....

..... [1]

(ii) t = 10 s to t = 12 s

.....

..... [1]

(b) Calculate the average speed of the car for the first 10 seconds.

average speed = ... m/s [1]

(c) The engine force of the car is 18 000 N. State and explain the magnitude of the resistive force acting on the car from t = 4 s to t = 8 s.

Resistive force = ...N

Explanation

.....

..... [2]

(d) Calculate the speed of the car when it is at 6 s.

speed = ... m/s [2]

(e) The mass of the car is 1 200 kg. The engine force of the car is reduced to 600 N while the resistive force acting on the car is 800 N.
Calculate

(i) the resultant force acting on the car,

resultant force = ... N [1]

(ii) the acceleration of the car.

acceleration = ... m/s^2 [2]

13 (a) Fig. 13.1 shows two containers of different colours filled with equal masses of the same liquid at a temperature of 75 °C.

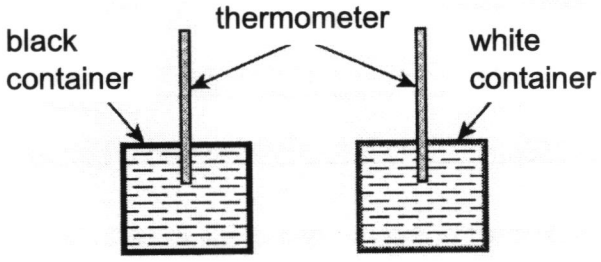


Fig 13.1

The liquid has a freezing point of 55 °C. Both containers are left to cool on a table and the temperature in each container is measured every minute.

(i) Explain why the hot liquid is losing thermal energy to the surroundings.

.....

..... [1]

(ii) State if the black or white container will keep the liquid warmer for a longer period of time. Explain your answer.

.....

.....

..... [2]

(iii) Fig. 13.2 shows the variation with time of the temperature of the substance in the white container.

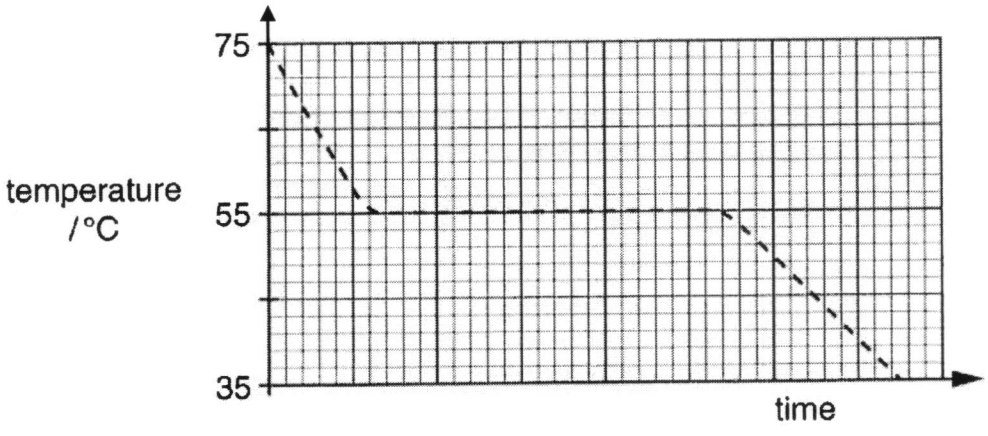


Fig 13.2

On Fig. 13.2, sketch the variation with time of the temperature of the substance in the black container between 75°C and 35°C. [2]

(b) A solid substance is heated. Fig.13.3 shows the heating curve.

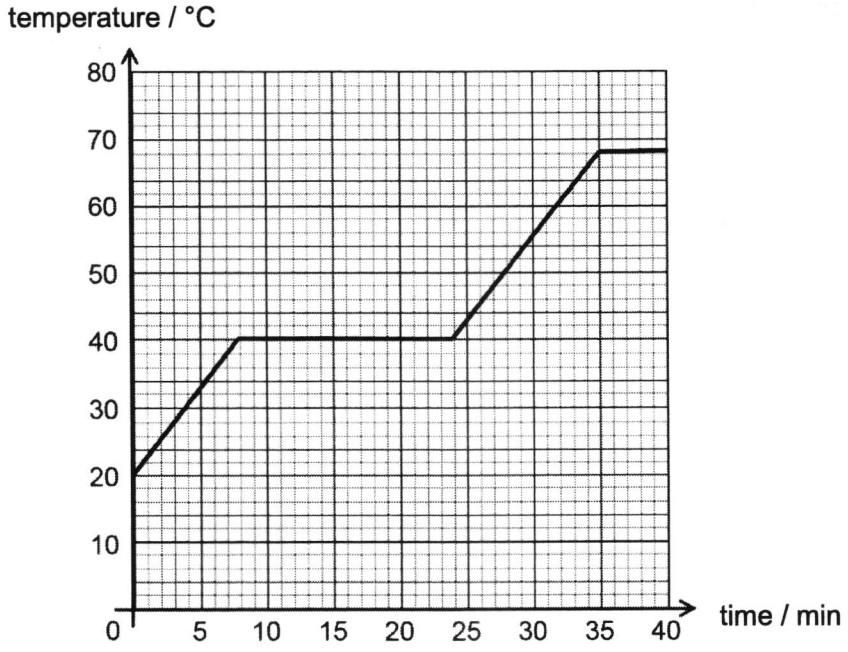


Fig. 13.3

(i) State the melting point of the substance.

..... [1]

(ii) Explain why the temperature remains constant during the time of 8 min to 24 min, even though the substance continues to be heated.

.....

.....

..... [2]

(iii) Describe the changes in the arrangement and movement of the particles of the substance from time of 24 min to 35 min.

.....

.....

..... [2]

14 **(a)** Fig. 14.1 shows circular wavefronts produced at the centre of a ripple tank by a vibrating source. The distance between two ripples is 4.0 cm.

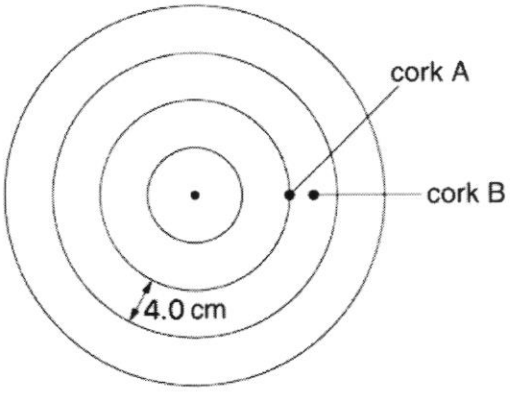


Fig. 14.1

Two corks, A and B, float on water in the ripple tank.

(i) State and explain whether the two corks will hit each other after some time.

.....

.....

..... [2]

(ii) Fig. 14.2 shows how the displacement of cork A varies with time.

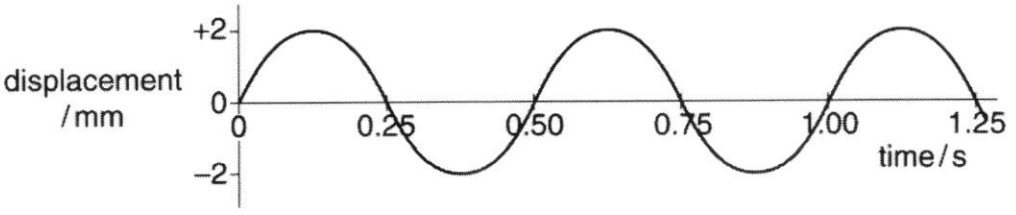


Fig. 14.2

Determine the frequency of the wave.

frequency = ... Hz [2]

(iii) Calculate the speed of the wave.

speed = ... cm /s [1]

(iv) The frequency of the vibration is increased. Suggest how the ripples formed in Fig. 14.1 will change.

.....

..... [1]

(b) Fig. 14.3 shows the components of the electromagnetic spectrum in order of decreasing frequency.

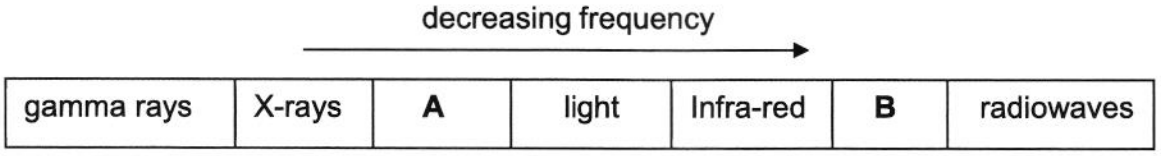


Fig. 14.3

(i) Name components **A** and **B**.

A : .....

B : ..... [2]

(ii) A lady is listening to the radio programme transmitted by Power 98 which has the frequency of 98 MHz. Assume that the speed of radiowave in air is the same as its speed in vacuum.

Calculate the wavelength of this radiowave.

wavelength = ... m [2]

End of Paper

P1

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

P2 Section A

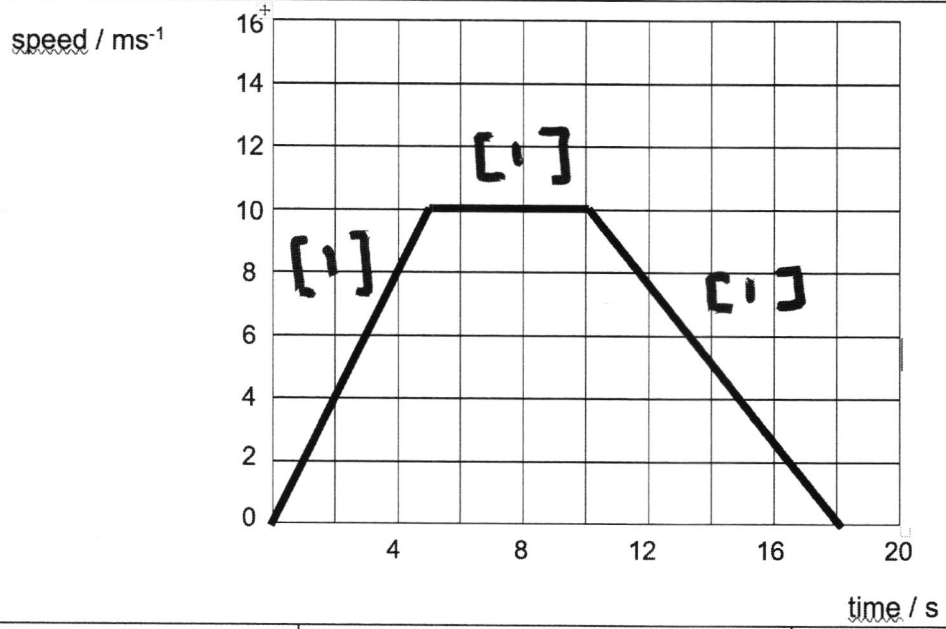
1

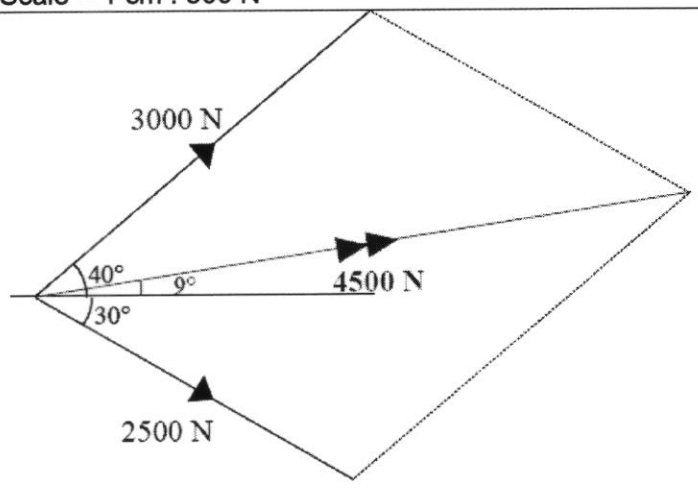
prefix	symbol	value
kilo	k	10^3
milli	**m**	**10^{-3}**
Mega	**M**	10^6
micro	μ	**10^{-6}**

2

Observed reading	2.62 mm [1]
Zero error	+0.02 mm [1]
Actual diameter (after correcting zero error)	2.60 mm [1]

3



4a	a = (v-u)/t = 20/5 = 4.0 m/s^2 F = ma = 1500 x 4 = 6000 N	 1 1
4b	driving force = 6000 + 1000 = 7000 N	 1
4c	Driving force equals frictional force.	1
5	Scale = 1 cm : 500 N	1
	 1m for correct orientation and directions for 3000 N and 2500 N 1m for correct direction for resultant force	2
	Magnitude of resultant force= 9.0 × 500 = 4500 N (accept 4280 N to 4730 N)	1
6a	P = F/ A (F) = 40 / 10 (S) = 4.0 N/cm^2 (AU)	 1 1
6b	F = P x A (F) = 4 x 2 (S) allow ecf = 8 N (AU)	 1
6c	Work done on the small piston = work done on the large piston F_s x d_s = F_L x d_L 8N x d_s = 40N x 3cm d_s = 15 cm = 0.15 m ~~OR~~ ~~Vol displaced by small piston = vol displaced by large piston~~ ~~2 x d = 10 x 3~~ ~~d = 15 cm~~	 1 1

7	**(a)** Total volume = $(D/m)_i + (D/m)_c$ = 480/8 + 900/9 = 160 cm^3	 1 1
	(b) D = total mass/total volume = 1380/160 (ecf allowed) = 8.63 g/cm^3	1 1
8a	ACM = F x d = 550 x 0.86 = 473 Nm	
	P.O.M: CM = ACM W x 1.1 = 473 W = 430 N	1 1
b	Claim: stated in qn that see saw tilted anti-clockwise Evidence: Distance moved away from pivot is the same but the weight of the girl is greater.[1] Reason (present a physics concept learnt): Anticlockwise moment is bigger than the clockwise moment [1], hence the see saw tilted anticlockwise.	2
9a	W = mg = 1500 x 10 = 15000 N	1
b	Gain in GPE = mgh = 1500 x 10 x 30 = 450 000 J	1 1
c	P = WD/t = 450000/ 90 = 5000 W	1 1
10a	(i) Conduction	1
	(ii) The water at the bottom expands when heated and becomes **less dense and rise.** **Denser and colder water sinks** to replace the hot water. [1] This **sets up a convection current** to transfer thermal energy. [1]	
	(iii) Paint the pot black. / Add a lid	[1]
b	The gas particles are spaced very far apart [1] and the number of molecules per unit volume in a gas is smaller than that in a solid [1] resulting in a lower density than solid.	
c	C: cooling effect occurs when water evaporates from surface of skin. (stated in qn) E: During evaporation, the <u>water molecules absorb heat from the skin</u>. [1]	

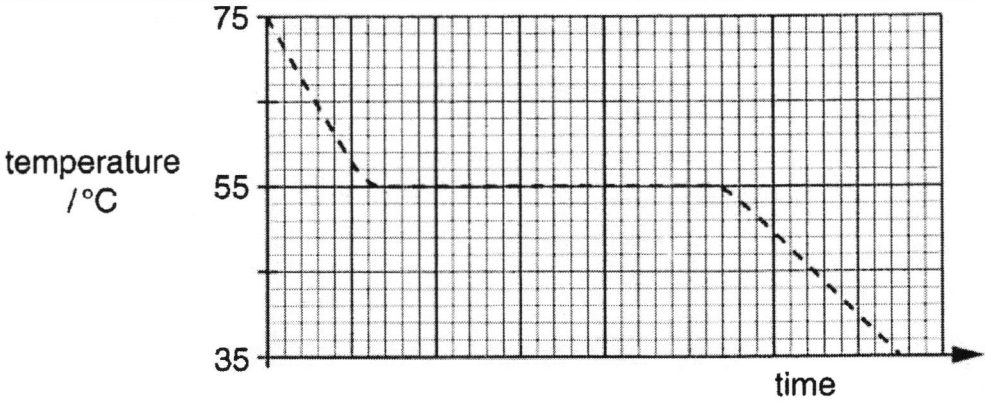
	R: The more energetic water molecules leave the surface of the skin and the average kinetic energy of the remaining molecules decreases. [1] Cooling occurs since the temperature decreases. (kinetic theory)	
11		2

statement	**true / false**
The substance is not gaining energy at **Q** and **S**.	false
The average internal energy of the substance is increasing at **T**.	true
The average internal kinetic energy of the substance is lower at **P** than at **R**.	true
The substance is changing state at **R**.	false

Every 2 correct answers = 1mk

P2 Section B

12a	i) Increasing speed / acceleration ii) At rest	1 1
2b	Ave speed = Total distance / total time = 170 /10 = 17 m/s	1
12c	Resistive force = 18 000 N Resultant force is zero as the car is moving at constant speed	1 1
12d	Gradient of the graph = (155 – 40) / 4 = 28.75 m/s (acceptable range 27.0 to 28.0)	1 1
12ei	600 – 800 = - 200 N (accept if no negative sign)	1
12e ii	$F_R = ma$ - 200 = 1200 x a $a = - 0.17\ m/s^2$	1 1

13ai	Heat travels from a region of higher temperature (hot water) to a region of lower temperature (surroundings)	1
13a ii	 1 mk – graph is constant at 55°C 1 mk – graph shows a faster rate of temperature decrease from 75°C to 55°C and from 55°C to 35°C.	
13aiii	White container White surfaces are poorer emitters of heat compared to black and hence retains heat better.	1 1
13bi	40 °C	1
13bii	Thermal energy supplied is used to overcome intermolecular forces KE is unaffected hence temperature remains constant.	1 1
13biii	The particles are <u>further apart</u> [1] and <u>slide past one other faster [1].</u>	

14ai	C: No. E: Water wave is a transverse wave. R: The water particles will only <u>vibrate up and down</u> **OR** Waves transfer energy not matter.	1 1
14aii	Period = 0.50 s $f = 1/T$ $= 1/0.5$ $= 2$ Hz	1 1
14aiii	$v = f\lambda$ $= 2(4)$ allow ecf $= 8$ cm/s	 1 1
14aiv	The ripples will get closer/wavelength decreases.	1
14bi	A: ultraviolet B: Micro wave	1 1
14b ii	$V = f\lambda$ $3 \times 10^8 = \mathbf{98 \times 10^6} \times \lambda$ $\lambda = 3.06$ m	 1 1