BEDOK VIEW SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

CANDIDATE NAME

REGISTER NUMBER

CLASS

SCIENCE (PHYSICS, CHEMISTRY)
Secondary 3 Express
Paper 1 Multiple Choice

5076/01
7 October 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.
A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.
The use of an approved scientific calculator is expected, where appropriate.

The maximum mark for this paper is 40 marks.

Setter(s): Mdm Nur Hazwah and Mr Roy Cher

This document consists of **16** printed pages.

[Turn over

1 What do all physical quantities consist of?

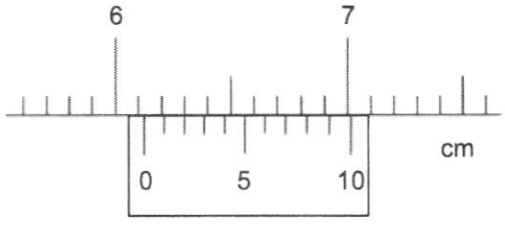
A a numerical magnitude, a unit and a direction

B a numerical magnitude and a direction

C a numerical magnitude and a unit

D a unit and a direction

2 The diagram shows a reading on the vernier caliper.



What reading is shown?

A 6.02 cm

B 6.12 cm

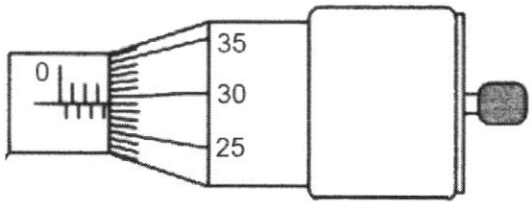
C 6.32 cm

D 9.02 cm

3 A micrometer is used to measure the thickness of a sheet of glass.

With the jaws closed and no glass sheet placed between the jaws, the micrometer shows a negative zero error of 0.02 mm.

With the jaws closed around the glass sheet, the micrometer reading is as shown.



What is the thickness of the glass sheet?

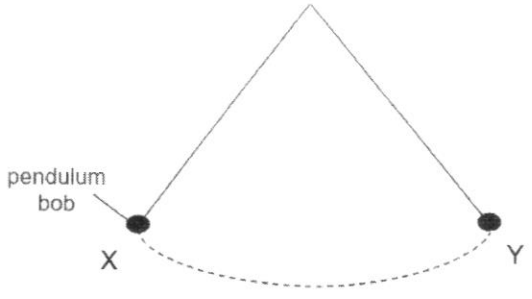
A 3.77 mm

B 3.79 mm

C 3.81 mm

D 7.27 mm

4 A pendulum swings freely between points X and Y as shown. It takes 16.4 s to swing from X to Y and back to X twenty times.



What is the period of another pendulum with a bob of half the mass?

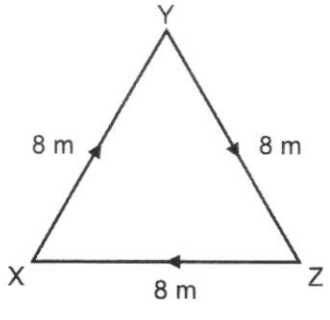
A 0.41 s

B 0.82 s

C 1.64 s

D 3.28 s

5 The diagram shows the path taken by an object to move from points X to Y to Z and back to X.



It took 1.0 s to move from points X to Y. It took another 4.0 s to move from points Y to Z and back to X.

What is its average velocity along the path?

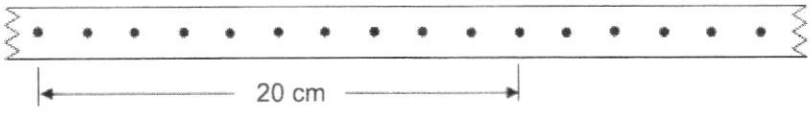
A 0 m/s

B 4.8 m/s

C 5.3 m/s

D 6.0 m/s

6 A toy car pulls a strip of paper tape under a vibrating arm. The arm vibrates regularly, making 50 dots in 1.0 second.



What is the average speed of the toy car?

A 4.0 cm/s

B 4.4 cm/s

C 90 cm/s

D 100 cm/s

7 Which of the following gives the best description of non-uniform acceleration?

A zero rate of change of velocity

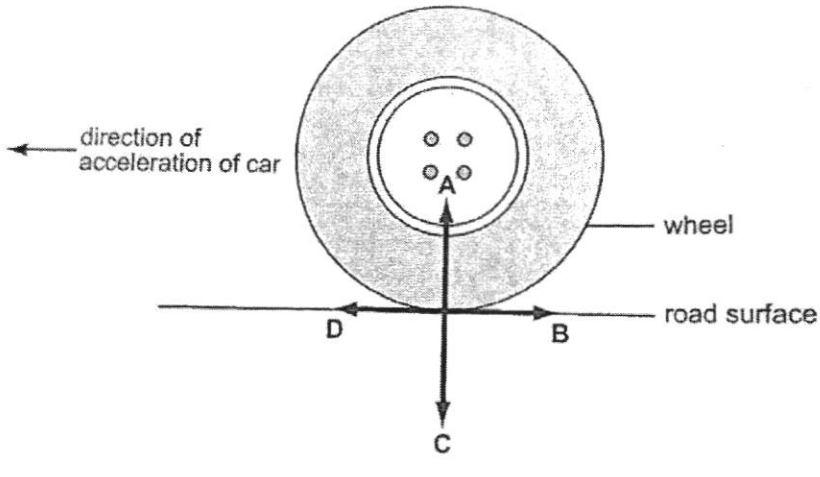
B constant rate of change of velocity

C increasing rate of change of velocity

D acceleration of free fall for a body near to the Earth

8 The wheel of a moving car is driven by the engine. The car is accelerating in the direction shown.

In which direction does the frictional force act on the wheel?



9 The gravitational field strength on the Moon is one sixth that on the Earth. An astronaut returns from the Moon to the Earth.

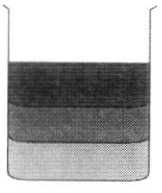
What effect does this have on the astronaut's mass and weight?

	mass	weight
A	decreases	remains the same
B	increases	remains the same
C	remains the same	decreases
D	remains the same	increases

10 The densities of three liquids P, Q and R are recorded below.

liquid	density in g/cm^3
P	1.2
Q	0.80
R	6.8

The three liquids, which do not mix, are poured into a beaker and they appear as shown in the diagram below.



Starting from the top, what is the order of the liquids in the beaker?

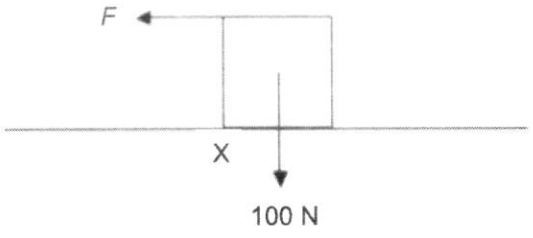
A P, Q, R

B P, R, Q

C Q, P, R

D R, P, Q

11 The diagram below shows a uniform cube of weight 100 N on a rough surface.



What is the minimum horizontal force *F* needed to just tilt the cube about X?

A 50 N

B 100 N

C 150 N

D 200 N

12 A box of mass 4.0 kg increases its speed from 3.0 m/s to 5.0 m/s.

What is the increase in its kinetic energy?

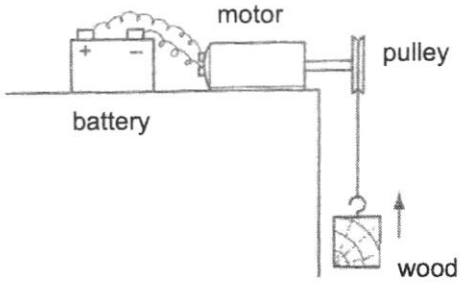
A 8.0 J

B 16 J

C 32 J

D 64 J

13 The diagram shows a battery-operated motor lifting a block of wood through 2.5 m at constant speed.



What is the **overall** energy change taking place?

A chemical to kinetic

B chemical to gravitational potential

C electrical to kinetic

D kinetic to gravitational potential

14 A student pulls a box with a force of 500 N across a rough floor. A frictional force of 100 N acts on the box.

How much work is done against friction when the box moves a horizontal distance of 3.0 m?

A 300 J

B 1 200 J

C 1 500 J

D 1 800 J

15 Assuming the temperature remains constant, which combination correctly describes the volume and the shape of a gas or liquid?

	state of matter	volume	shape
A	gas	fixed	not fixed
B	gas	not fixed	not fixed
C	liquid	fixed	fixed
D	liquid	not fixed	fixed

16 A gas expands as it is being heated up.

Which of the following explains this phenomenon?

A The particles move faster and expand.

B The distance between particles increases.

C The potential energy of the particles increases.

D The particles overcome the forces of attraction and move further apart.

17 When one end of a rod is heated, heat is transferred down the rod by

A molecules with greater kinetic energy moving along the rod.

B molecules with greater kinetic energy exchanging places with the molecules which have lesser kinetic energy.

C molecules with greater kinetic energy colliding with the neighbouring molecules which have lesser kinetic energy.

D the air around the rod, which moves after being heated.

18 "As the temperature of a substance increases, the molecules gain kinetic energy and vibrate more vigorously about their fixed positions. Eventually, they have enough energy to overcome the strong forces of attraction between them so that they can slide past one another."

Which statement describes the paragraph above correctly?

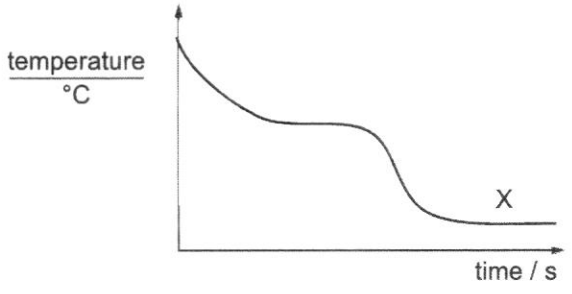
A Internal energy of the substance increases throughout.

B Internal energy of the substance remains constant throughout.

C Internal energy of the substance increases and then remains constant.

D Internal energy of the substance increases and then decreases.

19 A hot liquid is poured into a beaker. The graph shows how the temperature of the liquid varies as it cools in the laboratory.



What is happening at region X?

A The substance is changing state from liquid to solid.

B The solid substance is changing back into its liquid state.

C The substance has reached thermal equilibrium with its surrounding temperature.

D There is insufficient information given to determine what is happening at region X.

20 Which of the following actions will alter the rate at which water evaporates from a dish?

I increase the surrounding temperature
II increase the depth of water in the dish
III fan the air above the surface of the water

A I and II only

B I and III only

C II and III only

D all of the above

BEDOK VIEW SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

CANDIDATE NAME

REGISTER NUMBER

CLASS

SCIENCE (PHYSICS)
Secondary 3 Express
Paper 2 Theory

5076/02
3 October 2022
1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

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

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

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

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

For Examiner's Use	
Section A	/ 45
Section B	/ 20
Paper 2	/ 65

Setter(s): Mdm Nur Hazwah

Parent's / Guardian's Signature: .....

This document consists of **16** printed pages.

[Turn over

Section A

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

For Examiner's Use

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

.....

..... [1]

(b) Underline the vector quantities listed below.

acceleration, distance, mass, speed, velocity [1]

[Total: 2]

2 Fig. 2.1 shows how the speed of an object varies during a period of 30 s.

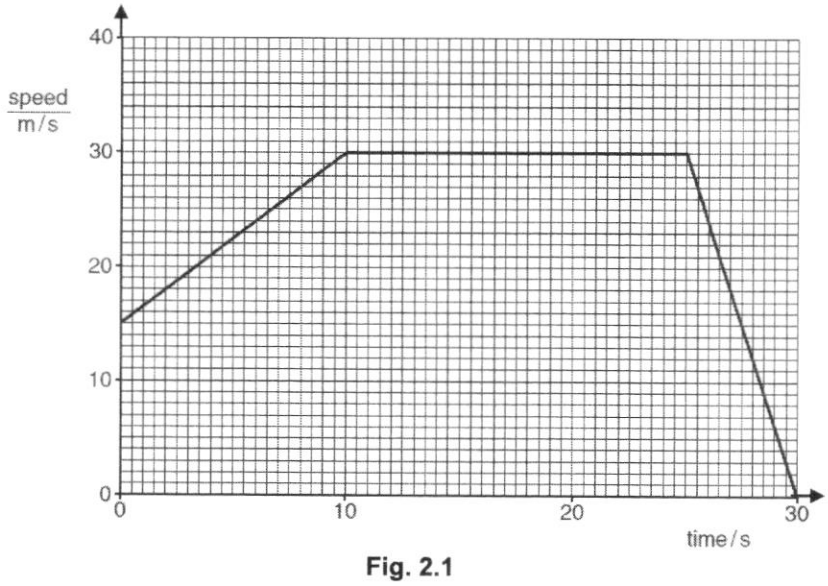


Fig. 2.1

(a) Calculate the acceleration of the object in the first 10 s.

acceleration = ... [2]

(b) Describe the motion of the object from 10 s to 30 s.

.....

.....

..... [2]

(c) Determine the distance travelled by the object in the last 5 s.

For Examiner's Use

distance = ... [2]

(d) Hence, calculate the average speed of the object in the last 5 s.

average speed = ... [1]

[Total: 7]

3 Fig. 3.1 shows a catapult used to project an object of mass 800 g. Force *F* pulls back the object, creating tension in the rubber cords.

For Examiner's Use

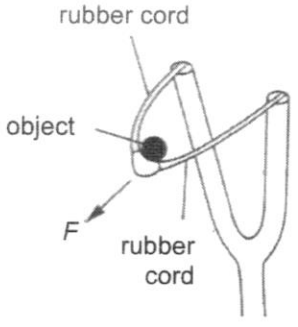


Fig. 3.1

The tension force in each rubber cord is 10 N and the two cords are at 60° to each other.

(a) Fig. 3.2 shows the direction of the two tension forces acting on the object.

By making a scale drawing on Fig. 3.2, find the resultant of these two tension forces acting on the object. State the scale used.

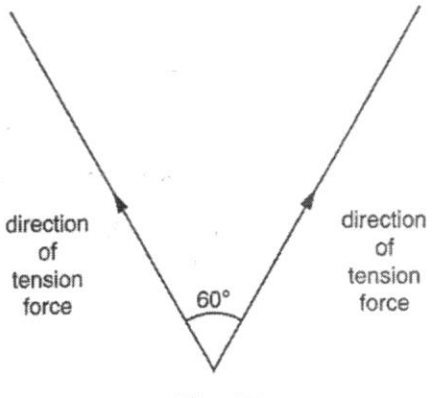


Fig. 3.2

scale = ...

resultant force = ...

[3]

(b) Calculate the acceleration of the object when it is released.

For Examiner's Use

acceleration = ... [2]

[Total: 5]

4 Fig. 4.1 shows the bottom section of an old bicycle tyre. The tyre exerts pressure on the ground.

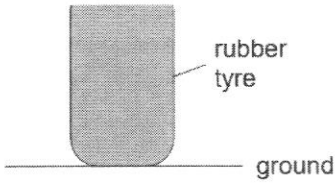


Fig. 4.1

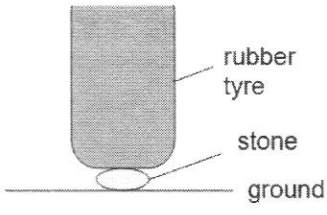


Fig. 4.2

The total mass of the rider and bicycle is 60 kg. The total area of the tyres in contact with the ground is 2.4×10^{-3} m^2. The gravitational field strength on Earth is 10 N/kg.

(a) Calculate the pressure exerted on the ground.

pressure = ... [3]

(b) One of the rubber tyres goes over a small stone as shown in Fig. 4.2.

State and explain how the pressure exerted on the ground changes.

.....

.....

.....

..... [2]

[Total: 5]

5 Fig. 5.1 shows two identical cans completely filled with sand. Can A is hung on a long string close to the surface of the Earth. Can B is hung in the same way close to the surface of the Moon. The gravitational field strength on the Moon is one sixth that on the Earth.

For Examiner's Use

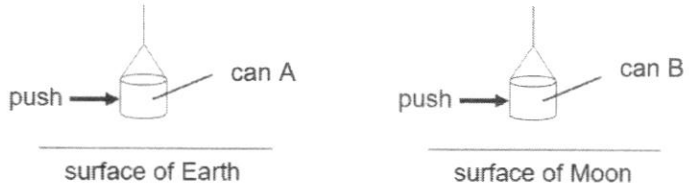


Fig. 5.1

(a) Define *gravitational field strength*.

.....

..... [1]

(b) The cans are given the same push force as indicated on Fig. 5.1.

State and explain which can, if any, would be easier to set in motion.

.....

.....

..... [2]

(c) The strings are cut and both cans fall freely.

Discuss how the time taken for can A to fall to the surface of the Earth compares with the time taken for can B to fall to the surface of the Moon.

.....

.....

.....

..... [2]

[Total: 5]

6 At a water theme park, an empty giant water container is suspended freely about pivot P. Fig. 6.1 shows the position of the container at equilibrium.

For Examiner's Use

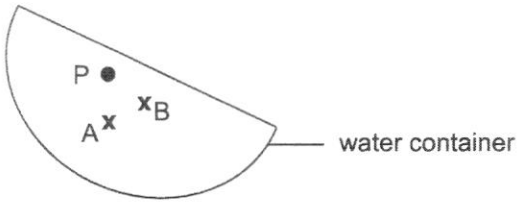


Fig. 6.1

Explain why the position of the centre of gravity of the giant water container is at A and **not** B.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 3]

7 Fig. 7.1 shows a fork-lift truck lifting a box.

For Examiner's Use

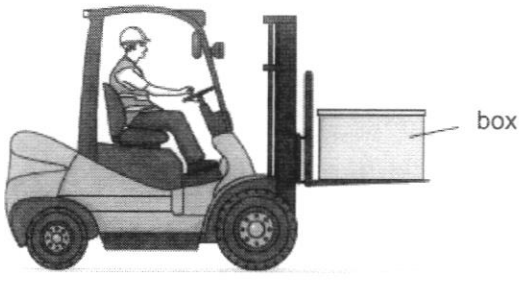


Fig. 7.1

The electric motor that drives the lifting mechanism is powered by batteries.

The lifting mechanism raises a box of 32 kg through a vertical distance of 2.5 m in 5.0 s. The gravitational field strength *g* is 10 N/kg.

(a) Calculate the gravitational potential energy gained by the box.

gravitational potential energy = ... [2]

(b) Calculate the power of the lifting mechanism.

power = ... [2]

(c) The power supplied to the lifting mechanism is greater than the answer in part **(b)**.

Explain how the principle of conservation of energy still applies to this system.

.....

.....

.....

..... [2]

[Total: 6]

8 Fig. 8.1 shows a refrigerator. The refrigerator walls are made of smooth white metal surfaces with a layer of polystyrene foam between the inside and outside walls.

For Examiner's Use

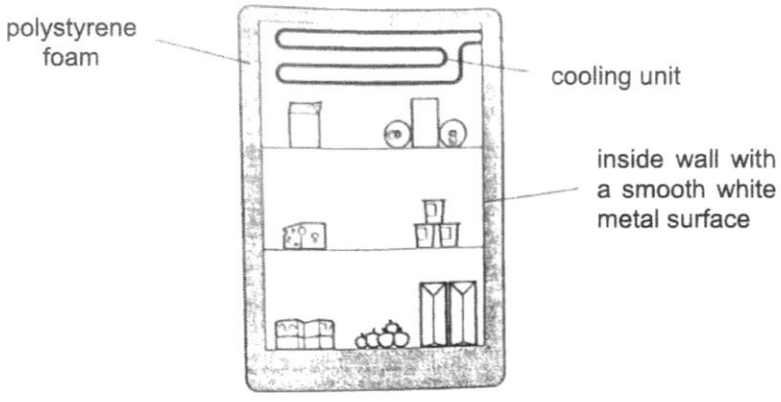


Fig. 8.1

(a) Describe how the polystyrene foam insulates the refrigerator.

.....

.....

..... [2]

(b) Explain how the cooling unit at the top cools all the contents of the refrigerator.

.....

.....

.....

..... [2]

(c) The inside wall radiates a small amount of thermal energy.

State how the colour of the surface affects the amount of energy radiated.

.....

..... [1]

[Total: 5]

9 A gaseous substance was cooled. The temperature of the substance was recorded at regular intervals of time. Its temperature-time graph is plotted as shown in Fig. 9.1.

For Examiner's Use

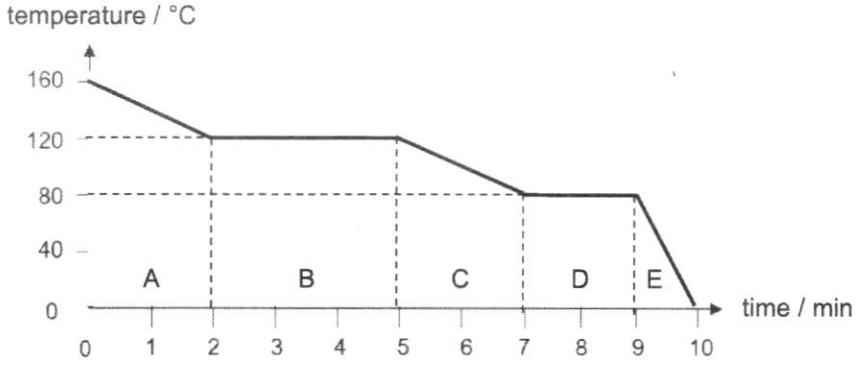


Fig. 9.1

(a) Explain, using kinetic theory, why a gas is compressible.

.....

.....

..... [2]

(b) State the freezing point of the substance.

freezing point = ... [1]

(c) Explain why the temperature remained constant between 2 and 5 minutes.

.....

.....

.....

..... [2]

(d) Compare the arrangement and motion of particles in sections C and E on Fig. 9.1.

.....

.....

.....

..... [2]

[Total: 7]

Section B

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

Write your answers in the spaces provided.

10 Fig. 10.1 shows how the distance travelled by a car varies with time as the car travels along a level road.

For Examiner's Use

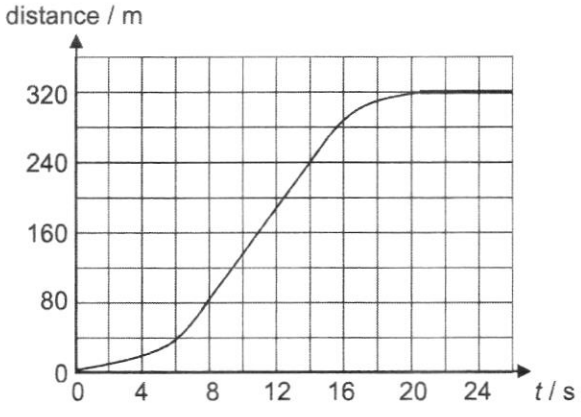


Fig. 10.1

The car has a mass of 800 kg and the forward driving force on the wheels is 1 200 N.

(a) Describe the motion of the car in the first 8 s.

.....

..... [1]

(b) **(i)** Determine the speed of the car between t = 8 s and t = 14 s.

speed = ... [2]

(ii) Hence calculate the kinetic energy of the car between t = 8 s and t = 14 s.

kinetic energy = ... [2]

(iii) When the car is travelling at constant speed, there is no change in its kinetic energy.

For Examiner's Use

Explain, in terms of forces, why the car engine is needed to maintain this constant speed.

.....

.....

.....

..... [2]

(c) Calculate the average work done by the driving force in the first 14 s.

work done = ... [2]

(d) At some point in its journey, the engine of the car is switched off.

State how Fig. 10.1 shows that the engine of the car has been switched off.

.....

..... [1]

[Total: 10]

11 **(a)** Fig. 11.1 shows how the volume of 10 g of pure ice changes as the temperature rises from -10 °C to 10 °C.

For Examiner's Use

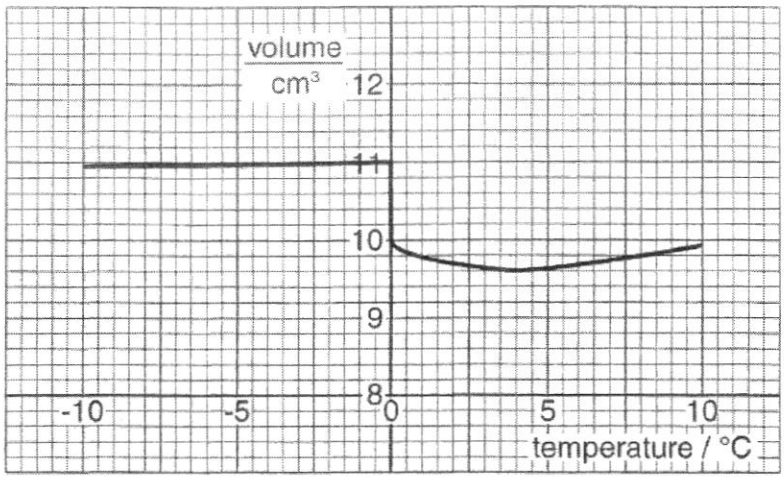


Fig. 11.1

(i) Calculate the density of ice at 0 °C.

density = ... [2]

(ii) With reference to Fig. 11.1, describe and explain how the density of ice and water changes as the temperature changes from -10 °C to 10 °C.

.....

.....

.....

.....

.....

..... [3]

(b) Fig. 11.2 shows a vacuum flask and an enlarged view of a section of the wall of the flask. The vacuum flask is filled with hot liquid and placed in a room temperature at 32 °C.

For Examiner's Use

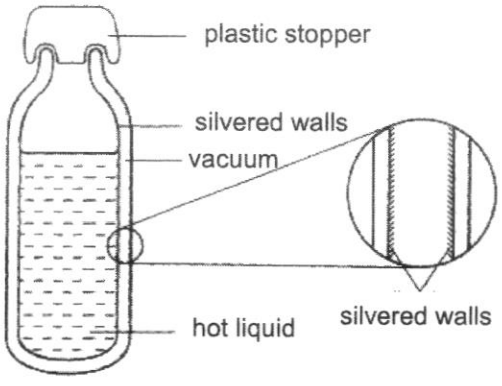


Fig. 11.1

(i) Explain how the vacuum between the walls ensure that the hot liquid remains hot for a longer period of time.

.....

..... [1]

(ii) When the plastic stopper is removed, some of the liquid evaporated and the temperature of the liquid dropped.

(1) Explain, using ideas about molecules, why evaporation causes a drop in temperature.

.....

.....

.....

.....

.....

..... [2]

(2) State two differences between evaporation and boiling.

.....

.....

.....

..... [2]

[Total: 10]

12 Fig. 12.1 shows a person of weight 700 N crossing a uniform bridge.

For Examiner's Use

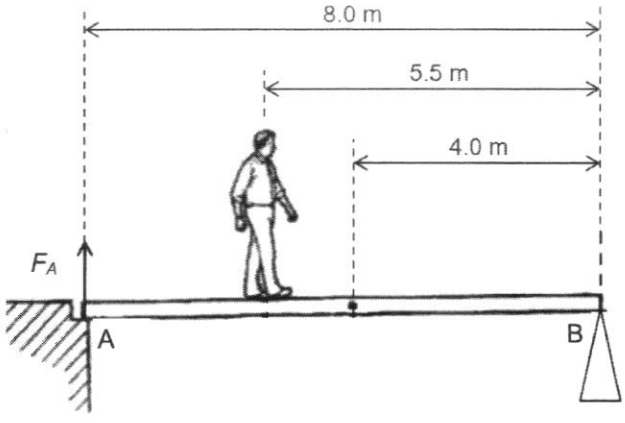


Fig. 12.1

The bridge is supported at points A and B. The length of the bridge is 8.0 m. It weighs 5 000 N.

(a) Draw on Fig. 12.1, using arrows, the weight of the person and the weight of the bridge. Label these forces clearly. [2]

(b) **(i)** State the *principle of moments*.

.....

.....

..... [2]

(ii) Taking moments about point B, calculate

(1) the moment due to the weight of the person,

moment = ... [1]

(2) the moment due to the weight of the bridge.

moment = ... [1]

(iii) Hence or otherwise, determine the magnitude of F_A, the force exerted by the ground on the bridge at point A.

For Examiner's Use

F_A = ... [2]

(c) **(i)** On Fig. 12.1, draw F_B, the force exerted by the pivot on the bridge at point B. [1]

(ii) Determine the magnitude of F_B.

F_B = ... [1]

[Total: 10]

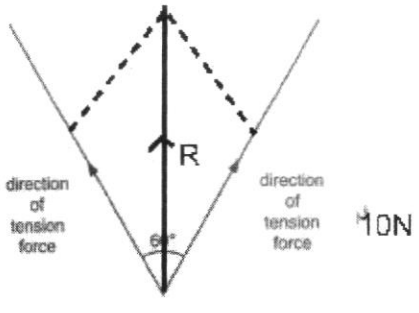
End of Paper

Paper 1 (20 marks) [1] × 20

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

Paper 2

Section A (45 marks)

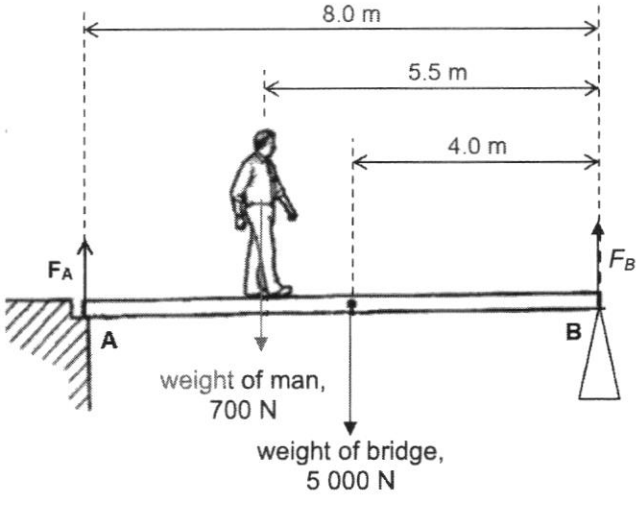
1	(a)	A vector quantity has direction while a scalar quantity does not.	B1
	(b)	*acceleration, distance, mass, density, velocity*	B1
2	(a)	a = (v – u) / t = (30 – 15) / 10 = 1.5 m/s^2	M1 A1
	(b)	The object moves at constant speed for the next 15 s The object moves with constant decleration in the last 5 s.	B1 B1
	(c)	Distance travelled = area under graph = ½ x 5 x 30 = 75 m	M1 A1
	(d)	Average speed = total distance / total time = 75 / 5 = 15 ms	 A1
3	(a)	scale = 1 cm: 2 N (accept other reasonable answers)  Tension forces drawn to scale Resultant force = 17 N (15 – 19 N) drawn in the correct direction	B1 B1 B1
	(b)	F = ma 17 = 0.800 x a a = 21.3 m/s^2	M1 A1
4	(a)	W = mg = 60 x 10 = 600 N P = F / A = 600 / (2.4 x 10^{-3}) = 2.5 x 10^5 Pa	M1 M1 A1

	(b)	P: Since pressure = force / area R: and the **area of stone in contact with the ground** in Fig. 3.2 is **smaller** compared to the area of tyre in contact with the ground in Fig. 3.1, O: **pressure exerted on the ground increases** when the tyre goes over a small stone.	B1 B1
5	**(a)**	Gravitational force per unit mass	B1
	(b)	P: Since the cans have the **same mass**, they will have the **same inertia**. O: Both cans would be **as easy or as difficult to set in motion**.	B1 B1
	(c)	Since there is a larger gravitational field strength on Earth, **can A will fall with greater acceleration**. The **time taken for can A** to fall to the surface of the Earth will be **shorter** since it is moving at greater speeds compared to can B. [accept other reasonable arguments and hence conclusions]	B1 B1
6		P: Weight of the container appears to act at the centre of gravity. R: **At A**, the **perpendicular distance from the line of action of weight to pivot P is zero**. R: Since moment = F x d, **moment due to weight about pivot P will be zero**. O: Hence the container will no longer rotate. R: **At B**, the perpendicular distance from the line of action of weight to pivot P is **not** zero. R: Since moment = F x d, moment due to weight about pivot P will **not** be zero. O: Hence the container will not be in equilibrium.	 B1 B1 B1
7	**(a)**	GPE = mgh = 32 x 10 x 2.5 = 800 J	 M1 A1
	(b)	Power = energy converted / time = 800 / 5.0 = 160 W	 M1 A1
	(c)	R: **Some of the energy supplied to the lifting mechanism will be converted to heat and sound energy** in the system. P: Since **energy cannot be created or destroyed**, and can only be converted from one form to another or transferred from one body to another, O: the **power supplied to the lifting mechanism should be equal to the sum of power loss in the system and power needed to raise the box**. [accept other reasonable answers]	B1 B1
8	**(a)**	Polystyrene foam **traps air which is a poor conductor of heat**. **Heat from the surroundings** will be transferred **into the refrigerator slowly**.	B1 B1
	(b)	P: The contents in the refrigerator are cooled by convection. R: When **air at the top gets cooled**, it becomes **denser** and **sinks**. **Hotter, less dense air at the bottom rises** and gets cooled. O: **Convection currents** are set up in the refrigerator to cool the contents.	 B1 B1

	(c)	**White is a poor emitter of radiation**. Hence the white surface radiates a small amount of thermal energy.	B1
9	(a)	P: **Particles** in gas are **far apart**. R: When a force is applied on the gas, particles have **space to move closer together.** O: Hence the gas can be compressed.	B1 B1
	(b)	80 °C	B1
	(c)	R: **Heat was released by the particles to form forces of attraction between them** as the substance changed from gaseous to liquid state. P: Since the **average kinetic energy of particles remained constant**, the temperature of substance remained constant between 2 and 5 minutes.	B1 B1
	(d)	The liquid particles in **section C are arranged close together in a disorderly manner** while the solid particles in **section E are arranged even closer together in an orderly manner**. The liquid particles in **section C slide past one another** while the solid particles in **section E vibrate in fixed positions**.	B1 B1

Section B (20 marks)

10	(a)	The car is accelerating.	B1
	(b)(i)	s = d / t = (240 – 80) / (14 – 8) = 26.7 m/s	M1 A1
	(b)(ii)	KE = ½mv^2 = ½ x 800 x 26.7^2 = 285 000 J	M1 A1
	(b)(iii)	P: F = ma R: The car engine needs to produce a **forward driving force that balances the resistive forces**, friction and air resistance, acting on the car. O: **Resultant force** acting on the car will be **zero** resulting in zero acceleration and hence the car travels at constant speed.	B1 B1
	(c)	Work done = F x d = 1 200 x 240 = 288 000 J	M1 A1
	(d)	The **gradient** of the distance-time graph starts to **decrease**, after a distance of 280 m.	B1
		Total marks	10
11	(a)(i)	D = m / V = 10 / 11 = 0.909 g/cm^3	M1 A1

	(a)(ii)	P: D = m / V R: Since **volume of ice remains constant as the temperature changes from -10 °C to 0 °C**, O: the **density of ice remains constant**. R: Since **volume of ice decreases as the temperature changes from 0 °C to 4 °C**, O: the **density of ice increases**. R: Since **volume of ice increases as the temperature changes from 4 °C to 10 °C**, O: the **density of ice decreases**.	B1 B1 B1
	(b)(i)	P: Vacuum between the walls **prevents** heat loss to the surroundings by **conduction and convection**.	B1
	(b)(ii) (1)	P: Evaporation causes cooling. R: During evaporation, **more energetic particles at the surface of the liquid overcome the forces of attraction** between them and **escape into the surroundings** as gas. O: Since the **average kinetic energy of particles in the liquid decreases**, the temperature of the liquid decreases.	B1 B1
	(b)(iii) (2)	Bubbles are seen during boiling but not during evaporation. Boiling occurs at a fixed temperature while evaporation occurs at any temperature. [accept other reasonable answers]	B1 B1
		Total marks	10
12	(a) (c)(i)	 	B1 B1 B1
	(b)(i)	For a body in equilbrium, the sum of clockwise moments about a pivot is equal to the sum of anticlocwise moments about the same pivot.	B1 B1
	(b)(ii) (1) (2)	Moment = F x d = 700 x 5.5 = 3 850 Nm Moment = F x d = 5 000 x 4.0 = 20 000 Nm	 B1 B1

	(b)(iii)	By principle of moments, Taking moments about point B, sum of clockwise moments = sum of anticlockwise moments F_A x 8.0 = 3 850 + 20 000 F_A = 2 980 N	 M1 A1
	(c)(ii)	Total upward forces = total downward forces 2 980 + F_B = 700 + 5 000 F_B = 2 720 N [accept taking moments about point A]	 B1
		Total marks	10