Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
END-OF-YEAR EXAMINATION

SCIENCE (PHYSICS/CHEMISTRY) 5076/01

Secondary Three Express 2022

Paper 1 Multiple Choice 1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions in 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 Multiple Choice 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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

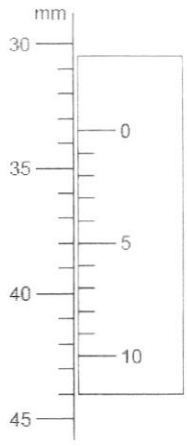
A copy of the Periodic Table is printed on page 7.

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

This document consists of 7 printed pages and 1 blank page.

Do not turn over the page until you are told to do so.

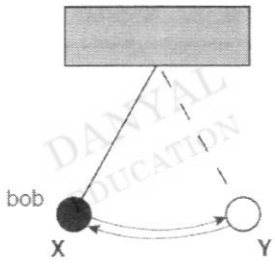
1 The diagram shows part of a vernier scale.



What is the correct reading?

A 30.5 mm **B** 33.5 mm **C** 38.0 mm **D** 42.5 mm

2 One oscillation of a swinging pendulum occurs when the bob moves from **X** to **Y** and back to **X** again.



Using a stopwatch, which would be the most accurate way to measure the time for one oscillation of the pendulum?

A Time 20 oscillations and divide by 20.

B Time 20 oscillations and multiply by 20.

C Time one oscillation.

D Time the motion from **X** to **Y**, and double it.

3 A car travels at an average speed of 60 km/h for 15 minutes.

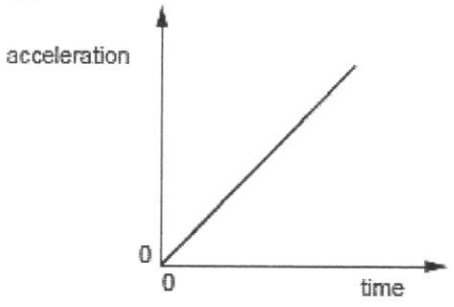
How far does the car travel in 15 minutes?

A 4.0 km **B** 15 km **C** 240 km **D** 900 km

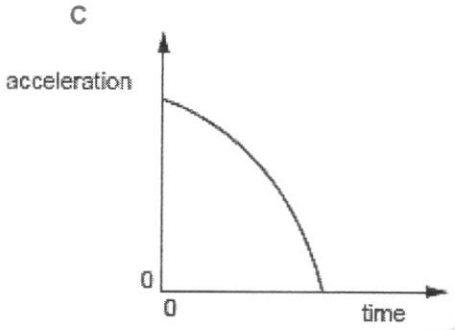
4 A stone falls freely from the top of a cliff into the sea. Air resistance may be ignored.

Which graph shows how the acceleration of the stone varies with time as it falls?

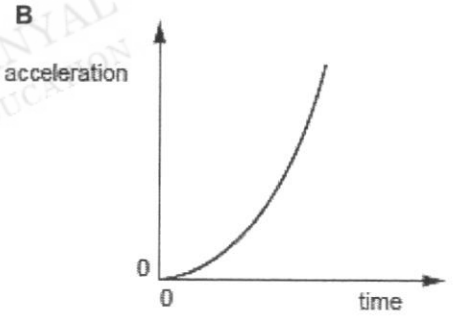
A



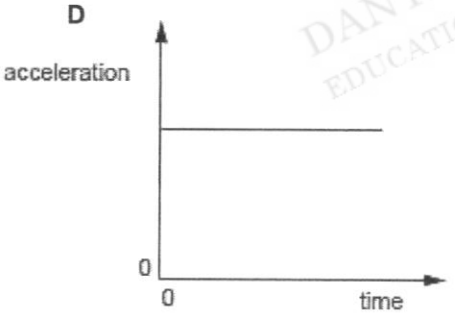
C



B

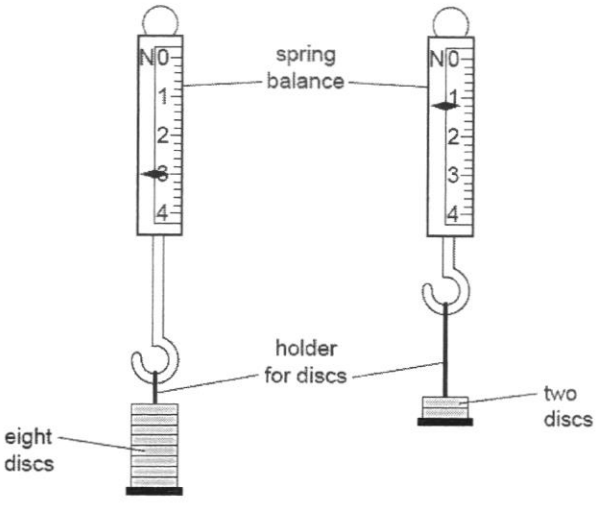


D



5 The reading on a spring balance with a holder and eight identical discs is 3.0 N.

Six discs are removed and the reading becomes 1.2 N.



What is the weight of one disc?

A 0.2 N **B** 0.3 N **C** 0.5 N **D** 0.6 N

6 A rocket of mass 200 kg accelerates vertically upwards from the surface of a planet at 2.0 m/s^2. The gravitational field strength on the planet is 4.0 N/kg.

What is the size of the force exerted by the rocket's engines?

A 400 N **B** 800 N **C** 1200 N **D** 2400 N

7 Which row is correct about the inertia and weight of an astronaut on Mercury compared to on the Moon? The gravitational field strength on Mercury is 3.70 N/kg and that of the Moon is 1.70 N/kg.

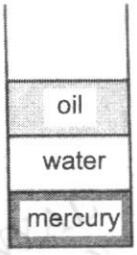
	inertia on Mercury	weight on Mercury
A	lower than on the Moon	higher than on the Moon
B	lower than on the Moon	same as on the Moon
C	same as on the Moon	same as on the Moon
D	same as on the Moon	higher than on the Moon

8 The densities of some liquids are stated below:

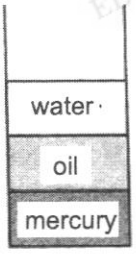
Oil: 893 kg/m^3
Mercury: 13560 kg/m^3
Water: 1000 kg/m^3

Which diagram displays the observation when they are added together?

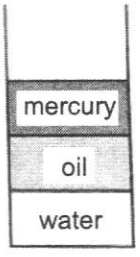
A



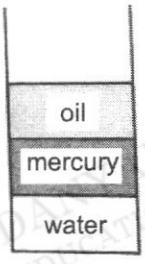
B



C

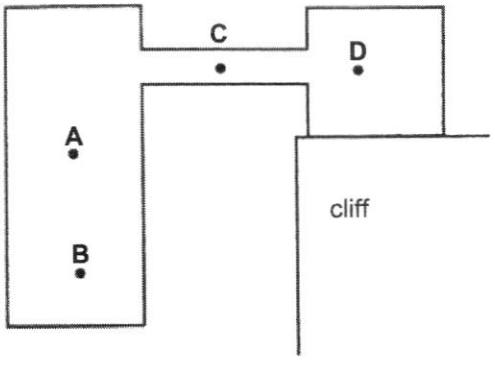


D

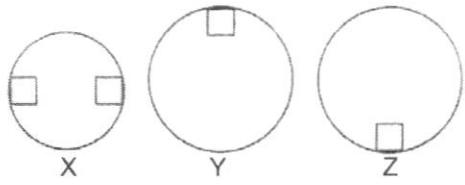


9 An object is balanced at the edge of a cliff as shown below.

At which point does the entire weight of the object appear to act?



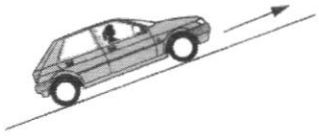
10 Boxes were attached to a cylinder and placed in the positions below.



Which row best represents the equilibrium state of the systems?

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

11 A car accelerates along a road as it rises uphill.



Which energy changes are taking place?

	kinetic energy	gravitational potential energy
A	decreasing	decreasing
B	decreasing	increasing
C	increasing	decreasing
D	increasing	increasing

12 A car is moving along a straight horizontal road. The car has 1.6 MJ of kinetic energy. The car accelerates for 20 s until the kinetic energy of the car increases to 2.5 MJ.

What is the minimum average power developed by the car engine for this acceleration?

A 45 W **B** 205 W **C** 45 kW **D** 205 kW

13 Some air is trapped inside a small balloon. The average kinetic energy of the air molecules in the balloon is increased.

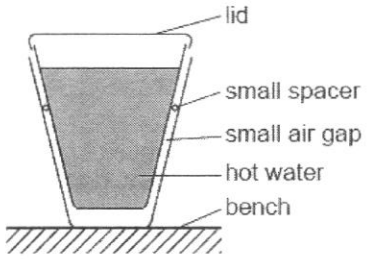
What remains the same?

A the density of the air in the balloon
B the mass of the air in the balloon
C the temperature of the air in the balloon
D the volume of the air in the balloon

14 Which of the following correctly compares the forces between the molecules in steam, water and ice?

	weakest forces ⟶		strongest forces
A	ice	steam	water
B	ice	water	steam
C	steam	water	ice
D	water	steam	ice

15 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top as shown.



Which statement is correct?

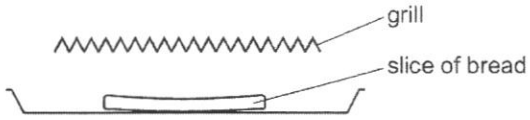
A Heat loss by radiation is prevented by the small air gap.

B No heat passes through the sides of either cup.

C The bench is heated by convection from the bottom of the outer cup.

D The lid is used to reduce heat loss by convection.

16 A slice of bread is placed under a red-hot electric grill to make toast.



How does heat energy reach the bread?

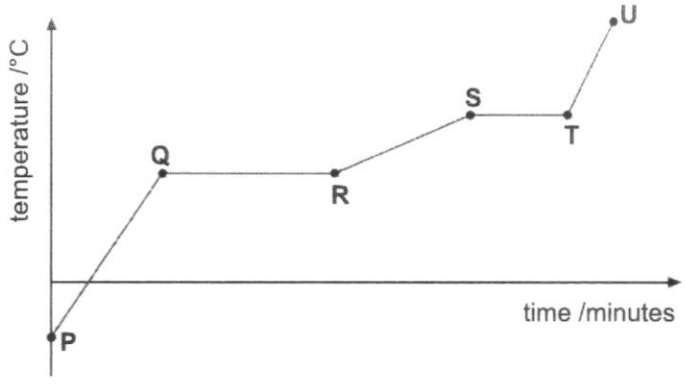
A conduction and convection

B conduction only

C convection and radiation

D radiation only

17 A solid substance is placed in an insulated container and is heated at a constant rate. The graph shows how the temperature of the substance changes with time.



During the time interval **QR**, which of the following statements is/are correct?

I There is a change in the state of the substance.

II The substance changes state from a liquid to a gas.

III Heat is absorbed by the substance.

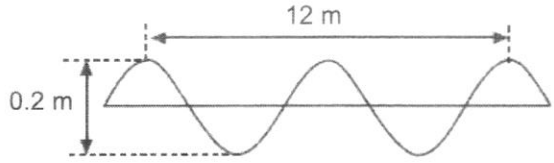
A I only **B** III only **C** I & III only **D** I, II & III

18 A block of ice cream is prevented from melting by wrapping it in newspaper soaked in water. The water evaporates from the newspaper.

Which molecules escape from the water and what happens to the average speed of the water molecules that remain in the newspaper?

	escaping molecules	average speed of the remaining water molecules
A	the more energetic ones	decreases
B	the more energetic ones	increases
C	the less energetic ones	decreases
D	the less energetic ones	increases

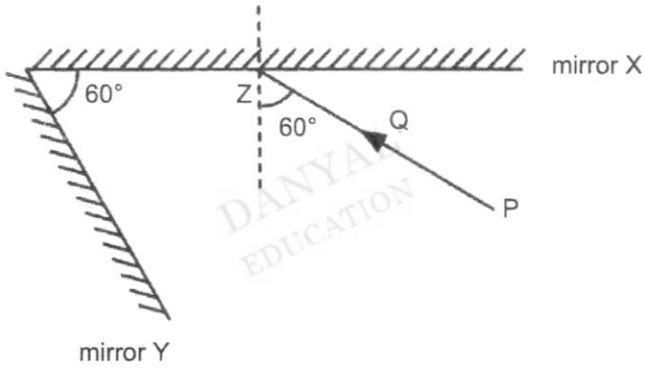
19 The following diagram shows a wave.



Which row in the table gives the wavelength and amplitude of the wave?

	wavelength / m	amplitude / m
A	6	0.1
B	6	0.2
C	12	0.1
D	12	0.2

20 The diagram below shows two plane mirrors X and Y with an angle of 60° between them. Light ray PQ strikes the mirror X at Z, making an angle of incidence 60°.



What is the angle of reflection on mirror Y?

A 0.0° **B** 30° **C** 60° **D** 90°

END OF PAPER

Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
END-OF-YEAR EXAMINATION

SCIENCE (PHYSICS) 5076/02

Secondary Three Express

6 October 2022

Paper 2 Theory

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

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

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 do not use appropriate units.

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**
1	/ 5
2	/ 3
3	/ 7
4	/ 4
5	/ 5
6	/ 9
7	/ 7
8	/ 5
Section B	**/ 20**
	/ 10
	/ 10
Total	**/ 65**
Total %	**/ 100**

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

This document consists of **14** printed pages and **0** blank page.

Do not turn over the page until you are told to do so.

[Turn over

Section A

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

1 The distance-time graphs for two runners, **A** and **B**, in a 100 m race are shown in Fig. 1.1.

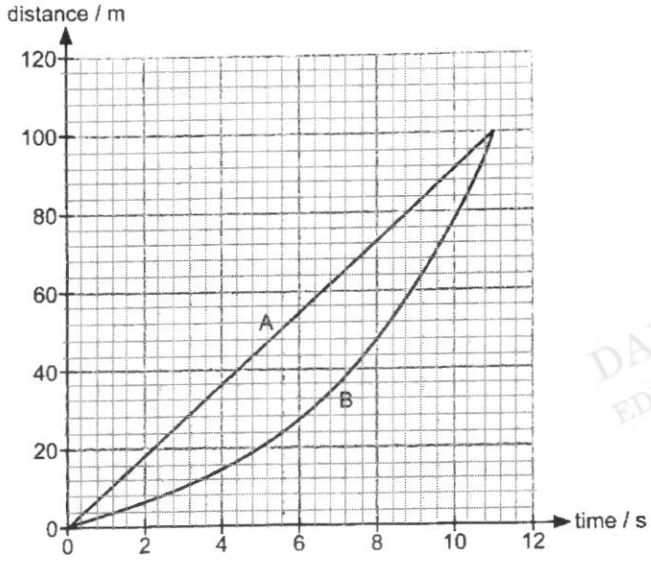


Fig. 1.1

(a) Explain how the graph shows that **B** accelerates throughout the race.

.....

..... [2]

(b) Estimate the maximum distance between the runners.

maximum distance = ... [1]

(c) Calculate the average speed of **A** during the race.

average speed = ... [2]

[Turn over

2 A fairground ride uses a giant catapult to launch people upwards using elastic cords. Each cord applies a force of 800 N and the cords are at 90° as shown in Fig. 2.1.

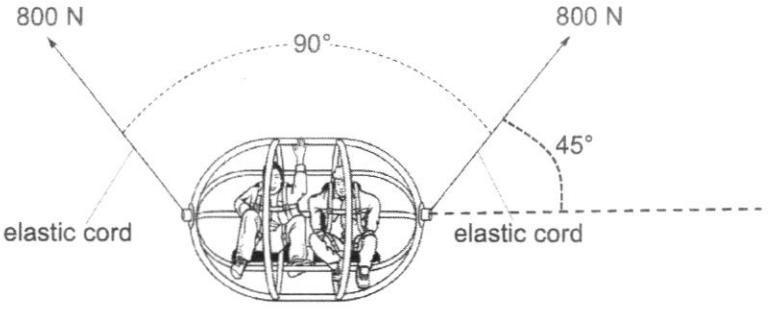


Fig. 2.1

Using a scale diagram, find the size of the resultant of these two forces.

scale = ...

resultant force = ... [3]

[Turn over

3 Fig. 3.1 shows a thin sheet of plastic. A student tries to measure the thickness of the sheet with a ruler, but the sheet is too thin to be measured accurately.

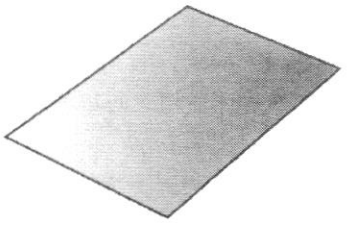


Fig. 3.1

The student measures the mass of the sheet and obtains the value 0.12 g.

(a) **(i)** State what is meant by *mass*.

..... [1]

(ii) The student is told that the density of the plastic is 0.91 g/cm^3.

Calculate the volume of the plastic sheet.

volume = ... [2]

(iii) The student measures the length and width of the sheet. The readings obtained are:

length of sheet = 3.0 cm
width of sheet = 2.0 cm

Calculate the thickness of the sheet.

thickness = ... [1]

(b) State a measuring instrument that can be used to measure the thickness of the sheet accurately.

..... [1]

(c) Determine the largest pressure that can be exerted by the plastic sheet on the ground.

pressure = ... [2]

4 Students were asked to estimate the mass of a retort stand in the laboratory. One student set up the apparatus shown in Fig. 4.1.

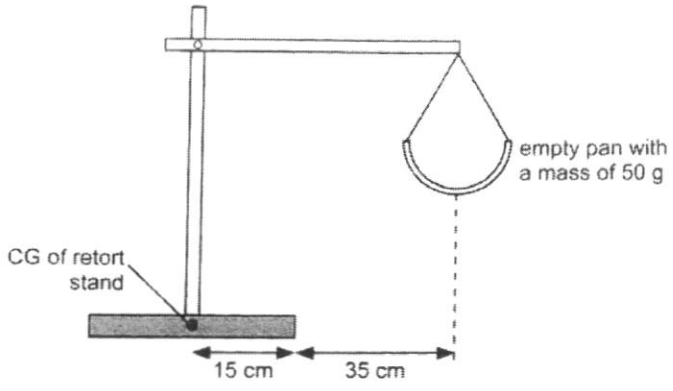


Fig. 4.1

(a) When the student added 400 g to the pan, she noticed that the retort stand was just about to topple. Calculate the mass of the retort stand.

mass of retort stand = ... [2]

(b) List two methods to ensure the retort stand remain stable when more than 400 g is added.

1. .....

2. ..... [2]

5 A man has to lift some crates a vertical distance of 1.0 m from the ground and load them onto the back of his truck. The mass of each crate is 24 kg.

(a) Determine the number of crates he would have to load onto the truck in 10 minutes so that his average power output to lift the crates is 30 W.

number of crates = ... [3]

(b) Sometime later, the man decided to make an inclined plane so that he can push the crates up instead of carrying them. He constructed the inclined plane out of a 2.0 m long wooden plank as shown in Fig. 5.1.

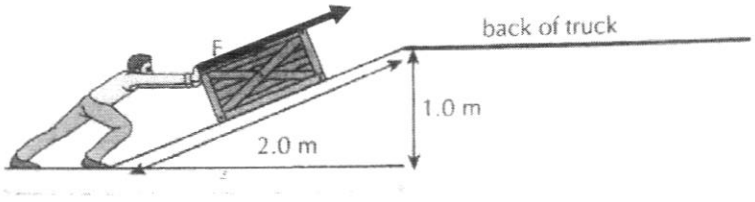


Fig. 5.1

(i) Determine the increase in gravitational potential energy of the crate when it is loaded to the back of the truck.

increase in GPE = ... [1]

(ii) Hence, determine the pushing force, F, applied parallel to the inclined plane by the man.

F = ... [1]

6 Fig. 6.1 shows a storage box made from a layer of shiny, silvery metal.

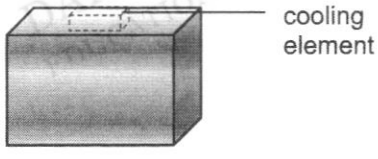


Fig. 6.1

(a) The box is used to store frozen food such as ice cream. Explain whether the storage box is suitable in reducing heat transfer through radiation and conduction.

(i) radiation:

.....

..... [2]

(ii) conduction:

.....

..... [2]

(b) The storage box has a cooling element located near the top of the box.

Explain how the cooling element cools the contents in the box.

.....

.....

..... [2]

(c) The ice cream stored in the box starts to melt.

(i) The temperature remains constant when ice cream melts. Explain why this is so.

.....

..... [2]

(ii) Describe the change in motion of the ice cream particles as the ice cream melts.

.....

..... [1]

7 Two students playing with a slinky noticed that when they move their hands back and forth repeatedly, a regular pattern appears in the spring. The two students stand 1.20 m apart from one another. Student **A** holds one end of the spring firmly in hand while student **B** moves her hand back and forth as shown in Fig. 7.1.

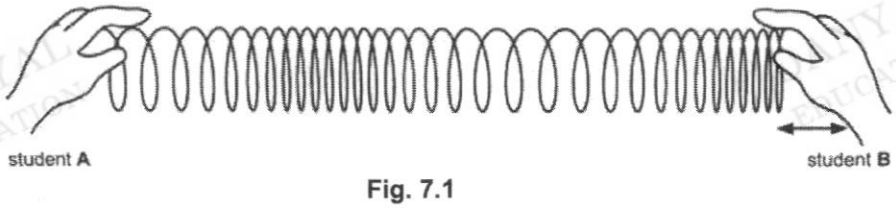


Fig. 7.1

(a) On Fig. 7.1, clearly indicate the direction of the wave travel in the spring with an arrow. [1]

(b) Student **B** moves her hand in a back and forth manner 3 times in 5 s. Calculate the frequency of her movement.

frequency = ... [2]

[Turn over

(c) Calculate the speed of the wave.

speed = ... [2]

(d) Explain if this is a transverse wave or longitudinal wave.

.....

..... [2]

8 A "bug viewer" has a plastic chamber with a lens in the lid. It is used to get a magnified view of small insects placed on the base of the chamber.

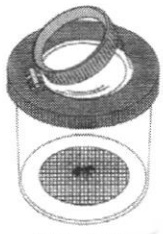


Fig. 8.1

(a) The lens used has a focal length of 60 mm and the base of the chamber is 30 mm from the lens.

Complete Fig. 8.2 by adding rays to show where the image of the bug will be formed.

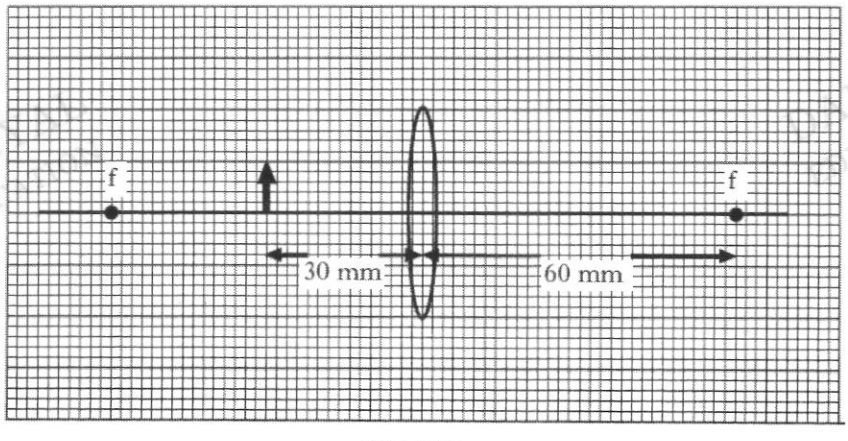


Fig. 8.2

[3]

(b) State the characteristics of the image formed by the "bug viewer".

..... [2]

Section B

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

9 The speed-time graphs for two cars are shown in Fig. 9.1 Both cars set off from the same starting point and travel on the same road.

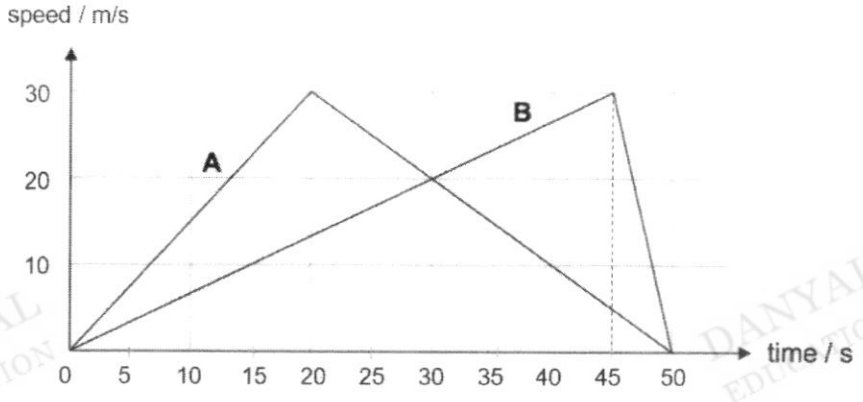


Fig. 9.1

(a) **(i)** Describe the motion of car **A** for the first 20 seconds.

.....

..... [1]

(ii) Calculate the distance travelled by car **A** for the whole journey.

distance = ... [2]

(iii) Hence, or otherwise, determine the average speed of car **A** for the whole journey.

speed = ... [2]

[Turn over

(b) Without the use of any calculations, state whether the two cars will meet at 30 s.

Explain how you arrive at your answer.

.....

.....

.....

..... [2]

(c) Calculate the acceleration of car **B** for the last 5 seconds of the journey.

acceleration = ... [2]

(d) Suggest a possible reason why car **B** reached 30 m/s 25 seconds later than car **A**.

.....

..... [1]

[Turn over

10 Fig. 10.1 shows a skateboarder of mass 60 kg about to descend a curved ramp in a skate park. The acceleration due to gravity is $g = 10\ m/s^2$.

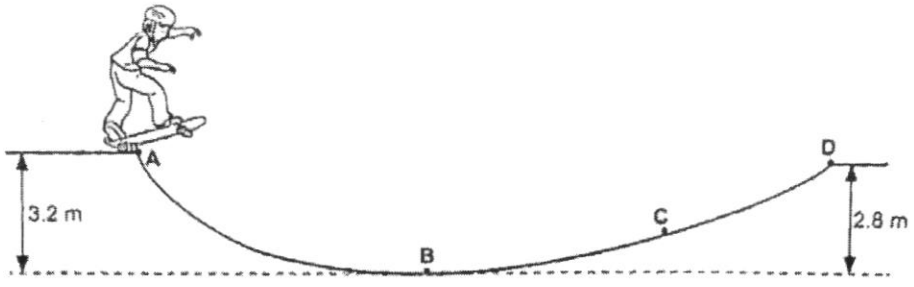


Fig. 10.1

(a) State the Principle of Conservation of Energy.

.....

.....

..... [2]

(b) The skateboarder is initially at rest at A. Assuming there is no frictional force acting, calculate

(i) the kinetic energy the skateboarder would have at B,

kinetic energy at B = ... [2]

(ii) the speed of the skateboarder at B.

speed at B = ... [2]

[Turn over

(c) In reality, the skateboarder has just enough energy to reach D because of friction. If the total length of the track between A and D is 10.0 m, calculate

(i) the energy lost due to friction as the skateboarder moves from A to D,

energy lost = ... [2]

(ii) the magnitude of the average frictional force.

magnitude of average frictional force = ... [2]

11 Fig. 11.1 shows a ray of light **PQR** passing along a simple optical fibre to its end at **R**.

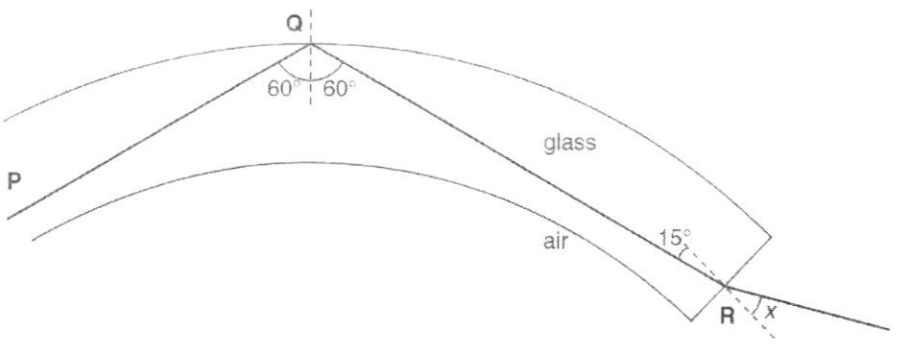


Fig. 11.1

The refractive index of glass is 1.5.

(a) What do you understand by "*refractive index of 1.5*"?

.....

..... [1]

(b) **(i)** Explain why the ray **PQ** does not leave the optical fibre at **Q**.

.....

.....

..... [2]

(ii) Explain why the ray **QR** changes direction at **R**.

.....

..... [1]

(c) The ray **QR** makes an angle of 15° with the normal to the glass surface at **R**.

Calculate the angle *x*, shown on Fig. 11.1.

angle x = ... [2]

[Turn over

(d) Determine the speed of the light ray **PQR** as it passes along the optical fibre.

speed of **PQR** = ... [2]

(e) It is suggested that an optical fibre made with higher refractive index would be more efficient than the one shown in Fig. 11.1.

Explain whether you agree with the suggestion.

.....

..... [2]

END OF PAPER

Sec 3E Science Physics EOY Examination 2022 Marking Scheme

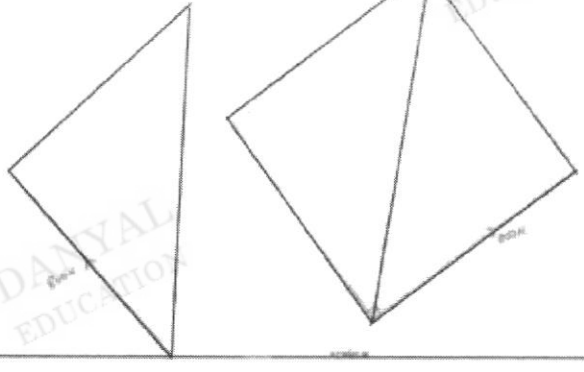
Paper 1

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

Paper 2

Section A

1	(a) - gradient increasing - speed is increasing If student indicates the graph is curving upwards but did not link to increasing speed – [1]	[1] [1]
	(b) estimated max 7 small squares in between the lines — 7 x 4 = 28 m	[1]
	(c) Average speed = total distance / total time = 100 / 11 = 9.09 m/s	[1] (for both formating working [1]

2	suitable scale vector diagram (either complete the parallelogram or tip-to-tail triangle method) resultant force = 1130 N (allow 1110 to 1150N) 	[1] [1] (minus for anything missing)

3	(a)(i) amount of matter / substance in a body	[1]
	(a) (ii) Density = Mass / Volume 0.91 = 0.12 / V V = 0.132 cm^3	[1] (for both formula and working) [1]
	(a)(iii) thickness = 0.132 / (3 x 2) = 0.022 cm	[1] *Allow full e.c.f. for wrong volume in (a)(ii)

	(b) micrometer screw gauge	[1]
	(c) P = F/A = (0.12 / 1000 x 10) / (0.022 x 2) = 0.0272 N/cm^2	[1] (for both formula and working) [1] *Allow full e.c.f. for wrong thickness in (a)(iii)

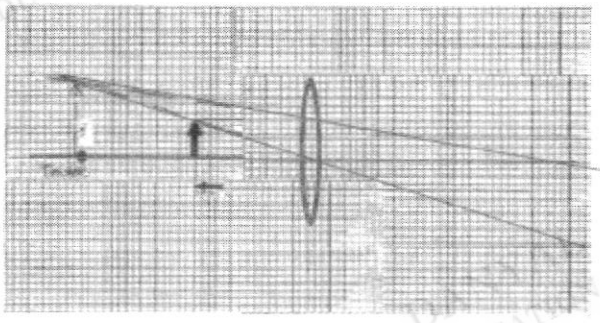
4	(a) By Principle of moments Total clockwise moment = total anticlockwise moment (0.45 x 10)x 35 = m x 10 x 15 m = 1.05 kg	 [1] any correct way of expressing clockwise moment = anticlockwise moment [1]
	(b) add mass to the base of the retort stand Increase the base area of the retort stand	[1] [1]

5	(a) E = Pt mgh = 30 x 10 x 60 m x 10 x 1.0 = 30 x 10 x 60 m = 1800 kg Number of crates = 1800 / 24 = 75	 [1] (for both formula and working) [1] [1]
	(b)(i) Increase in GPE = mgh = 24 x 10 x 1.0 = 240 J	 [1]
	(b)(ii) work done = force x distance 240 = F x 2.0 F = 120 N	 [1]

6	(a)(i) suitable Silver is a poor absorber of radiation, thus rate of heat gain will be slower	[1] [1]
	(a)(ii) not suitable Metal is a good conductor of heat, rate of heat gain will be faster	[1] [1]
	(b) The air is cooled, becomes denser and sinks. Warm air is less dense and rises, forming convection currents *convection currents must be mentioned for the full 2 marks to be given.	[1] [1]
	(c)(i) Thermal energy is used to overcome forces of attraction / intermolecular bonds To increase the internal potential energy and not the kinetic energy of the particles Hence temperature remains constant	[1] [1]

	(c)(ii) The particles start to slide past one another from vibrating about fixed positions.	[1]

7	(a) to the left	[1]
	(b) frequency = 3/5 = 0.60 Hz	[1] [1]
	(c) v = fλ = 0.60 (1.2/1.5) = 0.48 m/s *students must see that the distance between the students is 1.5 wavelength of wave	[1] (for both formula and working) [1] *Allow full e.c.f. for wrong frequency in (b)
	(d) longitudinal Direction of wave travel parallel to direction of vibration of particles	[1] [1]

8	(a) Any 2 correct light rays Dotted image 	[2] [1]
	(b) magnified virtual upright 1 correct characteristic - (0) 2 correct characteristics - (1)	[2]

Section B

9	(a)(i) constant acceleration	[1]
	(a)(ii) Distance traveled = ½ x 30 x 50 = 750 m	[1] [1]
	(a)(iii) Average speed = total distance / total time = 750 / 50 = 15 m/s	[1] (for both formula and working) [1] *Allow full e.c.f. for wrong distance in (a)(ii)
	(b) No. The area under the graph for A is larger than that of B (or vice versa)	[1] [1]
	(c) a = (v – u) / t = (0 – 30) / 5 = - 6.0 m/s²	[1] (for both formula and working) [1]
	(d) smaller force applied / greater mass (greater inertia)	[1]

10	(a) Energy cannot be created nor destroyed. It can only be converted from one form to another. The total energy in the isolated system remains constant.	[1] [1]
10	(b)(i) Loss in GPE = Gain in KE KE at B = mgh = 60 x 10 x 3.2 = 1920 J	[1] (for both formula and working) [1]
	(b)(ii) KE = ½ mv^2 1920 = ½ x 60 x v^2 v = 8.0 m/s	[1] (for both formula and working) [1] *Allow full e.c.f. for wrong KE in (a)(i)
	(c)(i) Energy lost = 1920 – 60x 10 x 2.8 = 240 J	[1] [1] *Allow full e.c.f. for wrong KE in (a)(i)
	(c)(ii) Work done = force x distance 240 = force x 10 force = 24 N	[1] (for both formula and working) [1] *Allow full e.c.f. for wrong energy lost in (b)(i)

11	(a) Ratio of the speed of light in vacuum to the speed of light in the medium is 1.5	[1]
	(b)(i) total internal reflection occurred As angle of incidence at Q is greater than the critical angle	[1] [1]
	(b)(ii) angle of incidence at R is now less than critical angle and light ray is refracted out.	[1]
	(c) η = sin i / sin r 1.5 = sin x / sin 15 x = 22.8°	[1] (for both formula and working) [1]
	(d) η = c/v 1.5 = 3.0 x 10^8 / v v = 2.0 x 10^8 m/s	[1] (for both formula and working) [1]
	(e) Agree with suggestion The critical angle will be even lower and possibilities of total internal reflections taking place will be even higher. Less energy will be lost.	[1] [1]