NAME:	NO:	CLASS:

ADMIRALTY SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2022

SUBJECT	:	Science (Physics)
CODE/PAPER	:	5076
LEVEL/STREAM	:	Secondary 3 Express
DATE	:	12 Oct 2022
TIME	:	0800h – 0930h
DURATION	:	1 hour 30 minutes

Instructions to candidates:
Write your name, index number and class on the cover page.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A: Multiple Choice Questions [20 marks]
Answer all questions in the OTAS provided.

Section B: Short Answer Questions [30 marks]
Answer all questions. Write your answers in the spaces provided in the question paper.

Section C: Structured Questions [20 marks]
Answer any two out of three questions. Write your answers in the spaces provided in the question paper.

Submit the question paper and OTAS separately.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/ 20
Section B	/ 30
Section C	/ 20
Total	/ 70

DO NOT TURN OVER THIS PAPER UNTIL YOU ARE TOLD TO DO SO.

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

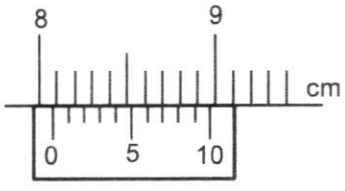
Section A

Answer all questions.

1 Which quantity is **not** a base quantity?

A force **B** length **C** mass **D** time

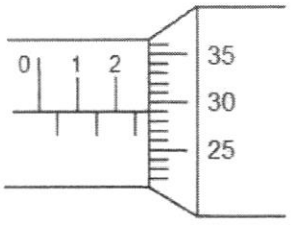
2 The diagram shows part of a vernier scale.



What is the reading?

A 8.07 cm **B** 8.17 cm **C** 8.70 cm **D** 8.77 cm

3 In the diagram below, a micrometer screw gauge is used to measure the thickness of a metal plate.



What is the thickness of the metal plate?

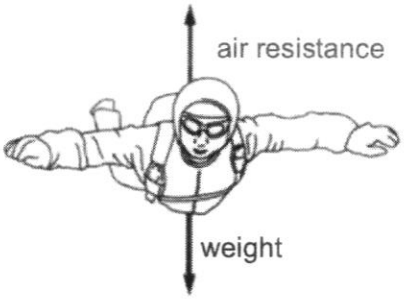
A 2.29 mm **B** 2.31 mm **C** 2.79 mm **D** 2.81 mm

4 Which formula defines velocity?

A $\frac{\text{change in displacement}}{\text{time taken}}$ **B** $\frac{\text{change in speed}}{\text{time taken}}$

C $\frac{\text{change in distance}}{\text{time taken}}$ **D** $\frac{\text{change in velocity}}{\text{time taken}}$

5 A parachutist jumps from a helicopter. Two forces act on the parachutist as shown.



When the air resistance is equal to his weight, which statement is correct?

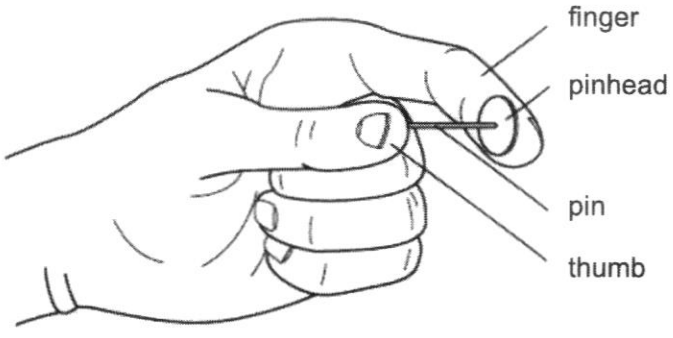
A The parachutist is falling at constant speed.

B The parachutist is falling with decreasing speed.

C The parachutist is falling with increasing speed.

D The parachutist is stationary in the air.

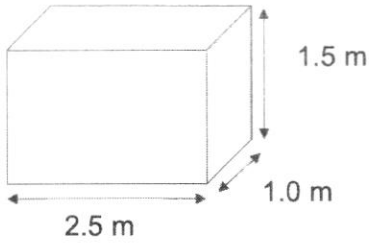
6 A pin is squeezed between finger and thumb as shown in the figure below.



Which statement is correct?

A The force of the pin is larger on the finger than on the thumb.
B The force of the pin is larger on the thumb than on the finger.
C The pressure of the pin is larger on the finger than on the thumb.
D The pressure of the pin is larger on the thumb than on the finger.

7 A block 2.5 m long, 1.0 m wide and 1.5 m high rests on the ground as shown.



Given that the block has a weight of 120 N, what is the largest possible pressure the block can exert on the ground?

A 32 Pa **B** 48 Pa **C** 80 Pa **D** 120 Pa

8 Three objects are cut from the same sheet of copper. They are of different shapes.

disc square rectangle

Which object has the greatest density?

A the disc
B the rectangle
C the square
D all have the same density

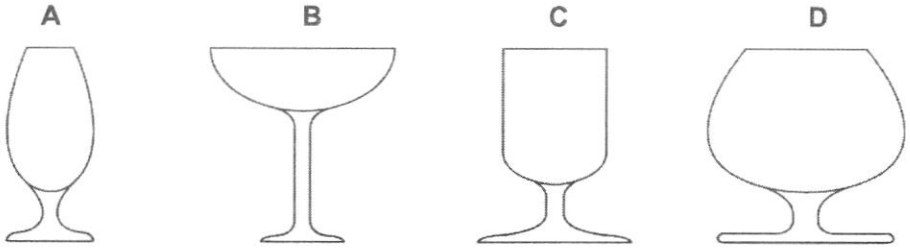
9 The table below shows the results of an experiment in which a sample of solid is placed in three liquids of different densities, X, Y and Z.

liquid	density of liquid in kg/m^3	observation
X	700	sinks
Y	1000	floats
Z	13600	floats

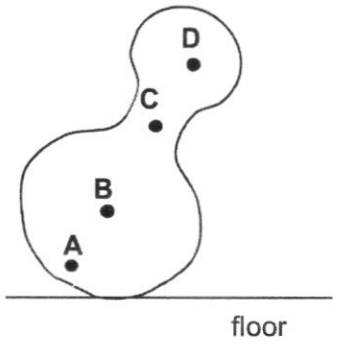
Which of the following statements about the density of the solid is correct?

A It is less than 700 kg/m^3.
B It is between 700 kg/m^3 and 1 000 kg/m^3.
C It is 1 000 kg/m^3.
D It is more than 13 600 kg/m^3.

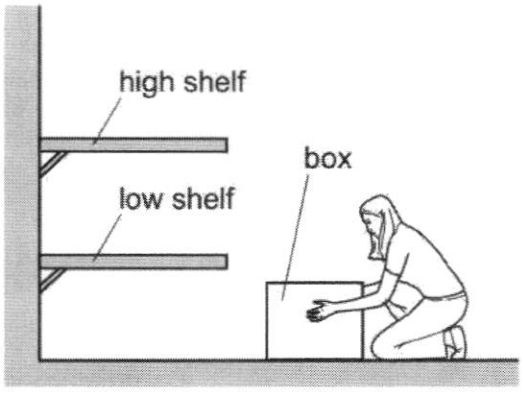
10 Four glasses are filled to their brims with the same liquid.
Which glass is the most stable?



11 A baby's toy balances on the floor as shown.
Which point is most likely to be the position of the centre of gravity of the toy?



12 A person in a factory has to lift a box onto a shelf.



Which action involves the person doing the **least** amount of work?

A lifting the box quickly to the high shelf
B lifting the box slowly to the high shelf
C lifting the box to the low shelf instead of to the high shelf
D lifting the box to the low shelf first then lifting it to the high shelf

13 An Olympic weight-lifter lifts a weight of 2120 N through a distance of 2 m in 9 s. What is the power exerted by the weight-lifter?

A 236 W **B** 471 W **C** 4240 W **D** 138160 W

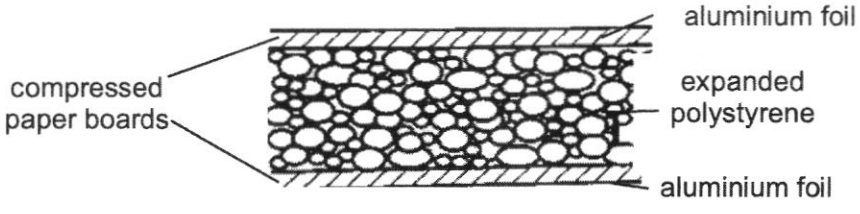
14 Which statement describes gravitational field strength correctly?

A It is a region where a mass experiences a gravitational force.
B It is a region where a mass experiences the acceleration due to gravity.
C It is the gravitational force of 10 N acting on the body.
D It is the amount of gravitational force acting on a unit mass.

15 A metal door knob feels cold to touch.
Which statement explains the effect?

A The metal knob conducts heat away from the hand quickly.
B Metal knob is a good absorber of infrared radiation.
C Metal knob loses heat to the hand.
D The temperature of the metal knob is lower than the temperature of the surroundings.

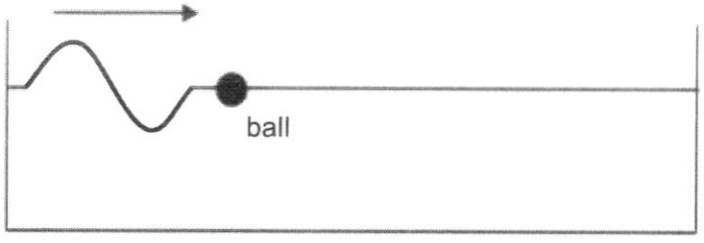
16 A particular type of building board is shown below.



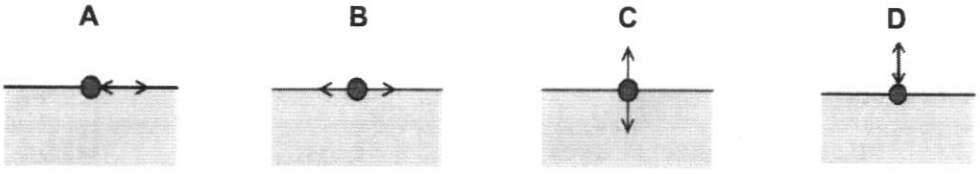
Which row explains why such boards provide good heat insulation?

	aluminium foil is	expanded polystyrene is
A	a good conductor	a good reflector
B	a good conductor	a poor reflector
C	a good reflector	a poor conductor
D	a poor reflector	a poor conductor

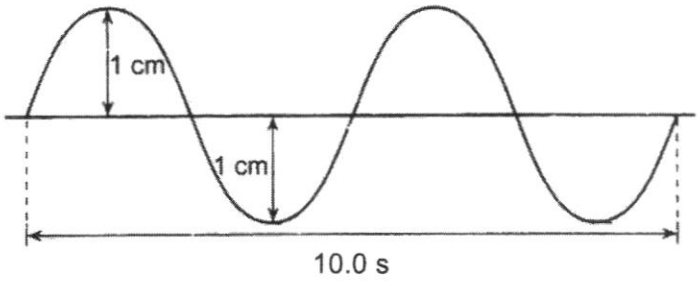
17 A ball is floating on the surface of the water when a wave moves from left to right.



What diagram best describes the motion of the ball as the wave passes by?



18 The diagram below shows a wave produced by a source oscillating at a constant frequency. Two complete waves are generated in 10.0 s.



Which row has the correct amplitude and period?

	amplitude / cm	period / s
A	1	2.5
B	1	5.0
C	2	5.0
D	2	10.0

19 A man beats a drum twice. On the second beat, the man beats the drum with a greater force than on the first beat.

Which statement describes the sound wave of the second beat compared to the sound wave of the first beat?

A The amplitude of sound wave decreases.

B The amplitude of sound wave increases.

C The frequency of sound wave decreases.

D The frequency of sound wave increases.

20 A ship sends a short pulse of high frequency sound down towards the sea bed and detects the reflected sound 0.24 s later.
The speed of sound in water is 1500 m/s.
What is the depth of the sea?

A 180 m **B** 360 m **C** 6250 m **D** 12 500 m

Section B

Answer all questions.

1 Complete the table by filling in the blank spaces with the correct unit, symbol and multiple.

unit	symbol	multiple
kilogram	kg	1×10^{3}
microgram	μg	
	ng	1×10^{-9}
milligram		1×10^{-3}

[3]

2 An astronaut boards a rocket and flies to the Moon. On the Moon, he decides to take a sample of Moon rock back to Earth.
The Moon rock weighs 20 N on the Moon.

(a) S.I. unit for mass is kilograms whereas S.I. unit for weight is Newton.
State one other difference between the mass and weight of an object.

.....

..... [1]

(b) **(i)** Take gravitational field strength on the Earth and Moon to be 10 N/kg and 1.6 N/kg respectively.
Calculate the mass of the Moon rock on the Moon.

mass of Moon rock = ... kg [2]

(ii) Hence, or otherwise, calculate the weight of the Moon rock on Earth.

weight on Earth = ... N [1]

3 A cube is pulled to the left by a force of 15 N and has a resistive force of 6.0 N as shown in Fig. 3.1.

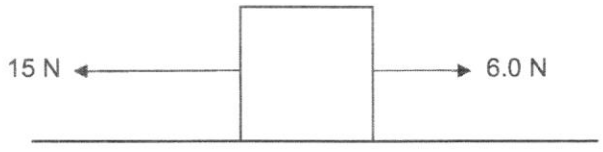


Fig. 3.1

(a) A frictional force of 2.0 N acts on the cube.
Draw and label this force, f on Fig. 3.1. [1]

(b) Calculate the resultant force acting on the cube.

resultant force = ... N [1]

(c) The cube has a mass of 2.5 kg. Using the answer in **(b)**, calculate the acceleration of the cube.

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

4 **(a)** State the Principle of Moments for a body.

.....

.....

..... [1]

(b) Fig. 4.1 shows a wind surfer in equilibrium by the wind exerting a force on the sail of his board. The weight of the windsurfer is 960 N.

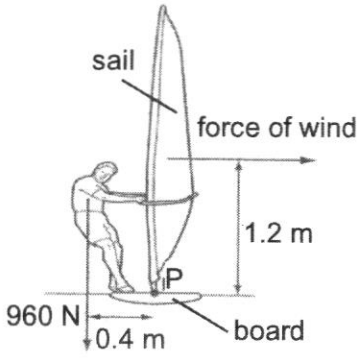


Fig. 4.1

(i) Calculate the moment exerted by the weight of surfer about point P.

moment by surfer = ... Nm [1]

(ii) Using the Principle of Moments, calculate the force of wind acting on the sail.

force of wind = ... N [2]

(c) Explain why the surfer needs to lean backwards more when the wind speed increases.

.....

..... [1]

5 Fig. 5.1 shows the arrangement of molecules of a substance in its different states of matter.

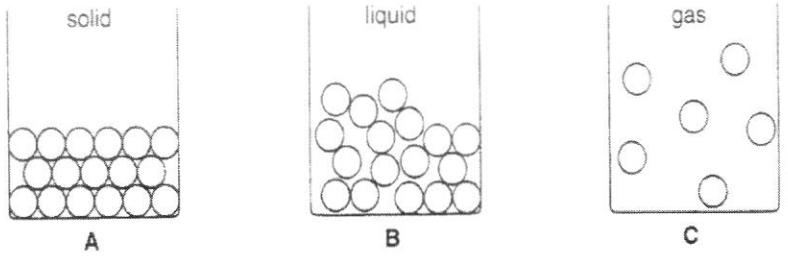


Fig. 5.1

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

.....

..... [1]

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

..... [1]

(c) Using the kinetic model of matters, describe the change in motion and arrangement of the molecules in container B as the temperature is increasing. Assume that the substance did not undergo any change of state.

.....

.....

.....

..... [2]

6 Fig. 6.1 shows the top view of the waves produced in a ripple tank experiment. The distance between some of the wavefronts is 0.24 m.

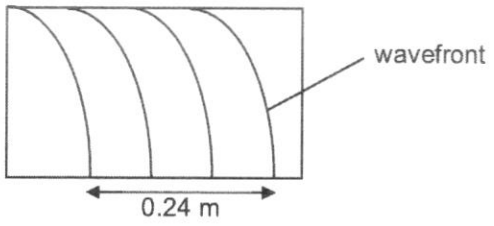


Fig. 6.1

(a) Explain the meaning of wavefront.

.....

..... [1]

(b) Calculate the wavelength of the waves.

wavelength = ... m [1]

(c) The frequency of the waves is 120 Hz. Calculate the speed of the waves.

speed = ... m/s [2]

7 Two waves in the electromagnetic spectrum are described as follows:
Wave M is used in the detection of temperature at the entrance of shopping centres to identify visitors who are having fever.
Wave N is used in detecting prohibited materials in the luggage at the entrance of the airport.

(a) Identify wave M and N from the electromagnetic waves.

wave M = ...

wave N = ... [2]

(b) State one property that both electromagnetic waves M and N have in common.

..... [1]

8 Fig. 8.1 shows a glass saucepan containing water placed on a hot plate. .

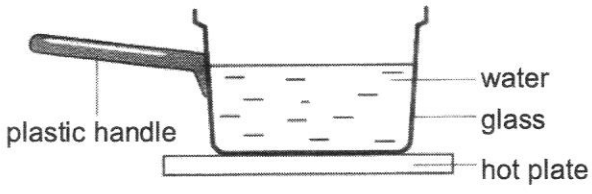


Fig. 8.1

(a) State the mode of heat transfer from the hotplate to the base of the saucepan.

..... [1]

(b) Describe how thermal energy is transferred throughout the water.

.....

.....

.....

.....

..... [2]

Section C
Answer any two questions.

9 **(a)** Fig. 9.1 shows a 20 N force pulling a crate of mass 3 kg from X through a distance of 17 m up a rough slope to Y. Given gravitational field strength, g = 10 N/kg.

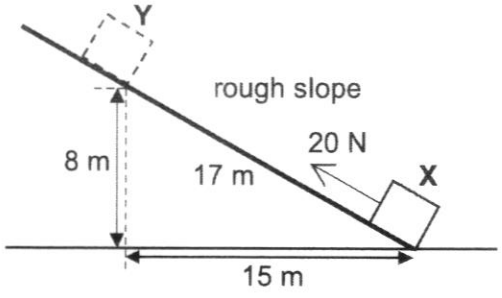


Fig. 9.1

Calculate

(i) the gain in gravitational potential energy of the crate at Y,

gravitational potential energy = ... J [2]

(ii) the work done to push crate along the rough slope from X to Y,

work done from X to Y= ..... J [2]

(iii) the work done against friction using answer in **(a)(i)** and **(a)(ii)**.

work done against friction = ... J [1]

(b) The crate in **(a)** is transferred to a frictionless slope with similar dimensions. Fig. 9.2 shows the crate sliding from rest at P through a distance of 17 m down to Q, just before it reaches the ground.

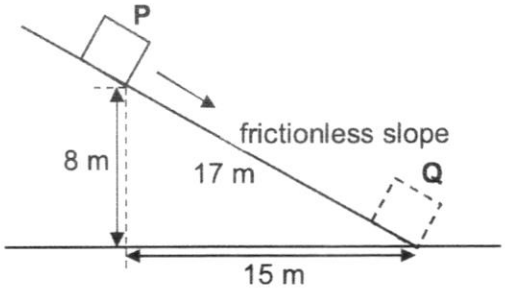


Fig. 9.2

(i) Using the Principle of Conservation of Energy, explain the change in energy on the crate as it moves from P to Q on the frictionless slope.

.....

.....

.....

.....

.....

..... [3]

(ii) Using the Principle of Conservation of Energy and the answer in **(a)(i)**, calculate the speed of the crate at point Q.

speed at Q = ... m/s [2]

10 Fig. 10.1 shows a 80 kg box dropped from an aeroplane. The box contains supplies. A parachute is attached to the box. The parachute is opened when the time is 4 s.

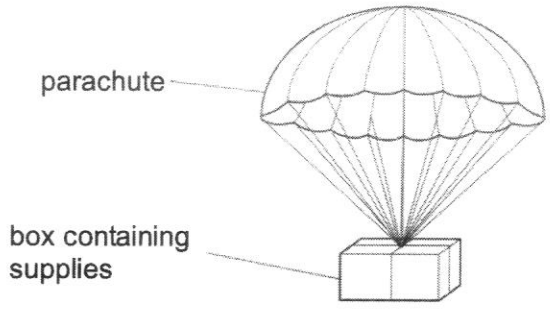


Fig. 10.1

Fig. 10.2 shows the graph of the vertical speed of the box as it falls.

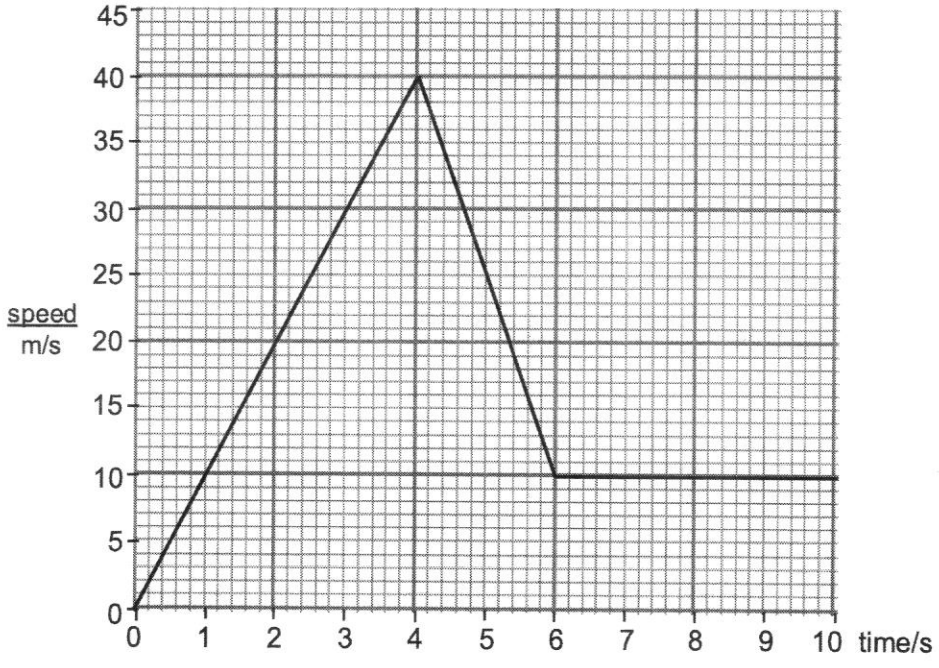


Fig. 10.2

(a) Describe the speed of the box in the first 6 s.

.....

.....

.....

..... [2]

(b) **(i)** Calculate the distance travelled by the box in the first 6 s.

distance = ... m [2]

(ii) Calculate the average speed of the box in the first 6 s.

average speed = ... m/s [2]

(c) Calculate the acceleration of the box in the first 4 s.

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

(d) Without calculation, explain whether the magnitude of the deceleration of the box in Fig. 10.2, is greater than the answer in **(c)**.

.....

.....

.....

..... [2]

11 In an accident, a truck goes off the road and slipped into a drain.
Fig. 11.1 shows two breakdown vehicles P and Q that are used to pull the truck out of the drain.

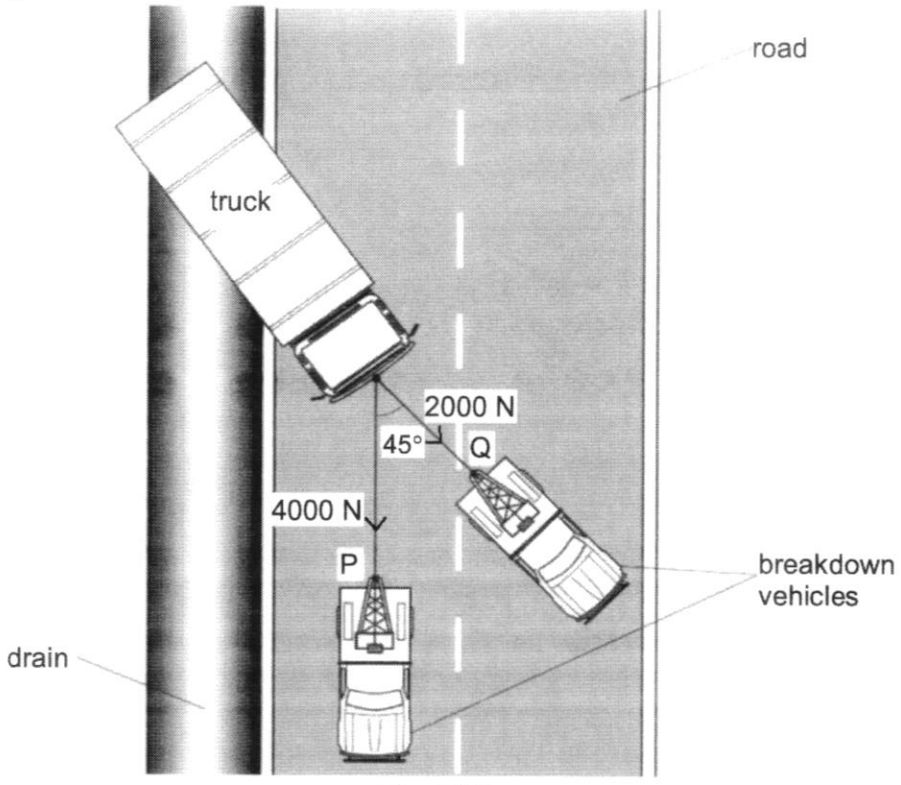


Fig. 11.1

During the rescue operation, vehicle P exerts a force of 4000 N and vehicle Q exerts a force of 2000 N. The angle between the paths of the two breakdown vehicles is 45°.

(a) (i) State why force is a vector quantity.

..... [1]

(ii) Suggest another quantity that is considered a vector quantity.

..... [1]

(b) Use the concept of inertia, explain why it is more difficult to move the truck out of the drain if it is fully loaded with cargo than when it is empty.

.....

.....;..

..... [2]

(c) Construct a scaled diagram to find the magnitude and direction of the resultant force on the truck. State the scale in your drawing.

[1]

scale = 1 cm : ..... [1]

magnitude of resultant force = ... N [1]

direction of resultant force = ... [1]

(d) State what happens to the magnitude of the resultant force if

(i) the angle between the two breakdown vehicles is increased,

..... [1]

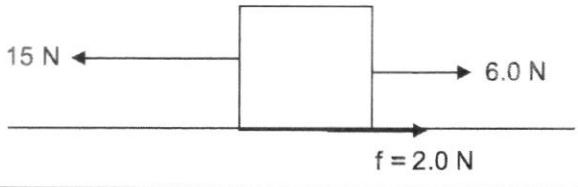
(ii) the force exerted by vehicle P is reduced.

..... [1]

END OF PAPER

ADMIRALTY SEC SCH
END-OF-YEAR EXAM 2022
3E SCIENCE(PHYSICS) MARKING SCHEME

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

	SECTION B		
1	1×10^{-6} nanogram mg	1 1 1	
2a	Mass is the measure of the amount of substance in a body but Weight is the force of gravitational pull on the body. Mass is a scalar quantity but Weight is a vector quantity. Mass is measured using a beam balance but Weight is measured using a spring balance. Mass remains unchanged but Weight changes as it is dependent on gravitational field strength.	1	
bI	W(Moon) = mg 20 = m x 1.6 m = 20/1.6 = 12.5 kg	 1 1	
bii	W(Earth) =mg W = 12.5 x 10 = 125 N	 1	
3a		1	frictional force must be between contact surfaces
b	F = 15 – 6 -2 F = 7 N	 1	ECF
c	F = ma 7 = 2.5 x a a = 7/2.5 = 2.8 m/s^2	 1 1	ECF
4a	For an object in equilibrium, the sum of clockwise moments about the pivot is equal to the sum of anti-clockwise moments about the same pivot.	1	
bi	moment = F x d moment = 960 x 0.4 = 384 Nm	 1	
bii	Taking moments about P, sum of anticlockwise moments = sum of clockwise moments 384 = F x 1.2 F = 320 N	 1 1	
c	When the wind force increases, the clockwise moments increases. Leaning backwards increases the perpendicular distance of his weight to the pivot, increasing the anti-clockwise moments to keep the sailboard in equilibrium.	1	Accept balances sailboard

5a	Solid – regular, orderly arrangement and closely packed Gaseous state – random, disorderly, far away from one another.	1	
b	C	1	
c	the increase in internal kinetic energy causes the molecules in liquid to slide past one another at a higher rate there is no change in internal potential energy and molecules are closely packed in a irregular arrangement.	1 1	
6a	wavefront is an imaginary line that join all points that are in phase	1	
b	3 waves = 0.24m 1 wave = 0.24/3 = 0.08m	1	
c	$v = f\lambda$ v = 120 x 0.08 = 9.6 m/s	1 1	ECF
7a	wave M = infra red waves wave N = X-rays	1 1	
b	transverse waves / travel in same speed in vacuum	1	
8a	conduction	1	
b	The water at the bottom of the sauce pan is heated, being less dense rises to the top of water. The water near the surface is cooled, being denser, sinks to the bottom. This sets up a convection current which thermal energy is transferred throughout the liquid.	1 1	

	SECTION C		
10	Ep = mgh		
ai	Ep = 3 x10 x8	1	
	Ep = 240 J	1	
aii	Work done from X to Y = F x s		ECF
	W = 20 x 17	1	
	W = 340 J	1	
aiii	Work done against friction= Work done – Ep at X		
	Work against friction = 340 – 240 = 100 J	1	
bi	At P, box has gravitational potential energy (Ep) only	1	
	As the height decreases, Ep decreases and kinetic energy(Ek) increases	1	
	At Q, all the Ep is converted into Ek.	1	
bii	decrease in Ep = increase in Ek		
	$3(10)(8) = 0.5(3)v^2$		
	$240 = 1.5v^2$	1	
	$v = \sqrt{160} = 12.6$ m/s	1	
11	speed increases uniformly in the first 4 s	1	
a	speed decreases uniformly in the time interval 4 to 6 s	1	
bi	d = area under v-t graph		
	d = (0.5x4x40) + (0.5)(40+10)(6-4)	1	
	d = 80 + 50 = 130 m	1	
bii	average speed = total d / total t		
	v = (80+50) / (4+2)	1	ecf max 2
	v = 21.7 m/s	1	
c	a = (v-u) / t		
	a = (40-0)/(4-0)	1	
	$a = 10$ m/s^2	1	
d	Yes, the magnitude of deceleration is greater than initial acceleration	1	
	Deceleration shows a steeper gradient in the graph	1	
12ai	it has magnitude and direction	1	
aii	velocity/acceleration	1	
b	The fully loaded truck has more mass and higher/larger inertia	1	
	It is harder to change the state of motion from rest and move out of drain	1	
c	scale 1 cm : 400 N OR 1 cm : 500 N	1	
	correct vector diagram with arrows (P, Q and resultant force)	1	
	force = 5600 ± 100 N	1	
	direction = 30°±2° anticlockwise from P OR 15°±2° clockwise from Q	1	
di	resultant force is smaller	**1**	
dii	resultant force is smaller	**1**	