COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2020
SECONDARY 4 EXPRESS PHYSICS

Name: _____( ) Class: _____

Physics	**6091/01**
Paper 1 Multiple Choice	**Friday 18 September 2020**
	1000 – 1100
Additional Materials: Multiple Choice Answer Sheet	**1 hour**

READ THESE INSTRUCTIONS FIRST
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces.

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 answer in **soft pencil** on the separate answer sheet.

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.

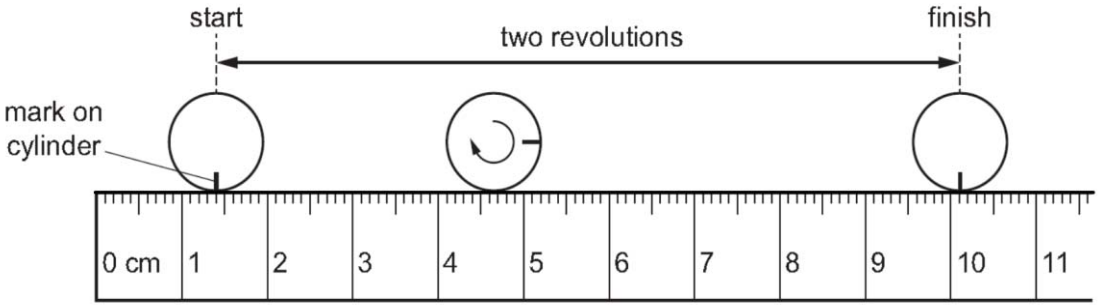
Name of setter: Mrs Wong Sok Foon

Answer **all** questions

1 What is the order of magnitude of the diameter of an atom?

A 10^{-7} cm **B** 10^{-7} mm **C** 10^{-7} nm **D** 10^{-7} μm

2 A small cylinder is rolled along a ruler and completes two revolutions.



The circumference is the distance around the outside of a circle.

What is the circumference of the cylinder?

A 4.4 cm **B** 5.2 cm **C** 8.7 cm **D** 10.1 cm

3 Fig 2.1 shows part of the vernier scale on a pair of vernier calipers when no object was placed between the jaws. Fig 2.2 shows the same vernier calipers when the diameter of a rod was measured.

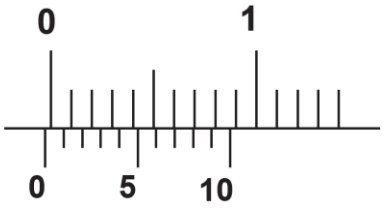


Fig. 2.1

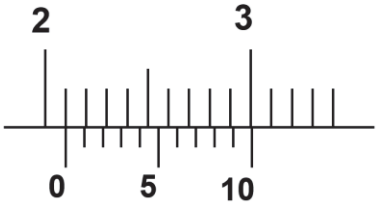
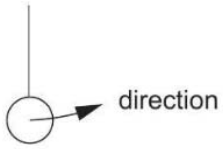


Fig. 2.2

Which is the correct reading of the diameter of the rod?

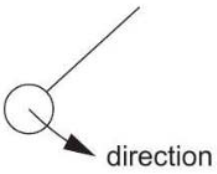
A 2.03 cm **B** 2.13 cm **C** 2.17 cm **D** 3.07 cm

4 A pendulum has a period of 1.0 s. A stopwatch is started when the pendulum is vertical and is moving to the right as shown.

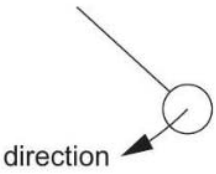


Which diagram shows the position and direction of the pendulum 2.5 s later?

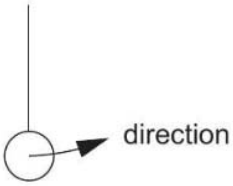
A



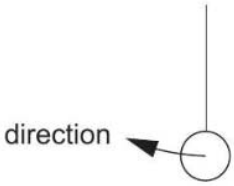
B



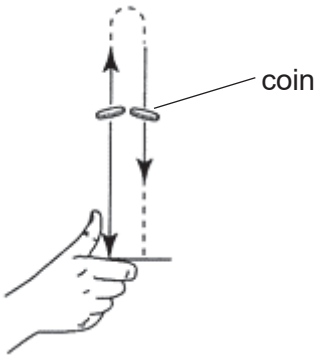
C



D

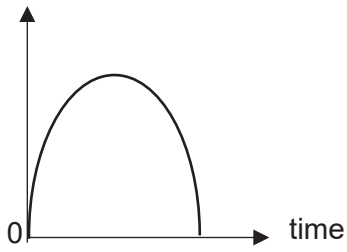


5 A student tosses a coin up as shown.

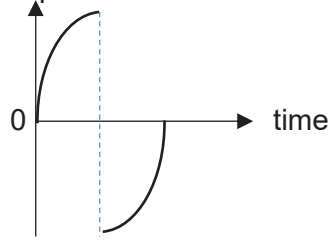


Which of the following graph is correct?

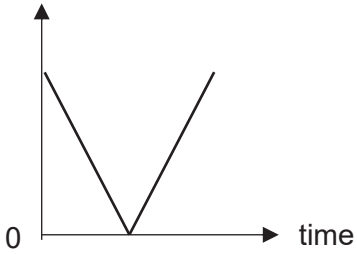
A



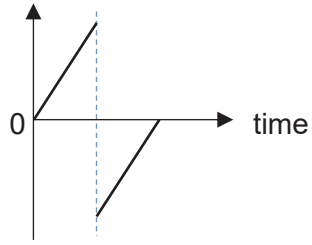
B



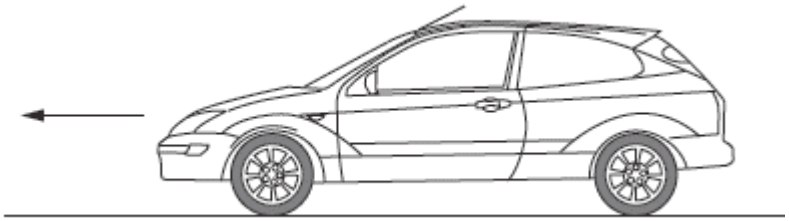
C



D



6 The front-wheel of the car is rotated by the car's engine. The car accelerates in the direction shown.



Which row best shows the direction of the total force exerted by the road on the front and back wheels?

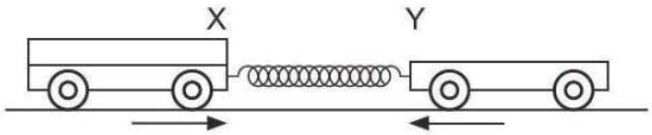
	front wheels	back wheels
A	→	→
B	→	←
C	←	→
D	←	←

7 A car of mass 700 kg is capable of exerting a maximum engine force of 5000 N. When travelling along a typical road, it has a maximum acceleration of 5.0 m/s^2.

What is the total resistive force acting on the car?

A 36 N **B** 1500 N **C** 3500 N **D** 5000 N

8 Trolley X and trolley Y are joined by a stretch of spring. Trolley X has twice the mass of trolley Y.



When the trolley are released, the initial acceleration of X is 2 m/s^2 to the right.

What is the initial acceleration of trolley Y to the left?

A 1 m/s^2 **B** 2 m/s^2 **C** 3 m/s^2 **D** 4 m/s^2

9 An astronaut has a mass of 80 kg on Earth. He can jump to a vertical height of 1.50 m on the surface of the Earth.

Which row describes the height that he can jump on the Moon and the reason?

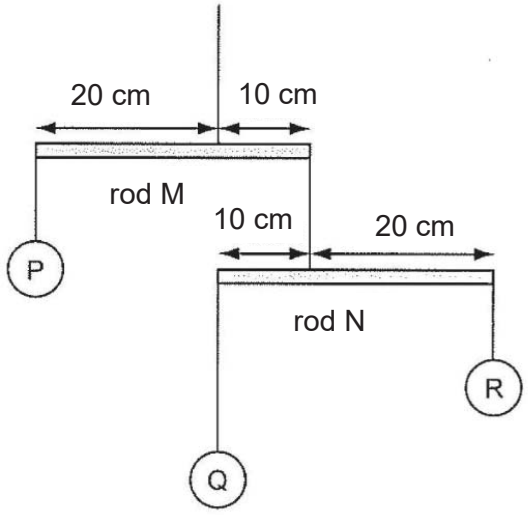
	height he can jump on Moon	reason
A	higher than 1.50 m	his mass is less on the Moon.
B	higher than 1.50 m	his weight is less on the Moon
C	1.50 m	his mass is the same on the Moon
D	lower than 1.50 m	his weight is the same on the Moon

10 A cuboid of dimensions 20.0 cm by 10.0 cm by 5.0 cm and mass 4.0 kg is cut equally into 6 pieces.

What is the density of one of the 6 pieces?

A 0.00067 kg/m^3
B 0.0040 kg/m^3
C 670 kg/m^3
D 4000 kg/m^3

11 The diagram below shows a decoration, which is made by suspending objects P, Q and R from light rods M and N. The masses of P, Q and R are such that the rods are horizontal.

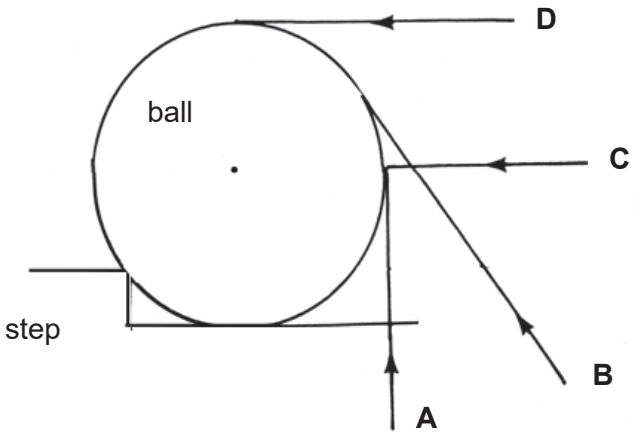


Which row gives a possible combination of the masses of P, Q and R?

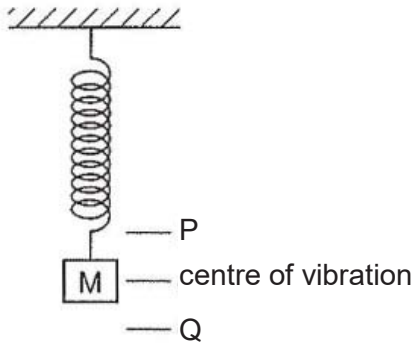
	mass of P/ g	mass of Q/ g	mass of R/ g
A	10	10	10
B	15	10	10
C	15	20	10
D	20	40	20

12 A man tries to push a ball up a step.

Which of the forces **A**, **B**, **C** or **D** would be the **smallest** force exerted?



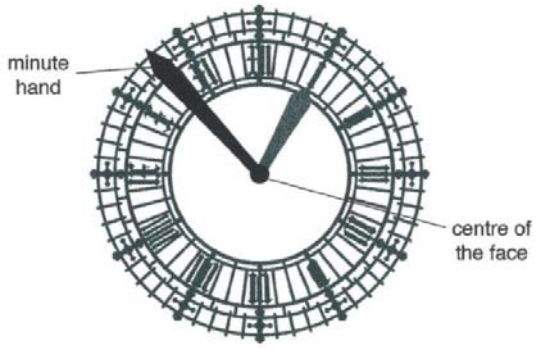
13 A mass M is hung from a spring. It is then pulled down slightly and allowed to vibrate vertically between P and Q.



Which row is correct?

	energy at point P	energy at point Q
A	kinetic	kinetic
B	kinetic	potential
C	potential	kinetic
D	potential	potential

14 The diagram below shows the minute hand of a large clock whose face is vertical.

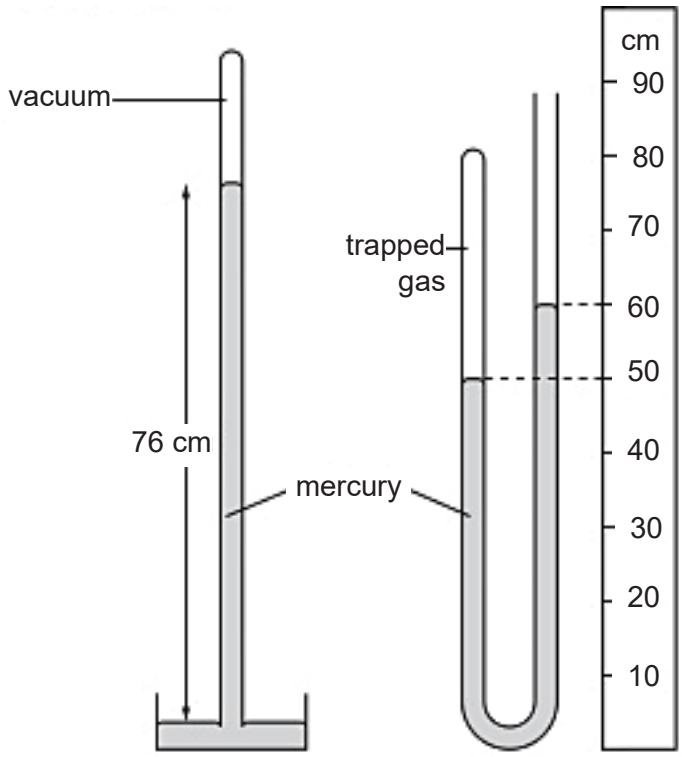


The minute hand has a weight of 40 N and takes 1.0 hour to make one complete rotation of the clock face. The centre of gravity of the minute hand is 1.0 m from the centre of the face. Neglect the effect of friction in the clock and the air-resistance.

What is the average power required to move the minute hand from pointing vertically downwards to vertically upwards?

A 0.044 W **B** 0.44 W **C** 2.7 W **D** 27 W

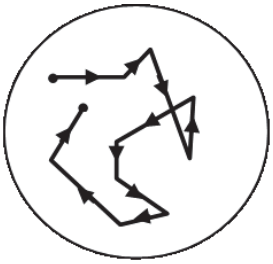
15 The diagram below shows a simple mercury barometer alongside a mercury manometer. The manometer contains some trapped gas.



What is the pressure of the trapped gas?

A 50 cm Hg **B** 60 cm Hg **C** 66 cm Hg **D** 86 cm Hg

16 Smoke particles in an illuminated transparent box are observed using a microscope. A small point of light is seen to move around as shown.



What can be inferred from this observation?

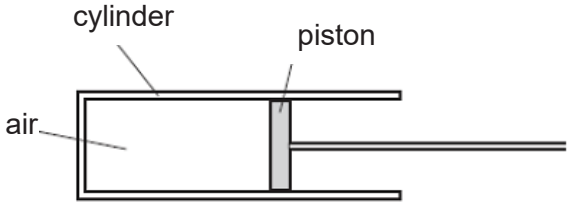
A The air molecules are in constant, random motion.

B The kinetic energy of the smoke particles is supplied by the light illuminating them.

C The smoke particles constantly attract and repel each other.

D There are convection currents in the box.

17 Air is trapped in a cylinder by a piston. The piston is pushed further into the cylinder while the temperature remains constant.



How do the average speed of the molecules and pressure change?

	average speed of molecules	Pressure
A	increases	increases
B	increases	unchanged
C	unchanged	increases
D	unchanged	unchanged

18 A non-calibrated liquid-in-glass thermometer has a mercury length of 3.0 cm when placed in pure melting ice. When placed in a mixture of temperature 36 °C, its length increases by 8.0 cm.

What is the length of the mercury when placed in boiling water?

A 19 cm **B** 22 cm **C** 25 cm **D** 31 cm

19 An insulated beaker contains 300 g of water, initially at 30 °C. Water at 100 °C is added until the temperature of the mixture reaches 50 °C.

The specific heat capacity of water is 4.2 J / (g °C).

How much water is added?

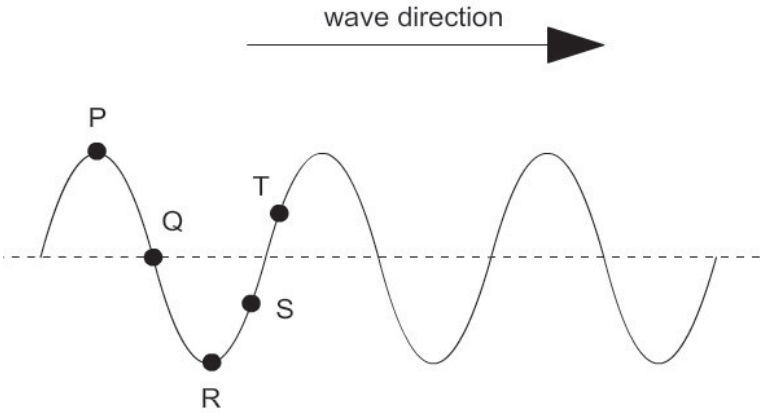
A 60 g **B** 120 g **C** 180 g **D** 750 g

20 Some of the liquid in a dish evaporates, as shown in the diagrams.

Which of the following about the molecules is correct?

	molecules that leave have	molecules in the liquid have greater average kinetic energy
A	more energy	before evaporation
B	more energy	after evaporation
C	lower energy	before evaporation
D	lower energy	after evaporation

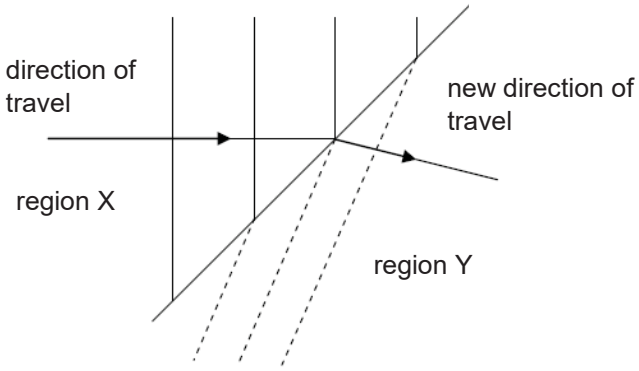
21 The diagram below shows a transverse wave moving to the right.



Which of the five points on the wave are moving upwards at the instant shown?

A P and T **B** Q and R **C** R and S **D** R, S and T

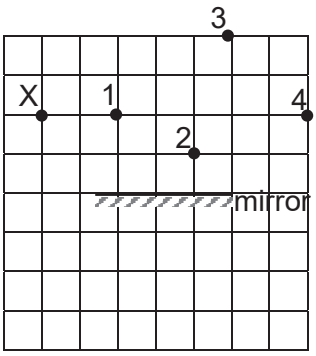
22 Water waves travel from region X to region Y.



Which row gives the speed of water waves and depth of water in region Y in comparison to X as the wave travels from X to Y?

	speed in region Y	depth of water in region Y
A	faster	deeper
B	faster	shallower
C	slower	deeper
D	slower	shallower

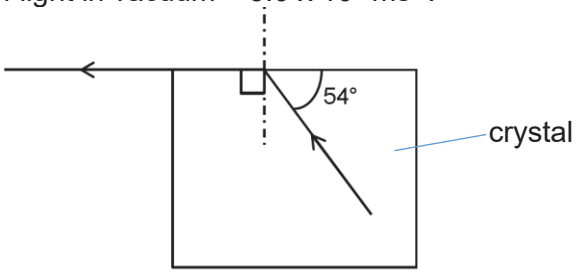
23 A student stands at point X as shown in the diagram. There are 4 objects placed at various positions 1, 2, 3 and 4.



Which objects will the student be able to see in the mirror from point X?

A 1 and 2 only **B** 1, 2 and 3 **C** 2, 3 and 4 **D** 1, 2, 3 and 4

24 In the diagram below, a ray of light within a crystal strikes the surface of the crystal and exits the crystal as shown. Speed of light in vacuum = 3.0×10^8 ms^{-1}.



What is the speed of light in the crystal?

A 1.2×10^8 ms^{-1} **B** 1.8×10^8 ms^{-1} **C** 2.4×10^8 ms^{-1} **D** 3.0×10^8 ms^{-1}

25 A laser shoots a ray of light into a stack of 3 different transparent material as shown in the diagram.

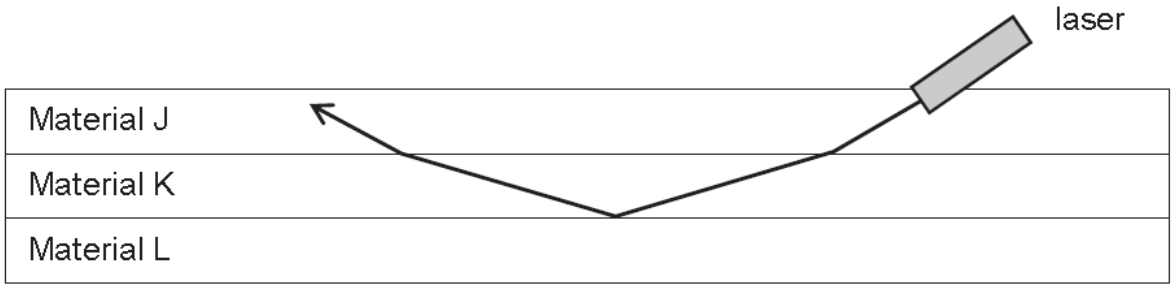


Diagram is not drawn to scale

Which of the following shows their correct refractive indices?

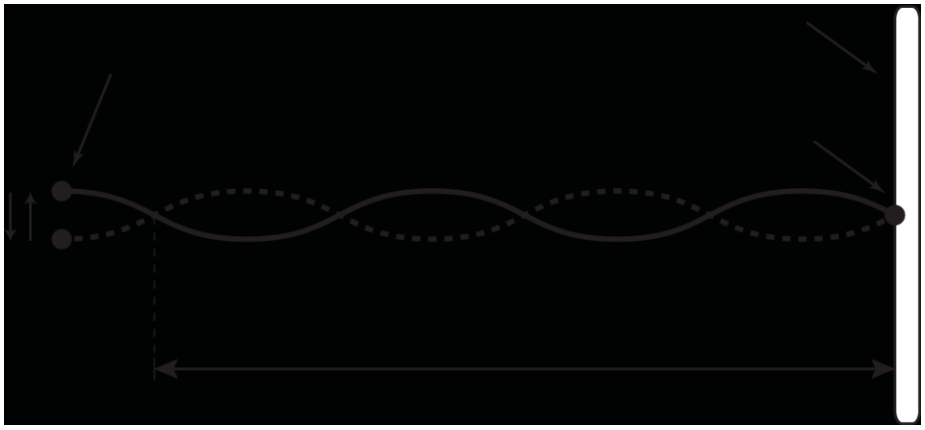
	Material J	Material K	Material L
A	1.13	1.44	1.52
B	1.44	1.13	1.52
C	1.13	1.52	1.44
D	1.52	1.44	1.13

26 Ultrasound is used to map the ocean floor. During one survey, the depth of water is 1200 m. An ultrasound pulse is sent from the surface and when it returns to the ship, another pulse is sent immediately. In a period of 8.0 s, five pulses are sent down from the surface and received.

What is the speed of the ultrasound in water?

A 300 m/s **B** 1500 m/s **C** 1900 m/s **D** 3800 m/s

27 The diagram shows waves set up in a rope by a student moving the free end up and down at a steady rate.



What is the wavelength of the waves shown, and what will be the wavelength when the student doubles the frequency at which the free end is moved up and down?

	wavelength as shown	wavelength when frequency is doubled
A	0.50 m	1.00 m
B	0.50 m	0.50 m
C	1.00 m	1.00 m
D	1.00 m	0.50 m

28 Why are humans **not** able to hear ultrasound?

A The amplitude is too low.

B The frequency is too high.

C The speed is too low.

D The wavelength is too long.

29 Which statement about radio waves is correct?

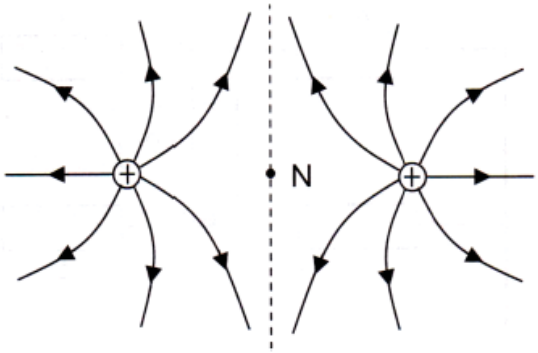
A They are refracted when they passed through a different medium.

B They are used for transmitting information in optical fibre.

C They travel as longitudinal waves in air.

D They travel in air at an approximate speed of 300 m/s.

30 The diagram shows an electron placed at point N in an electric field. Point N is mid-way between the two equally strong positive charges.



Which statement is correct?

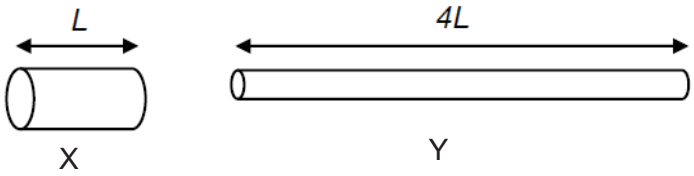
A The electron does not move.

B The electron moves downwards.

C The electron moves out of the plane of the paper.

D The electron moves to the right.

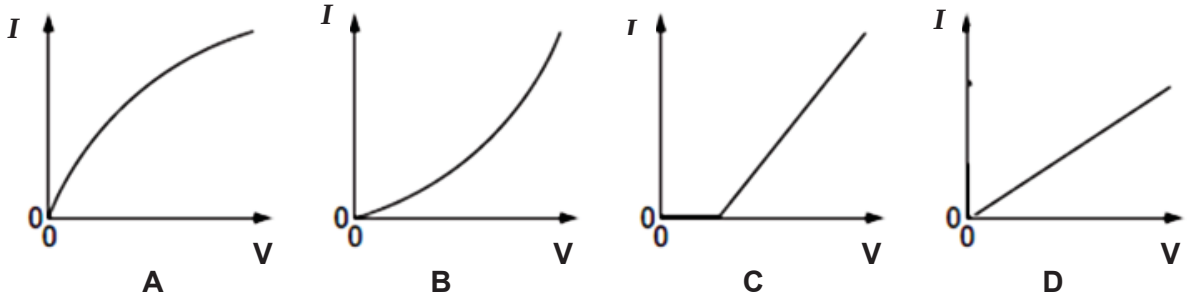
31 Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.



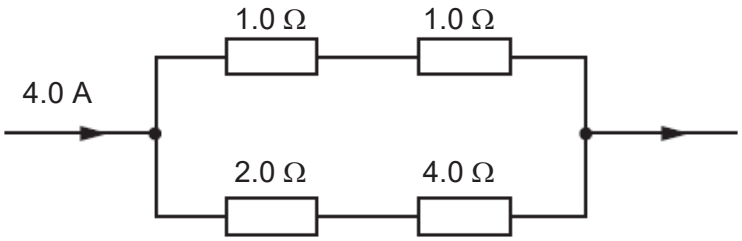
What is the ratio of the resistance of wire Y to the resistance of wire X?

A 4 **B** 8 **C** 16 **D** 24

32 Which of the following graph shows the correct current-voltage (I-V) relationship for a filament lamp?



33 The diagram shows part of an electric circuit.



What is the current through the 4.0 Ω resistor?

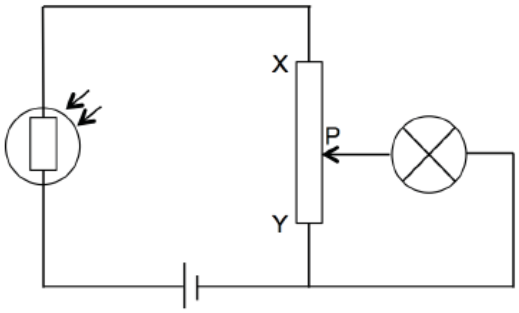
A 0.5 A **B** 1.0 A **C** 2.0 A **D** 3.0 A

34 A defibrillator is a device that is used to give an electric shock to a patient's heart. It supplies an electric shock with energy 240 J at an average voltage of 2000 V for 10 ms.

What is the average current it supplies in each shock?

A 0.012 A **B** 1.2 A **C** 12 A **D** 120 A

35 The circuit diagram shows a lamp, light-dependent resistor and potential divider.



Which adjustments will cause the lamp to be the **brightest**?

A Light is shining on the LDR and P is moved to X.

B Light is shining on the LDR and P is moved to Y.

C The LDR is covered and P is moved to X.

D The LDR is covered and P is moved to Y.

36 Why is a fuse used in an electrical appliance?

A to control the amount of current flowing through the appliance

B to earth the appliance

C to protect the appliance from being damaged

D to protect the user from being electrocuted

37 An electric cooker has a hotplate rated at 1500 W and an oven rated at 2000 W. In a day, the hotplate is switched on for 1.0 hour and the oven is switched on for 3.0 hours. The cost of electricity is 24 cents per kWh.

What is the cost of using the electric cooker in one day?

A 56 cents **B** 84 cents **C** 180 cents **D** 336 cents

38 Which statement about the use of energy source to generate electricity is correct?

A Fossil fuel is efficient but causes air pollution.

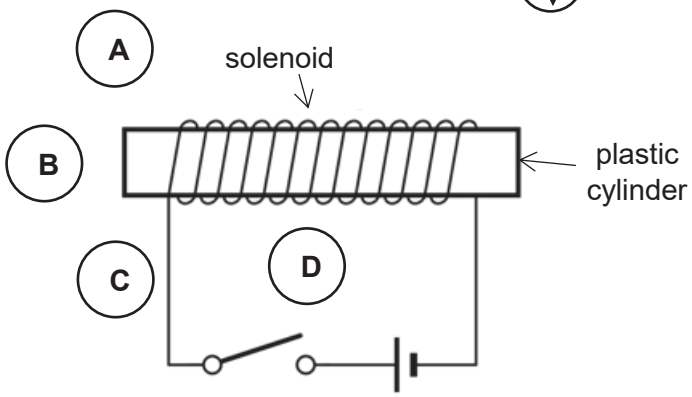
B Hydroelectric power is not efficient but cost per kWh to produce is low.

C Solar energy is highly efficient and pollution free.

D Wind power is highly efficient and pollution free.

39 Four plotting compasses are placed near a solenoid wound around a plastic cylinder. You may ignore any effects of the Earth's magnetic field.

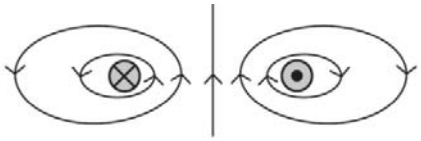
In which position does the compass appear like this  when the switch is closed?



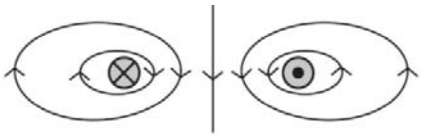
40 Each of the diagrams below is a cross-section through two parallel current-carrying conductors.

Which diagram correctly shows the magnetic field pattern formed by the currents in the two conductors?

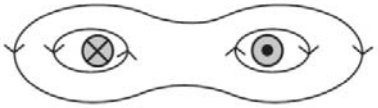
A



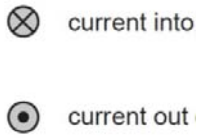
B



C



D



End of Paper

Answer

1. B	11. C	21. B	31. C
2. A	12. B	22. D	32. A
3. B	13. D	23. C	33. B
4. D	14. A	24. B	34. C
5. A	15. D	25. D	35. A
6. C	16. A	26. B	36. C
7. B	17. C	27. D	37. C
8. D	18. C	28. B	38. A
9. B	19. B	29. A	39. C
10. D	20. A	30. A	40. B

COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2020
SECONDARY 4 EXPRESS PHYSICS

Name: _____ Class: _____

_____( )

Physics **6091/02**

Paper 2 Theory **Tuesday 15 September 2020**

1100 – 1245

Candidates answer on the Question Paper. **1 hour 45 minutes**

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST
Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagram or graph.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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.

80

Name of setter: Mrs Wong Sok Foon

Section A

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

1 Fig 1.1 shows the displacement-time graph of a remote-controlled toy car.

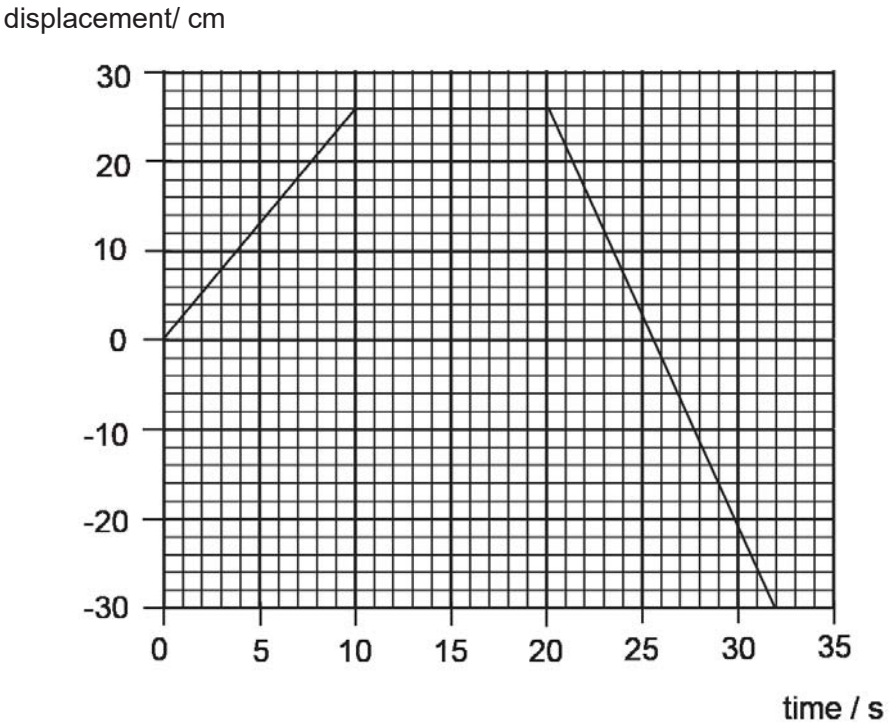


Fig 1.1

(a) Describe the motion of the toy car from 0 s to 32 s.

……

……

……

……

…… [3]

(b) Suggest a suitable electromagnetic wave for controlling the toy car remotely.

…… [1]

2 The skateboarder stands with both his feet on a stationery skateboard. Fig 2.1 shows the moment he jumps off his skateboard.

Fig 2.1

The skateboard moves backwards as the skateboarder jumps forwards.

(a) Using Newton's Law, explain why the skateboarder moves forwards while the skateboard moves backwards.

……

……

……

…… [2]

(b) State the useful energy change that occurs as the skateboarder jumps forwards.

……

…… [1]

(c) The mass of the skateboarder is 42 kg. He jumps forwards at a velocity of 0.30 m/s.

(i) Calculate the kinetic energy of the skateboarder.

kinetic energy = …… [2]

(ii) Describe how the skateboarder does work on the air.

……

…… [1]

(iii) State what eventually happened to the work done by the skateboarder on the air.

……

…… [1]

3 Before a new bus can be used on the roads, it must pass a stability test.
Fig 3.1 shows how the bus is tested.

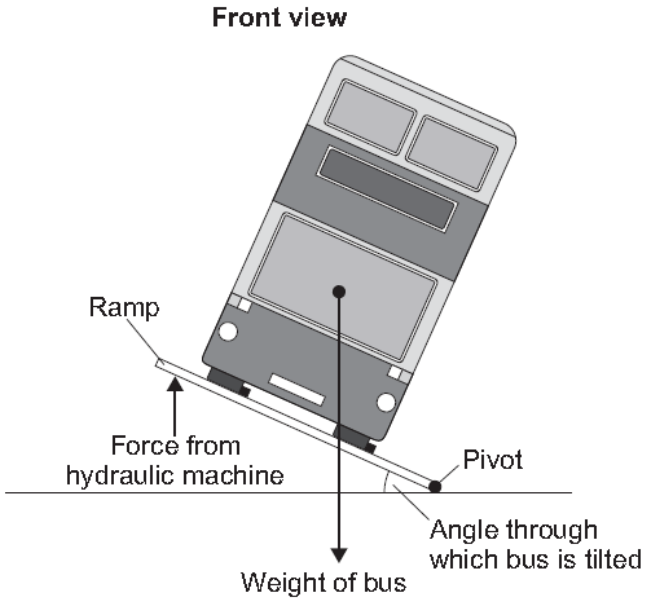


Fig 3.1

(a) Explain why the bus does not topple over at the position shown in Fig 3.1.

……

……

……

…… [2]

(b) During the test, the bus is tilted at an angle far greater than it would experience in normal use to ensure that it is safe for use.
Suggest a reason for the need to subject the bus through a greater angle of tilt.

……

…… [1]

(c) Fig 3.2 shows the hydraulic machine that is used to make the ramp tilt.

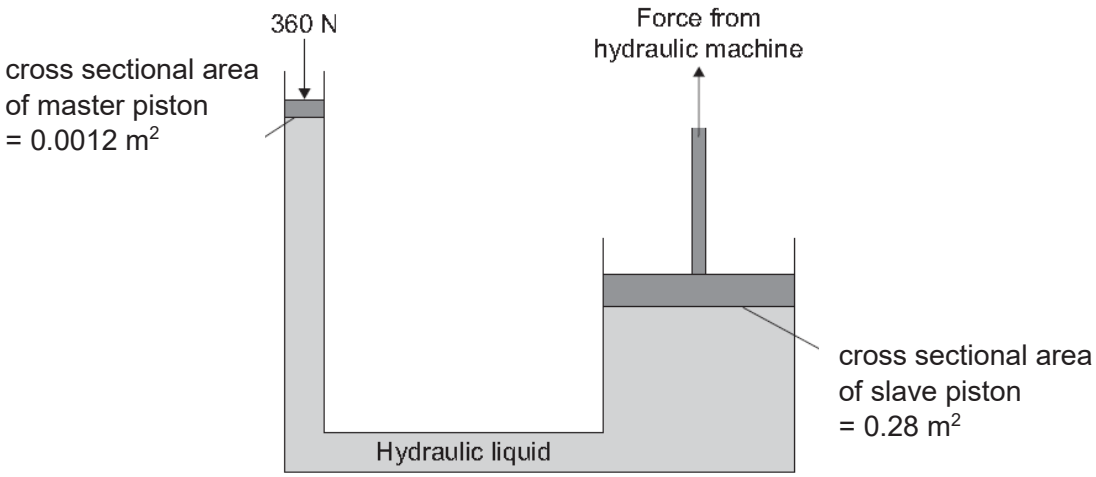


Fig 3.2

The pressure applied to the hydraulic liquid at the master piston is the same as the pressure applied by the hydraulic liquid to the slave piston.

(i) State the property of the liquid that keeps the pressure at both pistons the same.

……

…… [1]

(ii) A 360 N force acts on the master piston.
Use information from Fig 3.2 to calculate the force applied by the hydraulic liquid to the slave piston.

force = …… [2]

4 **(a)** Fig. 4.1 shows a ray of light, from the top of an object PQ, passing through two glass prisms.

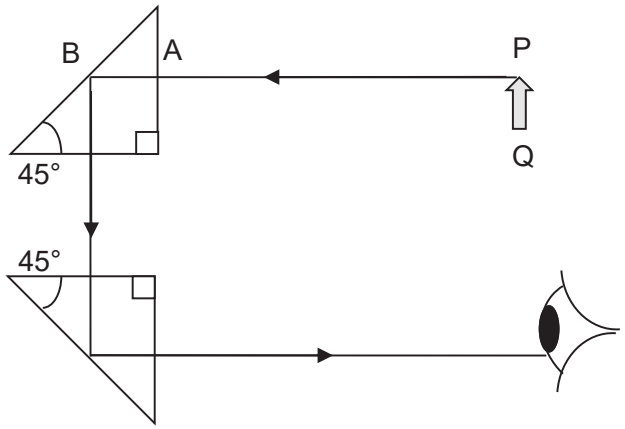


Fig. 4.1

(i) The speed of light as it travels from P to A is 3.0×10^8 m/s and the refractive index of the prism glass is 1.6. Calculate the speed of light in the prism.

speed = ... [1]

(ii) Calculate the critical angle of the glass prism.

critical angle = ... [2]

(b) Fig. 4.2 shows ray of light from the top of an object passing through a lens.

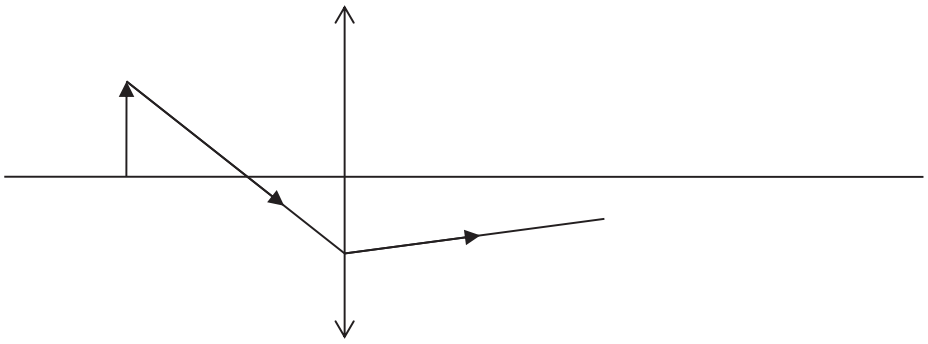


Fig. 4.2

(i) Draw another light ray from the object so that the image of the object can be located. Label the image **I**. [1]

(ii) Locate the principal focus of the lens by drawing another light ray from the object. Label the principal focus **F**. [1]

(iii) Describe one significant change to the characteristics of the image produced if part of the lens is broken and only the remaining lens is used.

……..…….……..……

……..…….. [1]

(iv) State how the lens should be moved in order to produce a smaller size image.

……..…….……..……

……..…….. [1]

5 Fig. 5.1 shows part of a machine used to investigate electrostatic charging.

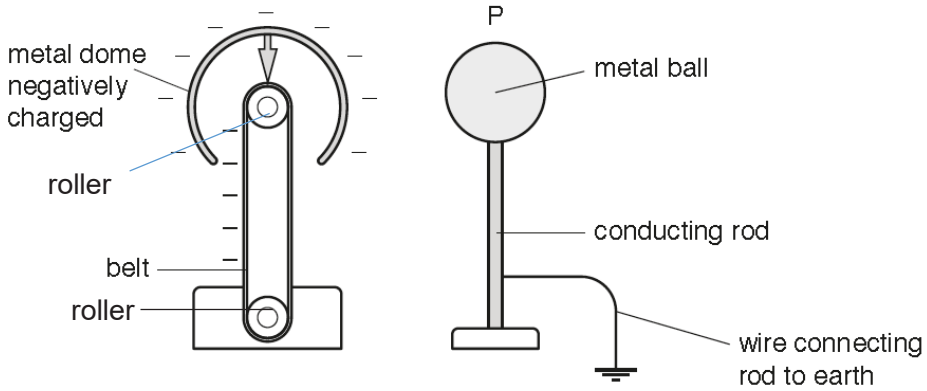


Fig 5.1

Before the machine is switched on, the metal dome and the ball are uncharged.
When the machine is switched on, the belt rubs against the rollers and becomes negatively charged. The belt carries negative charges to the dome, making it negatively charged.

(a) Explain how the belt becomes negatively charged.

……

……

……

…… [2]

(b) Explain how the charging dome caused metal ball P to become positively charged.

……

……

……

…… [2]

(c) On Fig. 5.1, draw the charges on the metal ball. [1]

(d) An electric field is set up between the dome and the metal ball.

(i) State what is meant by *electric field*.

……

…… [1]

(ii) When the electric field between the dome and the sphere is large enough, a spark jumps between the dome and the metal sphere. A charge of 0.0016 mC flows in a time of 0.0012 s.

Calculate the current produced.

current = …… [2]

6 A student connects a battery to a resistor and a bulb as shown in Fig. 6.1

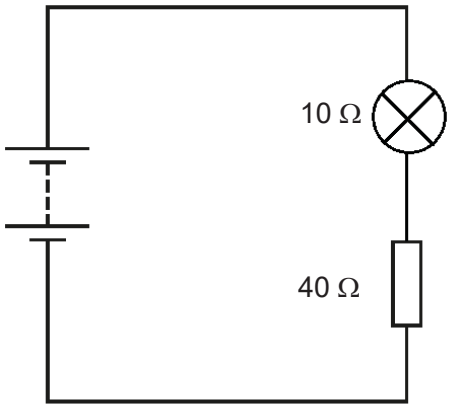


Fig 6.1

The potential difference (p.d.) across the 40 Ω resistor is 9.6 V.

(a) State what is meant by the *potential difference is 9.6 V* across a resistor.

……

……

…… [2]

(b) Calculate the current through the bulb.

current = …… [2]

(c) Calculate the power produced in the bulb.

power = …… [2]

(d) The student adds a resistor R to the circuit as shown in Fig 6.2.

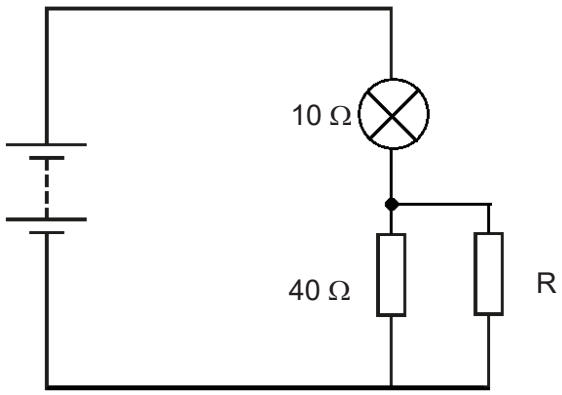


Fig 6.2

State and explain what happen to the brightness of the bulb.

……

……

……

…… [2]

7 An electric hairdryer and an electric oven are connected to the mains supply.
The cable from the oven to the mains supply has a live, a neutral and an earth wire.

(a) State the purpose of the neutral wire.

……

…… [1]

(b) The live wire in the electric oven touches the outer metal case.
Explain how the earth wire and the fuse together protect the user from electric shock.

……

……

……

…… [2]

(c) The hairdryer does not have an earth wire. Explain why this hairdryer is still safe to use.

……

…… [1]

8 A permanent magnet is held near an iron ball but not in contact with the iron ball. The iron ball swings towards the permanent magnet as shown in Fig 8.1.

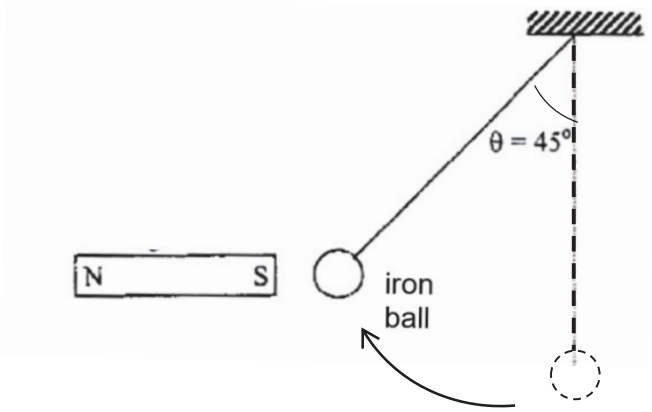


Fig 8.1

(a) Explain why the iron ball swings towards the magnet.

……

……

……

…… [2]

(b) The mass of the iron ball is 100 g.
When a horizontal bar magnet is held firmly about 2 cm away from the iron ball, the string attached to the iron ball makes an angle of θ = 45° from the vertical as shown in Fig 8.1.

The gravitational field strength *g* is 10N/kg.

(i) Calculate the weight of the iron ball.

weight = …… [1]

(ii) When the ball is stationery and next to the magnet as shown in Fig 8.1, the magnet exerts a magnetic force on the ball.

In the space below, draw a scale diagram to determine the magnitude of the force on the iron ball by the magnet.

force = …… [3]

Section B

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

9 A simulation of a roller coaster ride is done to investigate how the speed of the carriage is affected by the shape of the track as shown in Fig. 9.1. Track **X** is frictionless.

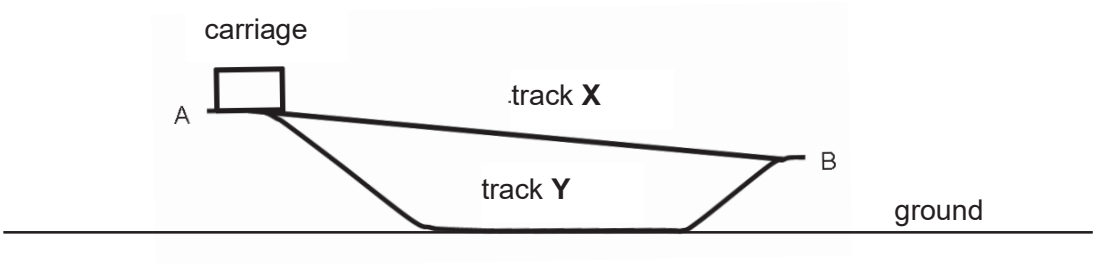


Fig 9.1

The carriage is released at point A. The speed of the carriage along each track is measured at various times until the carriage reaches point B. Fig. 9.2 shows the reading obtained.

	data 1	**data 2**
time/s	speed/ ms^{-1}	speed/ ms^{-1}
0	0	0
0.20	0.90	0.25
0.40	1.80	0.50
0.60	2.70	0.75
0.80	2.70	1.00
1.00	2.70	1.25
1.20	2.70	1.50
1.40	2.60	1.75
1.60	2.50	2.00
1.80	-	2.25
2.00	-	2.50

Fig 9.2

(a) (i) Explain how **data 2** in Fig 9.2 shows it corresponds to the motion of the carriage travelling along track **X**.

……..……

…… [1]

(ii) Calculate the length of track **X**.

length = …… [2]

(iii) Fig 9.3 shows the carriage at t = 0.20 s along track **X**.

Fig 9.3

One force, the weight of the carriage, is shown in Fig 9.3.
On Fig 9.3, draw and label another force that acts on the carriage. [1]

(iv) The mass of the carriage used for the simulation is increased.
State and explain the difference in final speed of the carriage on track **X**.

……

……

…… [2]

(b) (i) Using **data 1** in Fig 9.2, calculate the acceleration of the carriage at t = 0 s.

acceleration = …… [2]

(ii) Using **data 1** in Fig 9.2, explain how it can be deduced that track **Y** is frictionless.

……

……

…… [2]

10 Fig. 10.1 shows a simplified design of an air-conditioning unit. Warm air is drawn into the unit by operating a fan such that the air runs over a coiled pipe containing a coolant liquid. The air loses thermal energy to the coolant and leaves the unit as cooled air.

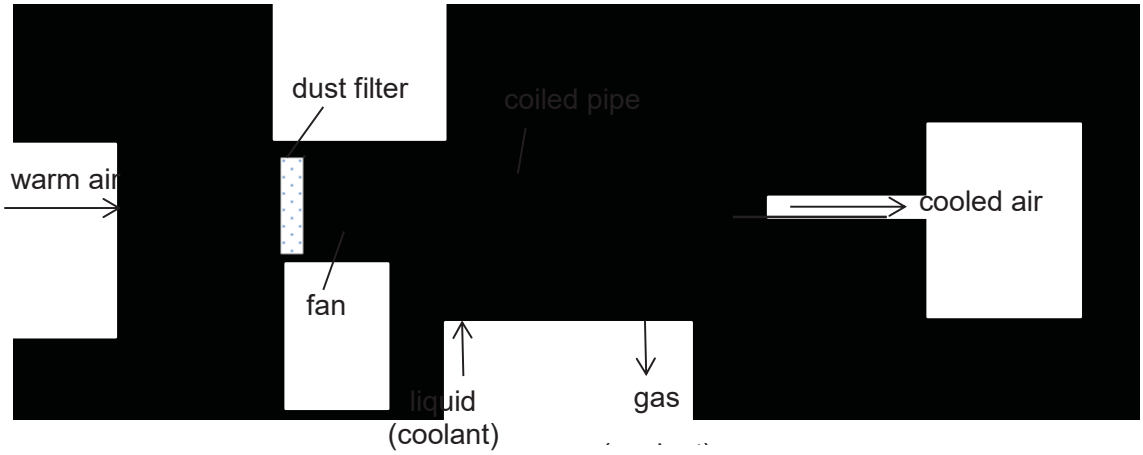


Fig.10.1

The coolant which is initially a liquid absorbs heat from the warm air and evaporates. The process of evaporation enables more thermal energy to be absorbed by the coolant to make the air much cooler.

(a) (i) Explain, in terms of molecules, why the evaporation of the coolant inside the pipe makes the air cooler.

……

……

……

…… [2]

(ii) Explain why the coolant is circulated in a pipe that is coiled instead of straight within the air-conditioning unit.

……

……

……

…… [2]

(b) The air-conditioning unit is able to remove thermal energy from the air at a rate of 1200 W. In one second, 85 g of air at 35 °C enters the air-conditioning unit and emerges as cold air. The heat capacity of the air is 94 J/°C.

Calculate the average temperature of the cold air that emerges.

temperature = …… [2]

(c) Fig. 10.2 shows the comparison of the properties of two different liquids to be considered as the coolant.

liquid	specific heat capacity / kJ $kg^{-1}K^{-1}$	specific latent heat of vaporisation / kJ kg^{-1}
Y	3.8	2000
Z	1.2	300

Fig. 10.2

Using the data in Fig. 10.2, state and explain which is a more suitable liquid to be used as the coolant.

……

……

……

…… [2]

(d) State which of the following materials would be most suitable for the pipe in the air-conditioning unit as shown in Fig 10.1.

Black plastic; white plastic; glass; black-painted copper; polished steel.

……

Give two reasons for the choice of material.

1. ……

2. …… [2]

11 EITHER

(a) Fig. 11.1 shows part of a loudspeaker made by a student. A coil is attached to a paper cone and is suspended freely next to a permanent magnet.

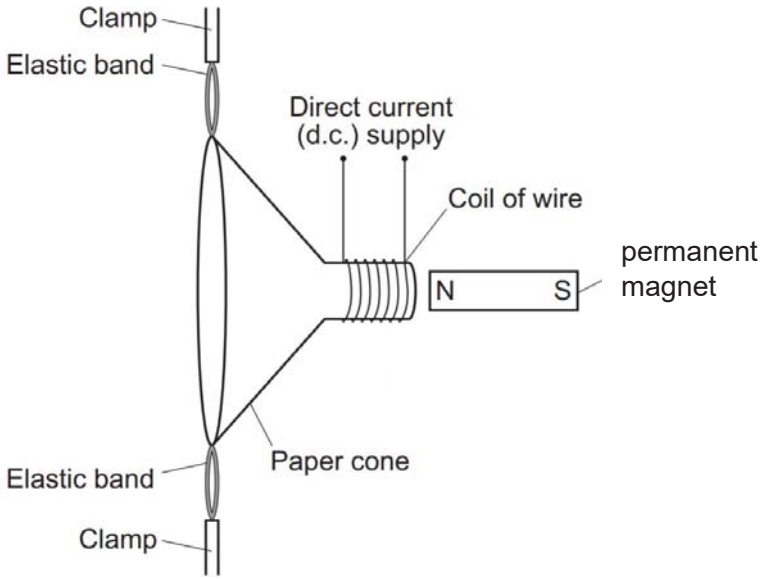


Fig 11.1

(i) Explain why a current in the coil causes the paper cone to move.

……

……

…… [2]

(ii) Describe and explain the movement of the cone when there is an alternating current in the coil.

……

……

…… [2]

(b) A sound wave produced by the cone passes through air. The particles in air vibrate from side to side as shown in Fig 11.2.

Fig 11.2 (not drawn to scale)

Particle P vibrates from the position shown to X, then to Y and then back to the position shown.

The distance between X and Y is 6.0 mm.
Time t = 2.0 s is the first time that all the particles are back in the positions shown in Fig. 11.2.
The wavelength of the wave is 40 cm.

(i) Describe what happens to the distance between adjacent particles, as the wave moves through air.

……

…… [1]

(ii) On Fig 11.2, indicate two particles separated by a distance of one wavelength by labelling them both with a letter Q. [1]

(iii) Calculate the frequency of the wave.

frequency = …… [1]

(iv) Calculate the speed of the wave.

speed = …… [2]

(v) On line **Z** in Fig. 11.2, mark the positions of the centre of two compressions at t = 3.0 s. Label these compressions C. [1]

OR

(a) Fig 11.3 shows a d.c. motor.

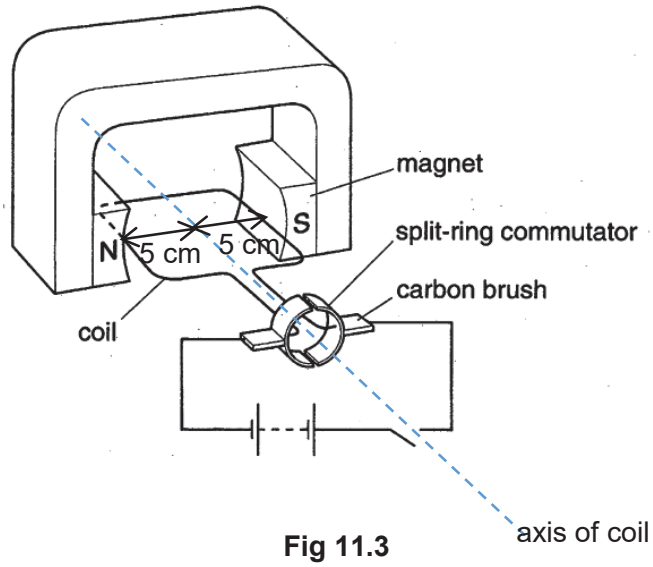


Fig 11.3

The coil is horizontal, as shown in Fig. 11.3.

(i) Explain why a current in the coil causes the coil to move.

.....

.....

.....

..... [2]

(ii) On Fig 11.3, draw arrows to show the directions of the forces acting on the sides of the coil. [1]

(iii) Explain why the coil continues to turn in the same direction when it has turned 180 °.

.....

.....

.....

..... [2]

(b) When the coil is at the position as shown in Fig 11.3, the magnitude of force on each sides of the coil is 4.0 N.

(i) Calculate the resultant moment about the axis of the coil caused by the forces acting on the coil.

moment = …… [2]

(ii) Describe what happens to the resultant moment as the coil rotates through one complete oscillation.

……

……

…… [2]

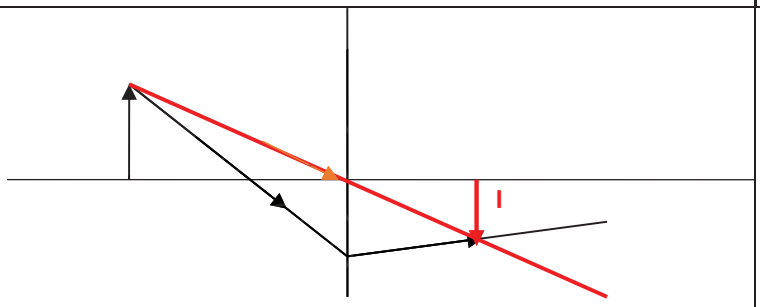
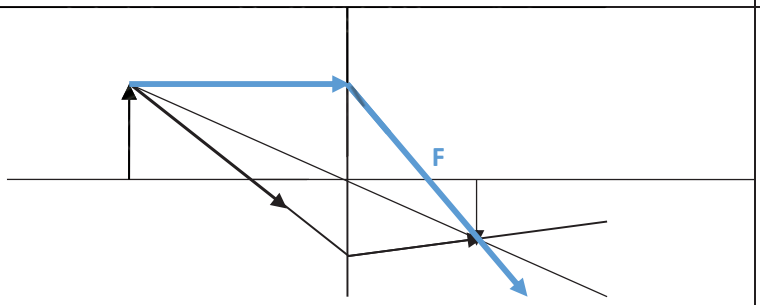
(c) The e.m.f of the battery is increased. State one observable change to the motion of the coil.

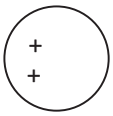
……

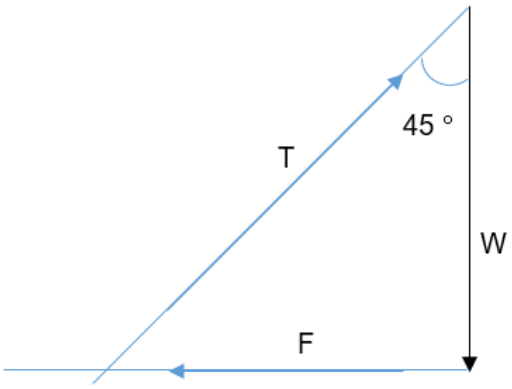
…… [1]

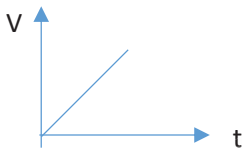
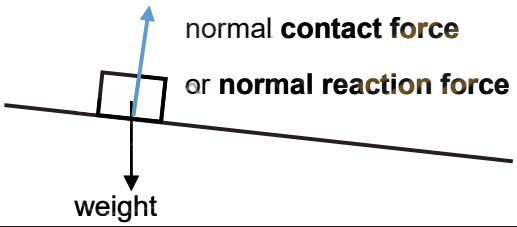
CWSS Prelim 2020
Physics P2 Answer

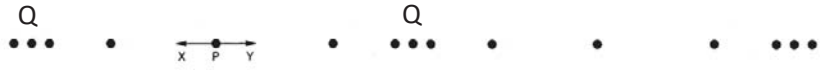
1	**(a)**	0 s to 10 s: constant velocity or displacement increases at a constant rate 10 s to 20 s: at rest or velocity = 0 20 s to 32 s: moving in **opposite direction** at **constant velocity** or velocity is constant and negative		1 1 1
	(b)	Anyone: • Infra-red radiation • Radio wave		1
			total	4
2	**(a)**	The **skateboarder's foot pushes the skateboard to the left/ backwards**, this causes the skateboard to move backwards/ to the left. By Newton's 3rd law, **the skateboard exerts a forward force**/ force towards the right acts **on the skateboarder** making him moves forwards/ to the right.		1 1
	(b)	**Chemical potential energy** to **kinetic energy**		1
	(c)	**(i)**	ke = ½ mv^2 = ½ x 42 x 0.30^2 = 1.89 = 1.9 J (2 s.f.)	 1 – working 1 – ans + unit + s.f.
		(ii)	The skateboarder exerts a **force on the air** with his body as he moves forwards and **move the air through a distance**.	1
		(iii)	Converted to **thermal energy** of the air.	1
			total	7
3	**(a)**	**The line of action of the weight** of the bus is on the left side of the wheel on the right. This creates an **anticlockwise moment** about the wheel on the right wheel. Hence it will not topple.		1 1
	(b)	The **c.g of the bus will be raised** if there are more passengers in the upper deck than lower deck. This will cause the bus to be less stable. Or The **c.g of the bus will be shifted more to one side of the bus** if there are more passengers seated on one side of the bus than the other side.		1

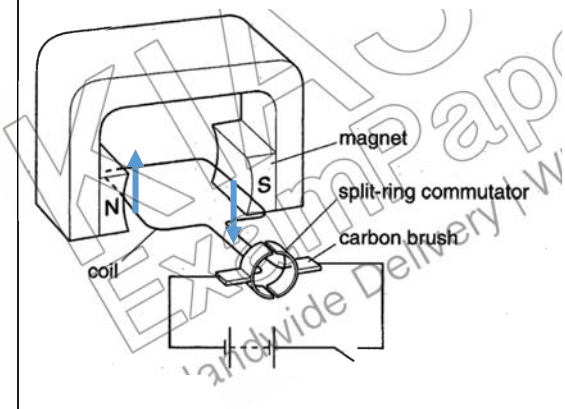
		This will cause the bus to be less stable when the bus turn on the side with more passengers.		
	(c)	**(i)**	Liquid is **incompressible**.	1
		(ii)	360/0.0012 = F/0.28 F = 84 000 N (2 s.f.)	1 - working 1 – ans + unit + s.f.
			total	6
4	**(a)**	**(i)**	n = 3.0 x 10^8 / speed of light in prism speed of light in prism = 3.0 x 10^8 / 1.6 = 1.9 x 10^8 m/s (2 s.f.)	1 – ans + unit + s.f.
		(ii)	n = 1 / sin c c = $\sin^{-1}$ (1/1.6) = 39° (2 s.f.)	1 working 1 ans and unit + s.f.
	(b)	**(i)**		1
		(ii)	 F must be marked clearly	1
		(iii)	Image will be dimmer	1
		(iv)	Move the lens further away from the object	1
			total	7

5	**(a)**	**Friction** causes **electrons/negative charges** to **move from the roller** to the **belt**. Excess negative charges on the belt caused it to be negatively charged		1 1
	(b)	The **electrons/negative charges in metal ball** is **repelled** by the negative charges on the dome through the conducting rod **to the Earth**. because **like charges repel**.		1 1
	(c)	 One or more positive charges drawn on the left side of the sphere.		 1
	(d)	**(i)**	**Region** in which an electric **charge** experiences a **force**.	1
		(ii)	$I = Q/t = 0.0016 \times 10^{-3} / 0.0012$ $= 0.0013$ A or 1.3×10^{-3} A (2 s.f.)	1 – working 1 – ans + unit
			total	8
6	**(a)**	**9.6 J of work** is done to drive 1 columb of charge/ **a unit charge** through the resistor.		1 1
	(b)	Current thru the bulb = current through reisstor = V/R = 9.6/ 40 =0.24 A		 1 – working 1 – ans + unit + s.f.
	(c)	$P = I^2R = 0.24^2 \times 10$ = 0.58 W (2.f.)		1 – working 1 – ans + unit + s.f.
	(d)	R **lowers the effective resistance** in the circuit and **increases the current through the bulb**. Since **$P = I^2R$**, **bulb** becomes **brighter** . Or R **lowers the effective resistance** across both the resistors in parallel and **lowers the p.d. difference across the resistors** and **increases the p.d. across the bulb**. Since **$P = V^2/R$**, **bulb** becomes **brighter** . Or R **lowers the effective resistance** in the circuit and **increases the current through the bulb.** This **increases the p.d. across the bulb**. Since **$P = IV$**, **bulb** becomes **brighter** .		1 1 1 1 1 1
			total	8

7	(a)	Any one: • to provide a **complete circuit** (with live) so that **current can flow** • to pass current back to mains • provide a return path for the current		
	(b)	when live touches metal case, **current flow to earth / earth wire / ground** or a short circuit is formed between the case and the earth. A large current flows, this causes **fuse to melt / blow and disconnects circuit / cuts live / stops current**		1 1
	(c)	doubly insulated or case / body made of plastic / insulator / not made of metal so user cannot touch the parts at high potential		1
			total	4
8	(a)	The iron ball is **magnetically induced** / becomes an induced magnet with **unlike pole facing the magnet**. Since **unlike poles attract**, the ball is **attracted** to the magnet.		1 1
	(b)	(i)	W = mg = 0.100 x 10 =1.0 N (1, 2 or 3 s.f.)	1 ans+unit
		(ii)	Weight drawn in correct direction to correct scale. Scale MUST be convenient and sufficiently large. Minimum Scale : 1 cm represents 0.2 N Magnetic force and Tension drawn at correct angle & direction with respect to weight. Clearly labelled. Final answer Force = 1.0 N ± (0.1 x scale)  	1 1 1

			total	6
9	**(a)**	**(i)**	Anyone: • The acceleration is constant • The speed of the carriage increases throughout the motion • The speed of the carriage increases at a slower rate initially compared to data 1.	1
		(ii)	distance = ½ x 2.00 x 2.50 = 2.50 m (3 s.f.) 	1 working 1 ans+unit + s.f.
		(iii)	Draw: **straight** line with **arrow in the correct direction** from the track and **90 °** to the track. Label : normal **contact force** or **force on carriage by the track** 	1
		(iv)	No difference the **gravitational potential energy of the carriage at the top of the track** is the **same** as **kinetic energy at the bottom of the track**. mgh = ½ mv^2 v = $\sqrt{(2gh)}$ or v is independent of the mass of the carriage	1 1
	(b)	**(i)**	a = (v-u)/t = (0.90-0)/0.20 or (1.8-0)/0.40 or (2.7-0)/0.60 =4.5 m/s^2 (2 s.f.)	1 working 1 ans+unit + s.f.
		(ii)	From t = 0.60 s to t= 1.20 s, **acceleration is zero/ the speed is constant**. when the carriage is on the horizontal/flat part of the track. This shows that the **resultant force is zero.** Hence track is **frictionless**.	1 1
			total	10
10	**(a)**	**(i)**	**Air molecules lose internal kinetic energy to the coolant** as it passes through. **thermal energy is absorbed by the coolant to weaken the forces of attraction between particles** of the coolant for the coolant to change from liquid to gaseous state / evaporate.	1 1

		(ii)	The coils **increase the surface area** exposed to the air. This **increases** the **rate of heat exchange** / heat absorption / rate of evaporation between the air and the coolant.	1 1
	(b)	Q = mcΔθ 1200 x 1 = 94 (35-T) T = 22 °C (2 s.f.)		1 working 1 ans+unit + 2 s.f.
	(c)	**Y** is more suitable Y has higher specific latent heat of vaporization, this allows it to draw the **more energy** from the air to **evaporate/ change state** and higher specific heat capacity, this allows it to **absorb more heat for each 1 ˚C increase/ unit change in temperature**.		1 – no mark if wrong liquid is selected 1 - no mark if wrong liquid is selected
	(d)	Black-painted copper Copper is a **good conductor of heat**. This enables heat to be conducted quickly from air to coolant. Black is **good absorber of radiation.** This enables heat to be absorbed quickly from air to coolant.		1 – no mark if material is identify wrongly 1 – no mark if material is identify wrongly
			total	10
11 Either				
(a)	**(i)**	Current in the coil makes it an **electromagnet**. This causes the coil to either **attract/ repel the permanent magnet**. or Current in the coil **creates a magnetic field** This **interacts with magnetic field** of the magnet that results in an unbalance magnetic field to **produce a force** acting on the coil.		1 1 1 1
	(ii)	Coil moves left and right/ into and out of magnet/ backwards and forwards. because current flow in one direction and then reverses hence reversing the force acting on the cone.		1 1
(b)	**(i)**	Distance between adjacent particles **varies from 0 to 3.0 mm** / increases and decreases/ decreases and increases		1 Ignore s.f.
	(ii)	Q Q  Accept answer between centre of two compressions/ rarefactions or distance between any 2 points moving in phase.		1

	(iii)	f = 1/T = 1/2.0 = 0.50 Hz	1 - ans + unit + s.f.
	(iv)	V = fλ = 0.5 x 0.4 = 0.2 m/s or 20 cm/s (1 or 2 s.f.)	1 – working 1- ans + unit + s.f.
	(vi)		1
		total	10
Or			
(a)	**(i)**	**Current** in the coil **creates a magnetic field** This **interacts with magnetic field** of the cylindrical magnet and resulted an unbalance magnetic field to **produce a force** acting on the wire.	1 1
	(ii)	Correct direction, must touch coil 	1
	(iii)	The **split ring commutator reverses the direction of the current in the coil after** it passes through its **vertical position**. This **reverses the direction of force on each side of the coil** allowing it to continue turning in same direction./ The **force on the coil next to the respective magnetic poles remain the same**.	1 1
(b)	**(i)**	Resultant moment = 2 x 4 x 0.05 = 0.4 Nm or 40 Ncm (1 or 2 s.f.)	1 – working 1- ans + unit + s.f.

	(ii)	The resultant moment **decreases** as coil rotates towards vertical position At the **vertical position, its moment = 0** As it rotates past the vertical position, the moment **increases** as it rotates towards horizontal position At **horizontal position, its moment = maximum or 0.40 Nm** again. Cycle repeats	1 1
(c)	Coil rotates faster.		1
		total	10