HILLGROVE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY FOUR (EXPRESS)

CANDIDATE NAME	( )	CLASS	-
CENTRE NUMBER	S	INDEX NUMBER	

PHYSICS

6091/01

Paper 1 Multiple Choice

20 August 2021

Additional Materials: Multiple Choice Answer Sheet

1 hour

8.10 AM to 9.10 AM

READ THESE INSTRUCTIONS FIRST

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

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

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

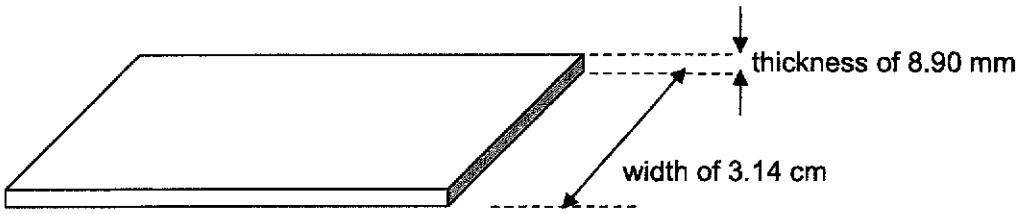
Setter: Mr Jonathan Ho

This document consists of **17** printed pages.

1 Which row shows a base quantity and its corresponding SI unit?

	base quantity	SI unit
A	area	m^2
B	length	m
C	speed	km/h
D	temperature	°C

2 In an experiment, a student has to measure the width and the thickness of a glass slide as precisely as possible using normal laboratory apparatus.



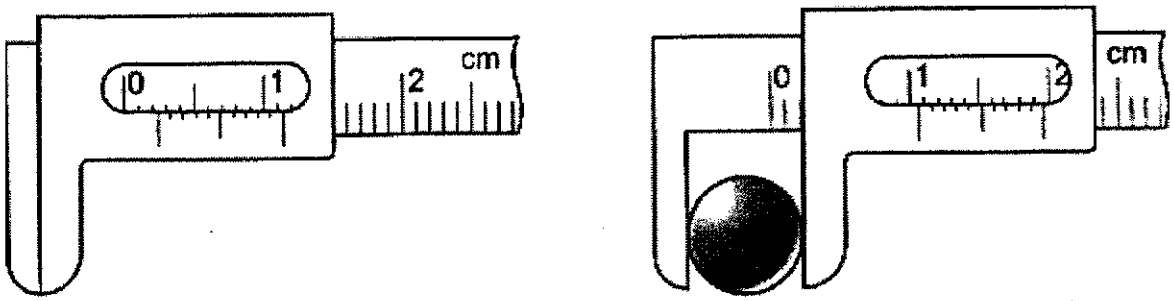
Which row shows the most appropriate instruments for these measurements?

	width of glass slide	thickness of glass slide
A	half-metre rule	vernier calipers
B	half-metre rule	micrometer screw gauge
C	vernier calipers	vernier calipers
D	vernier calipers	micrometer screw gauge

3 Vernier calipers are used to measure the diameter of a ball bearing.

Diagram 1 shows the calipers when the jaws are closed.

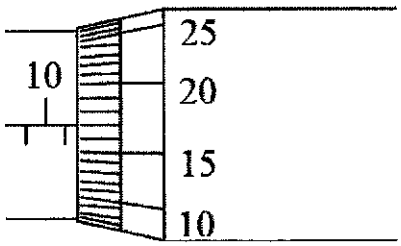
Diagram 2 shows the calipers when the ball-bearing is between the jaws.



What is the diameter of the ball bearing?

A 0.80 cm **B** 0.84 cm **C** 1.08 cm **D** 1.30 cm

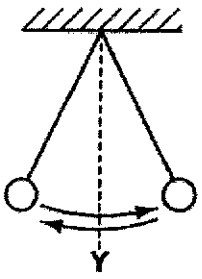
4 The diagram shows a micrometer scale.



Given that the micrometer has no zero error, what is the reading shown?

A 10.15 mm **B** 10.67 mm **C** 11.15 mm **D** 11.17 mm

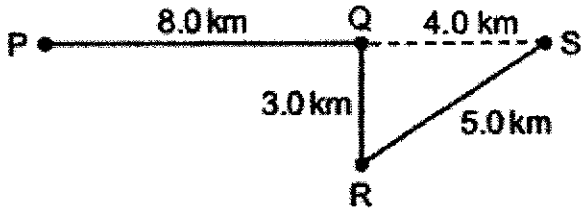
5 A pendulum swings backwards and forwards passing through Y as shown. The first time the pendulum passes through Y, a stopwatch is started. When the pendulum passes through Y the thirteenth time, the stopwatch is stopped. The reading on the stopwatch is 25 s.



What is the period of the pendulum?

A 1.92 s **B** 2.08 s **C** 3.85 s **D** 4.17 s

6 A lorry takes 15 minutes to travel along the path PQRS.



What is the average velocity of the lorry?

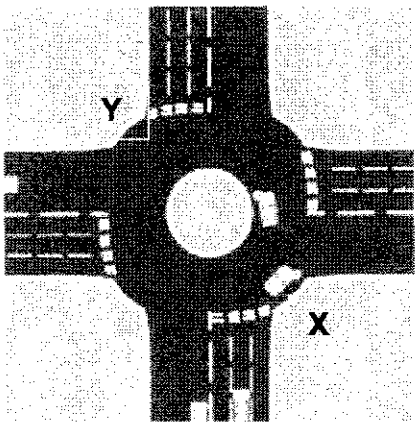
A 48 km/h

B 64 km/h

C 80 km/h

D 180 km/h

7 A car moves around a roundabout from X to Y as shown. The speedometer of the car is constant at 25 km/h.



Which statement about the motion of the car is correct?

A The speed and velocity of the car change as the car turns.

B The speed and velocity of the car is equal to 25 km/h.

C The speed of the car is 25 km/h while the velocity of the car changes as the car turns.

D The velocity of the car is 25 km/h while the speed of the car changes as the car turns.

8 A stone is dropped from the top of a building to the ground.

Which option describes a vector quantity?

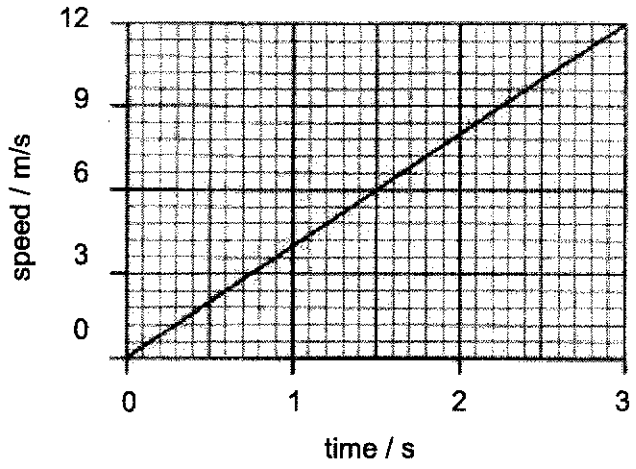
A heat gained by the stone through its impact with the ground

B kinetic energy of the stone as it reaches the ground

C time taken for the stone to reach the ground

D velocity of the stone when it is halfway to the ground

9 The speed-time graph shows a model car travelling on a flat surface.



What is the distance travelled by the car in 3 seconds?

A 4 m **B** 15 m **C** 18 m **D** 36 m

10 A car of weight 11 000 N moves with constant velocity along a horizontal road. A driving force of 5000 N acts on the car.

What is the force opposing the motion of the car and its resultant force?

	opposing force / N	resultant force / N
A	5000	0
B	5000	6000
C	11 000	0
D	11 000	6000

11 A man with an open parachute falls to Earth at constant speed. The following forces act on the man.

P: the upward force of the parachute on the man

Q: the upward force of the man on the Earth

R: the downward force of the Earth on the parachute

S: the downward force of the man on the parachute

Which two forces are an action-reaction pair?

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

12 The weight of a spacecraft on Earth is 1400 N. The gravitational field strength on Earth is 10 N/kg. The gravitational field strength on the Moon is 1.6 N/kg.

What is the weight of the spacecraft on the Moon?

A 87.5 N **B** 224 N **C** 875 N **D** 22 400 N

13 Which option is a property of inertia?

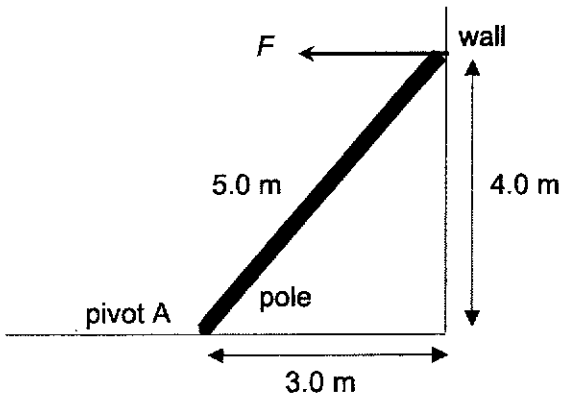
A mass of the body

B size of the body

C speed of the body

D weight of the body

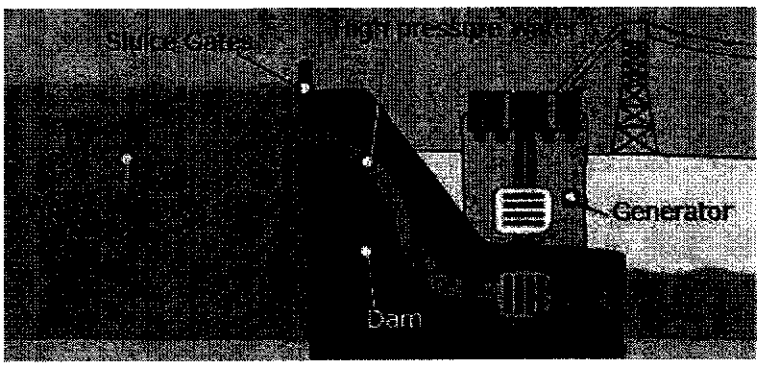
14 A pole of length 5.0 m leans against a wall. A force *F* acts on the pole as shown. A student wants to calculate the moment of force *F* about pivot A.



Which is the correct distance that should be used to calculate the moment of F about pivot A?

A 3.0 m **B** 4.0 m **C** 5.0 m **D** 7.0 m

15 The diagram shows water stored behind a dam. The water flows through a turbine and turns a generator.



Which option shows the correct sequence for the conversion of energy?

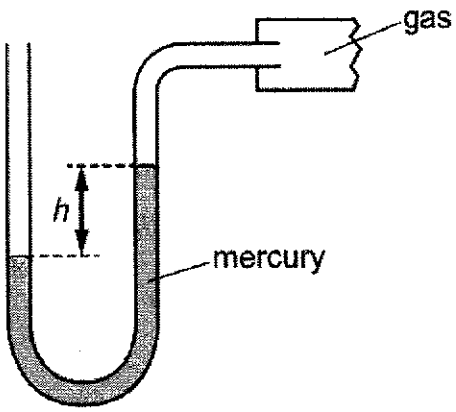
A gravitational potential energy → kinetic energy → electrical energy

B kinetic energy → gravitational potential energy → electrical energy

C gravitational potential energy → electrical energy → kinetic energy

D kinetic energy → electrical energy → gravitational potential energy

16 A mercury manometer is used to measure the pressure of a gas.

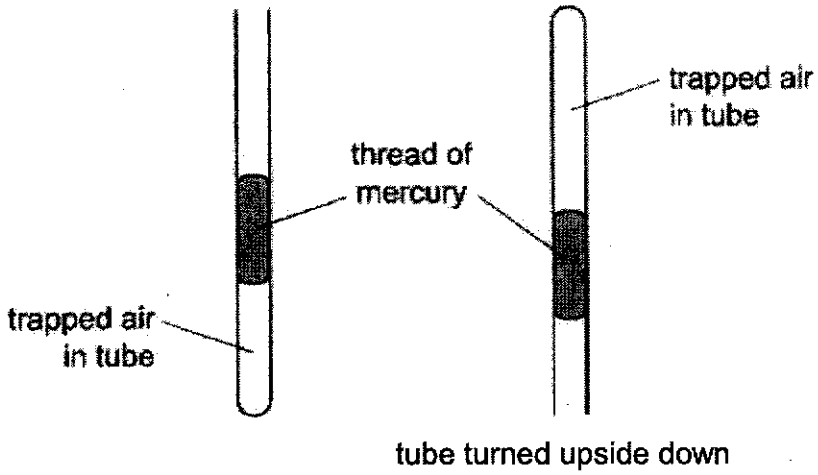


The pressure of the atmosphere is p_0 and the density of mercury is ρ.

What is the pressure of the gas?

A $p_0 - h\rho g$ **B** $p_0 + h\rho g$ **C** p_0 **D** $h\rho g$

17 A thin tube contains a thread of mercury which traps air at the end of the tube. The other end of the tube is open to the atmosphere.



When the tube is turned upside down, the volume of trapped air increases.

Which statement explains this?

A The air gets hotter when the tube is turned upside down.

B The atmosphere pushes less when it acts upwards on the mercury.

C The pressure of the trapped air is reduced.

D The trapped air molecules hit the mercury harder when travelling downwards.

18 Which statement about gamma rays and ultra-violet is correct?

A They have the same frequency in a vacuum.

B They have the same wavelength in air.

C They travel as longitudinal waves in air.

D They travel at the same speed in a vacuum.

19 According to the kinetic theory, matter is made up of very small particles in constant motion.

Which row best describes the particles in liquid state?

	arrangement of particles	forces between particles
A	close but packing in disorderly manner	strong
B	far apart in a disorderly arrangement	strong
C	close but packing in disorderly manner	weak
D	far apart in a disorderly arrangement	weak

20 Physical properties of materials are used in the measurement of temperature.

Which physical property is **not** suitable for this purpose?

A expansion of a metal

B mass of a liquid

C resistance of a metal

D volume of a liquid

21 The heat from the hot water in a metal radiator passes through the metal and then spreads around the room.

What are the main processes by which the heat is transferred through the radiator and then spread around the room?

	through the metal radiator	around the room
A	conduction	conduction
B	conduction	convection
C	radiation	conduction
D	radiation	convection

22 A person places one foot on a woollen carpet and the other foot on a stone floor. Both surfaces are initially at room temperature. Which statement describes how the person feels initially?

A The foot on the carpet feels warmer because the wool gives out heat to the foot.

B The foot on the stone floor feels cooler because the stone floor transfers the coldness to the foot.

C The foot on the stone floor feels cooler because the rate of heat transfer is faster through the stone floor than the woollen carpet.

D Both carpet and stone floor feel the same to the person since both surfaces are at the same temperature as the room.

23 What happens to molecules of water when it freezes?

A They attract each other more strongly.

B They expand.

C They get smaller.

D They stop moving.

24 How does evaporation of water result in cooling?

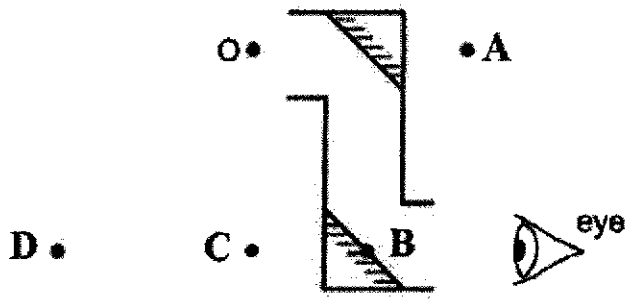
A The particles absorb thermal energy from the surrounding, thus resulting in increase of kinetic energy.

B The particles get further apart and release energy to the surrounding.

C The particles move nearer to each other and start to form attractive forces between each other.

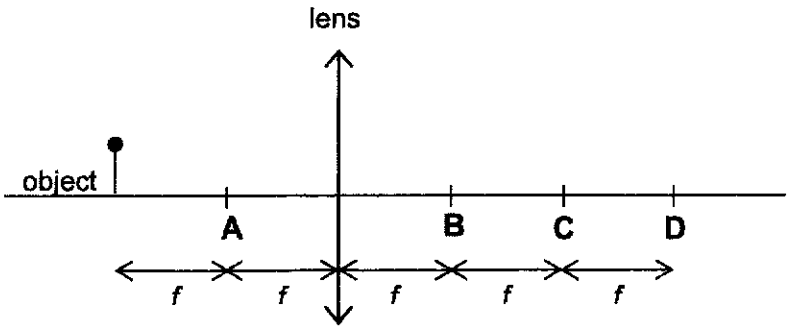
D The particles on the surface of the water escape if they have enough energy, leaving behind particles with lower average internal energy.

25 The diagram shows an object O viewed using two mirrors. A person looks into the mirrors as shown. At which position is the image of O seen?



26 The diagram shows an object placed in front of a converging lens at a distance $2f$ from the lens. f is the focal length of the lens.

At which position will the image be formed?



27 What can be said about electromagnetic waves?

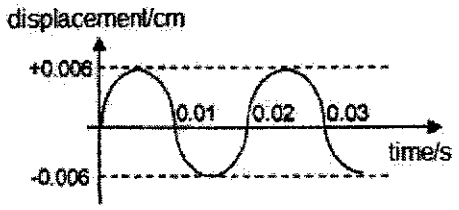
A Blue light has a higher frequency than red light.

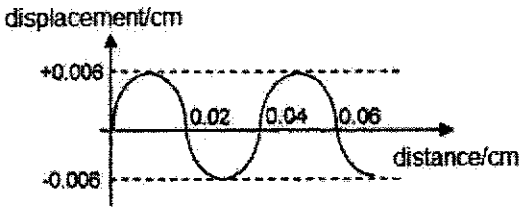
B Blue light has a higher speed than red light in vacuum.

C Infra-red radiation has a shorter wavelength than ultra-violet radiation.

D Microwaves have a shorter wavelength than visible light.

28 The diagrams show the displacement-time and displacement-distance graphs of a stationary boat on the surface of the sea as the waves pass it.

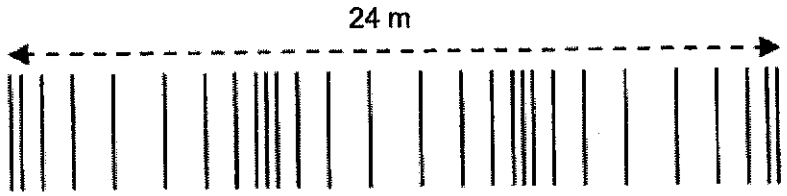




Which row is correct for the wavelength and frequency of the waves produced?

	wavelength / cm	frequency / Hz
A	0.02	0.01
B	0.02	10
C	0.04	0.02
D	0.04	50

29 The diagram shows a series of compressions and rarefactions for a sound wave.



What is the wavelength of the sound?

A 8.0 m **B** 12.0 m **C** 16.0 m **D** 24.0 m

30 When a polythene rod is rubbed with a soft sponge, the polythene rod becomes negatively charged.

What happened to the polythene rod and the soft sponge to cause this charge?

	polythene rod	soft sponge
A	gained electrons	gained protons
B	gained protons	gained electrons
C	gained electrons	lost electrons
D	lost electrons	gained electrons

31 A small negative charge is placed at a point where an electric field is acting vertically upwards.

There is a force on the charge due to the field.

In which direction does it act?

A vertically upwards

B vertically downwards

C horizontally to the right

D horizontally to the left

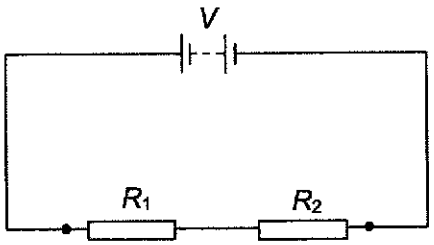
32 If 50 C of charge flows through a point in an electric circuit in 10 s, what is the current passing through that point?

A 0.2 A **B** 5 A **C** 60 A **D** 500 A

33 A 2.0 m long wire with a radius of 1.0 mm has a resistance of 16 Ω. What is the resistance of the same type of wire which is 4.0 m long and has a radius of 2.0 mm?

A 4.0 Ω **B** 8.0 Ω **C** 16 Ω **D** 32 Ω

34 Two identical resistors, R_1 and R_2, are connected to a battery with an e.m.f. of V.



Which statement is not true?

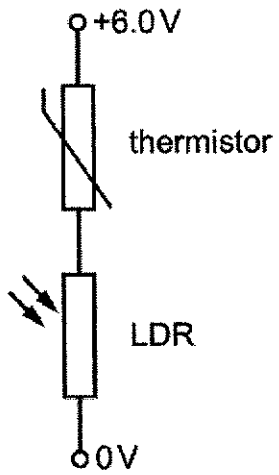
A The current flowing through each resistor is the same.

B The potential difference across each resistor is the same.

C The potential difference across R_1 is greater than the potential difference across R_2.

D The sum of potential difference across R_1 and R_2 is equal to V.

35 A thermistor and a light-dependent resistor (LDR) are connected in series. A potential difference (p.d.) of 6.0 V is applied across them as shown.



The thermistor has a resistance of 6000 Ω in a cold room and 1000 Ω in a warm room. The LDR has a resistance of 2000 Ω in dim light and 500 Ω in bright light.

When is the p.d. across the LDR equal to 2.0 V?

A in a cold room with bright light

B in a cold room with dim light

C in a warm room with bright light

D in a warm room with dim light

36 A kettle is connected to the 240 V mains supply using a plug containing a 13 A fuse. The kettle contains water. When it is switched on, the fuse blows. This happens again after a new fuse is fitted. Someone replaces the fuse with a nail, and the kettle works.

What else might happen as a result of replacing the fuse with a nail?

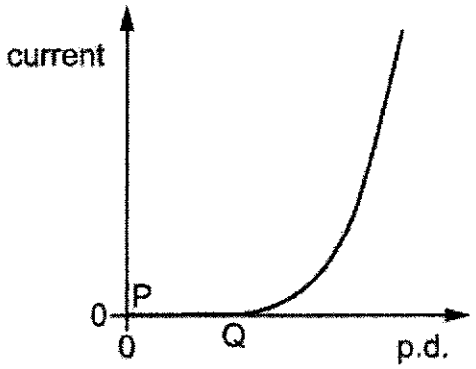
A A very large current overloads the wiring, causing a fire.

B The kettle boils the water less quickly.

C The kettle uses more energy to boil the water.

D The water boils at a higher temperature.

37 The diagram shows how the current in a semiconductor diode varies as the potential difference (p.d.) across it increases from zero.



What is the resistance of the diode between P and Q, and how does it change as the p.d. increases from Q?

	resistance between P and Q	resistance after Q
A	very large	decreases
B	very large	increases
C	zero	decreases
D	zero	increases

38 Which material is used for the needle of a plotting compass?

A aluminum

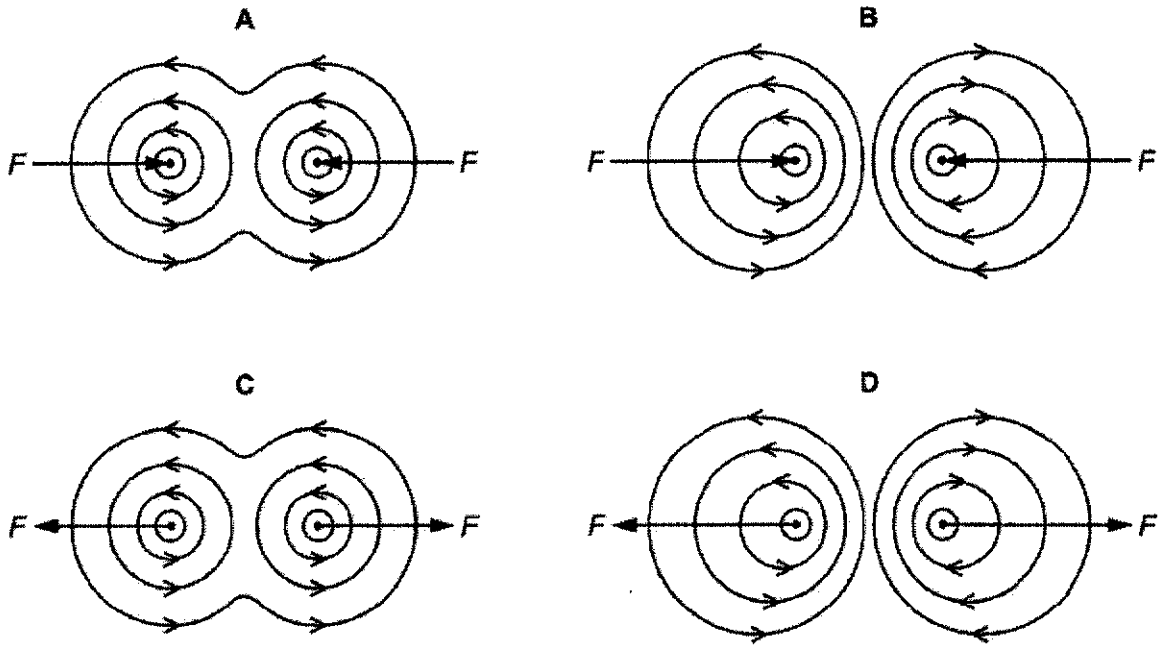
B brass

C iron

D steel

39 Two parallel, vertical wires each carry an upward electric current.

Which diagram shows the magnetic fieldpattern around the wires and the direction of the force *F* around the wire?



40 What correctly describes the field produced in the region surrounding a solenoid that carries a current?

A a region where stationary electric charges experience a force

B a region where electric charges gain energy

C a region where magnetic poles experience a force

D a region where magnetic poles gain energy

END OF PAPER

HILLGROVE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021
SECONDARY FOUR (EXPRESS)

CANDIDATE NAME	( )	CLASS	-
CENTRE NUMBER	S	INDEX NUMBER	

PHYSICS 6091/02

Paper 2 Theory

24 August 2021

1 hour 45 minutes

8.10 AM to 9.55 AM

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on the work you hand in.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
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 an 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.

For Examiners' Use	
P 1	
P 2	
Section A	
Section B	
Total	

Parent's/ Guardian's Signature: _____

Setter: Mr Jonathan Ho

This document consists of **23** printed pages.

Section A [50 marks]

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

1 When a car driver sees an emergency ahead while driving on a level road, he applies the brakes. During his reaction time the car travels at a steady speed and covers a certain distance. The braking distance is the distance travelled by the car after the brakes are applied.

Fig. 1.1 shows the speed-time graph of the car. The combined mass of the car and the driver is 850 kg.

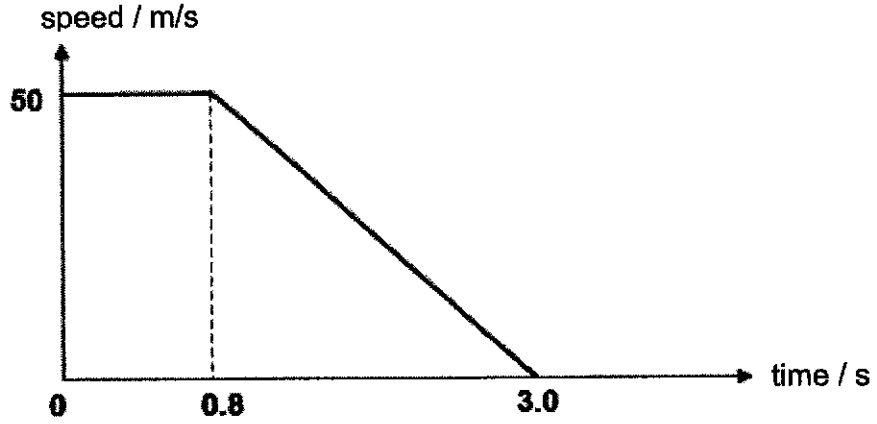


Fig. 1.1

(a) State the resultant force acting on the car during the driver's reaction time.

resultant force = ... [1]

(b) Find the braking distance.

braking distance = ... [2]

(c) Find the deceleration of the car during braking.

deceleration = ... [2]

(d) Hence, calculate the magnitude of the resultant force acting on the car during braking.

resultant force = ... [1]

2 Two men attempt to move a large wooden chest. They tie ropes to the chest and pull horizontally, one man exerting a force of 500 N and the other a force of 350 N. Fig 2.1 shows the top view of the forces and the directions pulled.

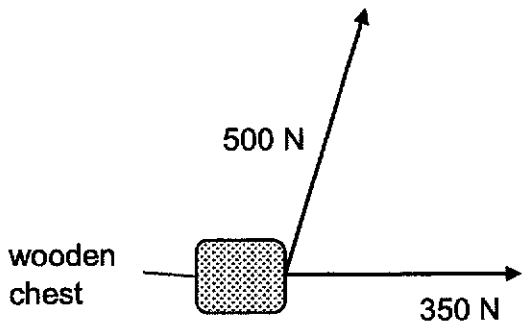


Fig. 2.1

On Fig 2.1, draw a vector diagram, using a scale of 1.0 cm representing 100 N, to determine the magnitude of the resultant force on the wooden chest and the angle of the resultant force measured from the 350 N force.

magnitude = ... N

angle = ... [4]

3 Fig. 3.1 shows a box of mass 2.00 kg sliding down a ramp, angled at 30.0° from the ground. The friction along the ramp is 2.50 N. When it passes **P**, it is at a height *h* above the ground and has a speed of 1.50 m/s.

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

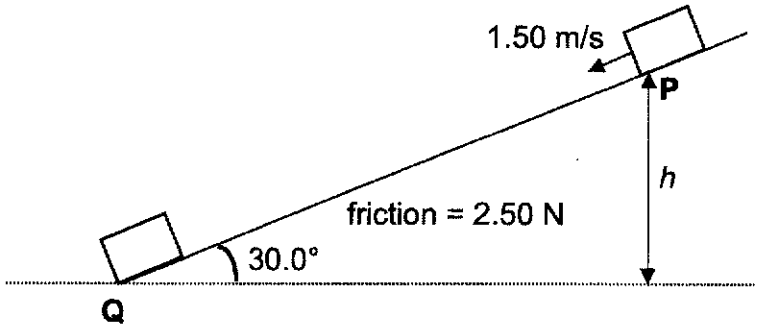


Fig. 3.1

(a) Calculate the kinetic energy of the box at **P**.

kinetic energy = ... [2]

(b) Show that *d*, the distance travelled by the box from **P** to **Q**, is given by

$$d = 2h$$

[2]

When the box reaches the bottom of the slope at **Q**, the kinetic energy of the box is 9.00 J.

(c) Find the height *h*.

height *h* = ... [4]

4 Fig. 4.1 shows the structure of a solar water heating system that uses liquid as a heating fluid. The fluid is a mixture of water and propylene glycol.

Water in copper pipes is heated by solar radiation. The hot water in the copper pipes is then used to heat cold water in a tank.

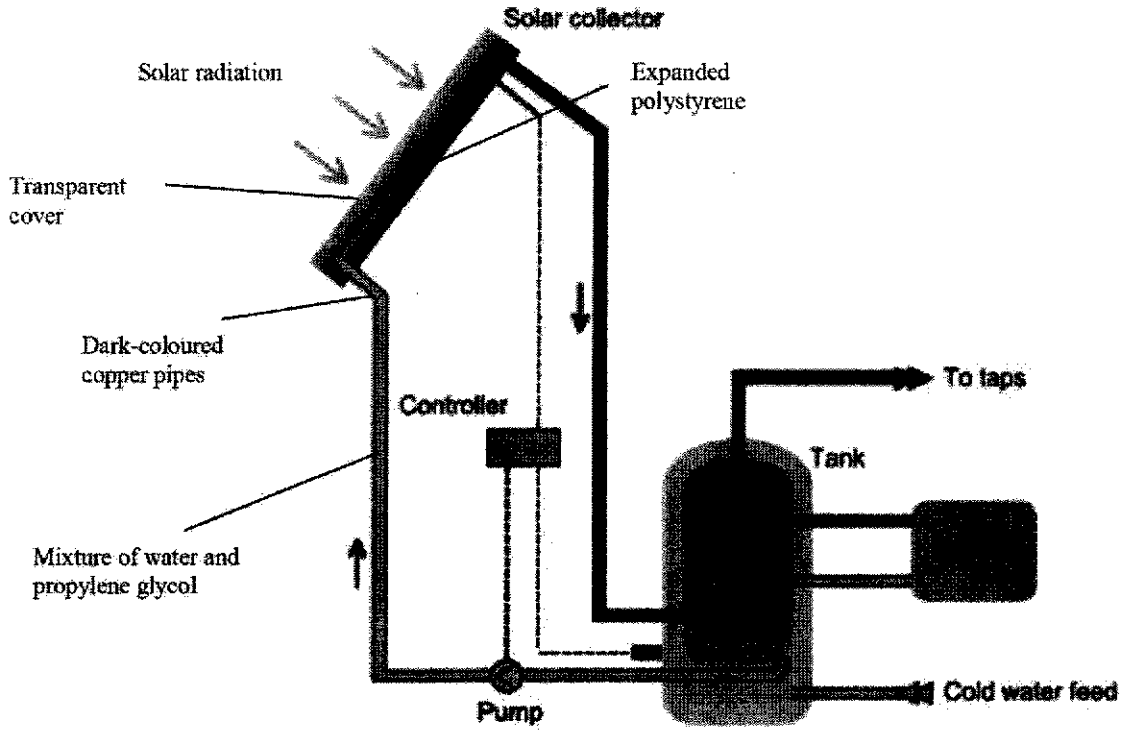


Fig. 4.1

(a) Explain the purpose of the

(i) expanded polystyrene backing board.

.....

..... [1]

(ii) dark-coloured copper pipes.

.....

.....

.....

..... [1]

(b) Describe, at a molecular level, how solar energy is transferred to the fluid through the copper pipes in the solar water heating system.

.....

.....

.....

..... [2]

(c) Explain why the cold water feed is at the bottom of the water tank while the hot water tap is at the top of the water tank.

.....

.....

.....

..... [2]

(d) The fluid used in the solar water heating system, which is a mixture of water and propylene glycol, has a lower freezing point than pure water. Suggest a reason why a fluid with low freezing point is important.

.....

..... [1]

5 Fig. 5.1 shows some parts of a thermocouple thermometer that is being used to determine the temperature of a liquid.

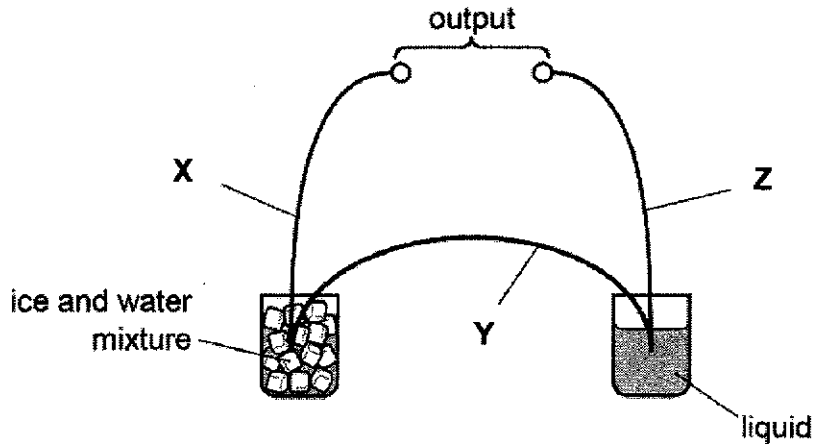


Fig. 5.1

(a) Suggest an appropriate material for:

- **X** .....
- **Y** .....
- **Z** ..... [1]

(b) All types of thermometers require the measurement of a physical property that varies with temperature in order to obtain a value for the temperature.

State the physical property of a thermocouple thermometer that is used in this way.

..... [1]

(c) State two advantages of a thermocouple thermometer over a liquid-in-glass thermometer.

1. .....
2. ..... [2]

6 (a) Name the component in the electromagnetic spectrum

(i) that is used in optical fibres for medical purposes such as endoscopy

..... [1]

(ii) that has the longest wavelength

..... [1]

(iii) that is used to sterilise medical equipment

..... [1]

(iv) that is used to carry signals to and from satellites for satellite TV

..... [1]

(b) State one way in which radio waves and sound waves are different.

.....

..... [1]

7 Fig. 7.1 shows the diagram of a speaker.

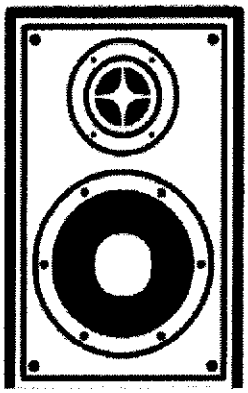


Fig. 7.1

The lowest frequency that a human can hear is 20 Hz and the highest frequency that a human with normal hearing can hear is 20 kHz.

(a) Explain what is meant by a frequency of 20 Hz.

..... [1]

(b) Given that the speed of sound in air is 340 m/s, calculate the shortest wavelength of sound that a human can hear.

wavelength =..... [2]

8 Fig 8.1 shows part of a household electrical installation where an electric kettle is used to heat the water.

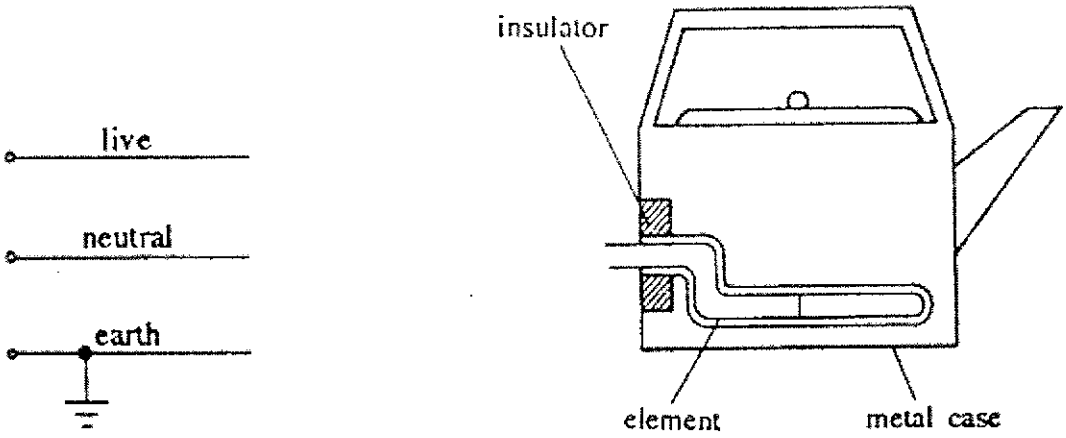


Fig. 8.1

(a) On Fig 8.1, complete the electric circuit by connecting the live, neutral and earth wires to the electric kettle. Include a fuse and a switch in the circuit diagram. [3]

(b) The electric kettle is rated 240 V, 2.5 kW.

Calculate

(i) the operating current for the kettle;

current = ... [1]

(ii) the total energy used in 6 hours;

energy = ...kWh [1]

(iii) the cost of electricity at the rate 30 cents per kWh for a week if the kettle is used for 6 hours a day.

cost = ... cents [2]

9 Fig. 9.1 shows a lamp from a car. It contains two metal filaments.

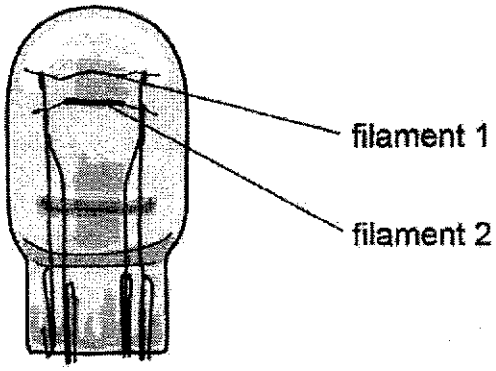


Fig. 9.1

Fig. 9.2 shows the current–voltage graph for the two filaments.

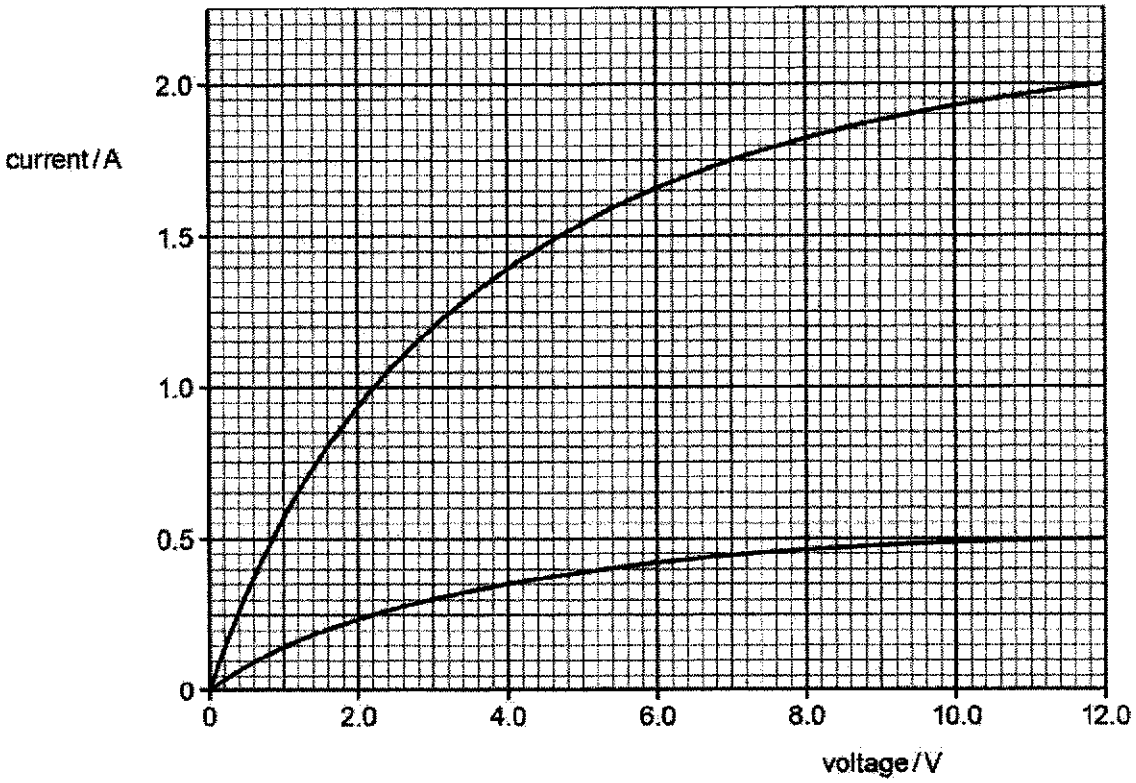


Fig. 9.2

(a) (i) Calculate the total resistance of the two filaments when they are connected in parallel to a voltage of 12 V.

resistance = ... [2]

(ii) The two filaments are made from the same type of metal and have the same length, when uncoiled. They both operate at the same temperature.

Suggest why one filament has a resistance that is greater than that of the other filament.

.....

..... [1]

(b) Fig. 9.3 shows a relay used to switch on a car headlamp.

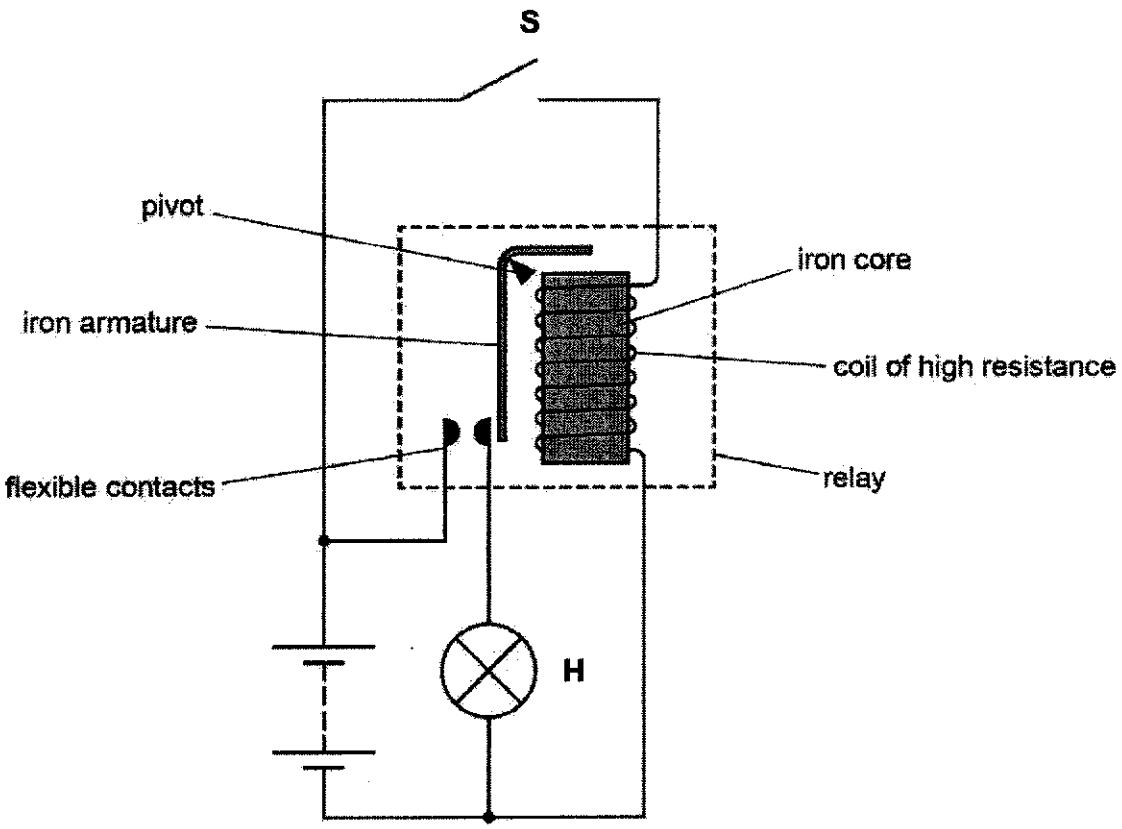


Fig. 9.3

Explain why headlamp **H** lights up when switch **S** is closed.

.....

.....

.....

.....

..... [3]

Section B [30 marks]

Answer **all** questions in this section.
Answer only one of the two alternate questions in **Question 12**.

10 Fig. 10.1 shows a motor lifting a mass. Fig. 10.2 shows part of the circuit diagram of the connections to the motor.

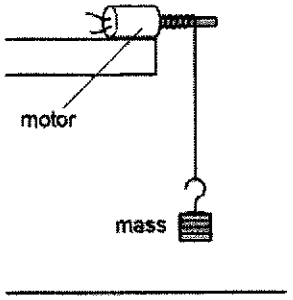


Fig. 10.1

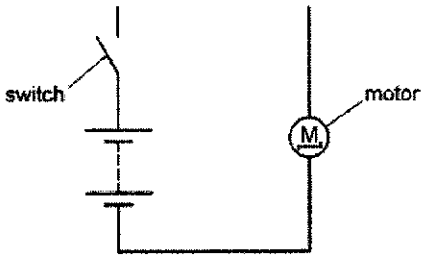


Fig. 10.2

(a) The current in the motor is 1.5 A and the voltage supplied by the battery is 8.0 V.

(i) The motor takes 4.0 s to lift the mass.

Calculate the electrical energy transferred to the motor in this time.

energy = ... [2]

(ii) The motor lifts the 150 g mass through a height of 80 cm in the 4.0 s.

Calculate the gravitational potential energy gained by the mass.

The gravitational field strength g = 10 N / kg.

gravitational potential energy = ... [2]

(iii) State one reason why the gravitational potential energy gained by the mass is less than the electrical energy supplied to the motor.

..... [1]

(b) Fig. 10.3 shows the structure of the motor, with the coil in a horizontal position.

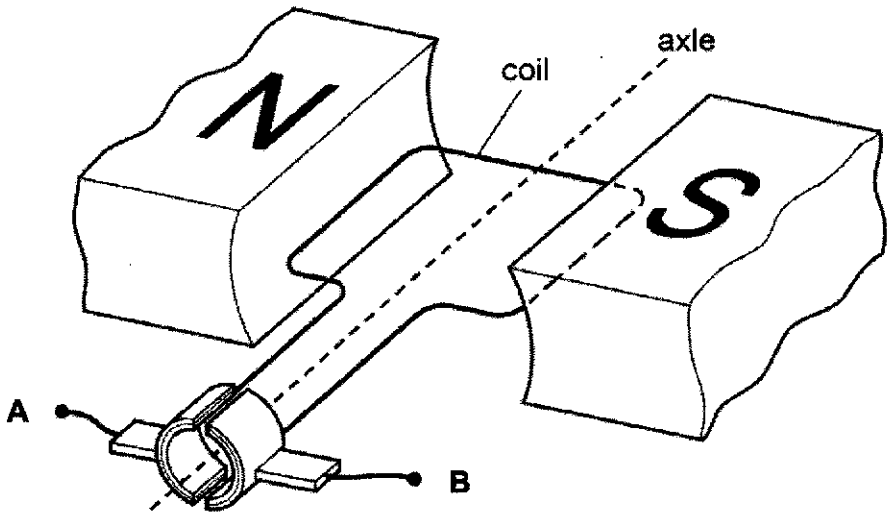


Fig. 10.3

(i) Describe and explain the rotational motion of the coil, when a direct current passes through the coil from **A** to **B**.

.....

.....

.....

.....

..... [3]

(ii) Describe two changes to the setup in Fig. 10.3 that would increase the rate of rotation of the coil.

1. .....

.....

2. .....

.....

[2]

11 Fig. 11.1 shows a uniform ladder leaning against a wall. The bottom of the ladder is 1.0 m away from the wall. The top of the ladder is 4.0 m above the ground.

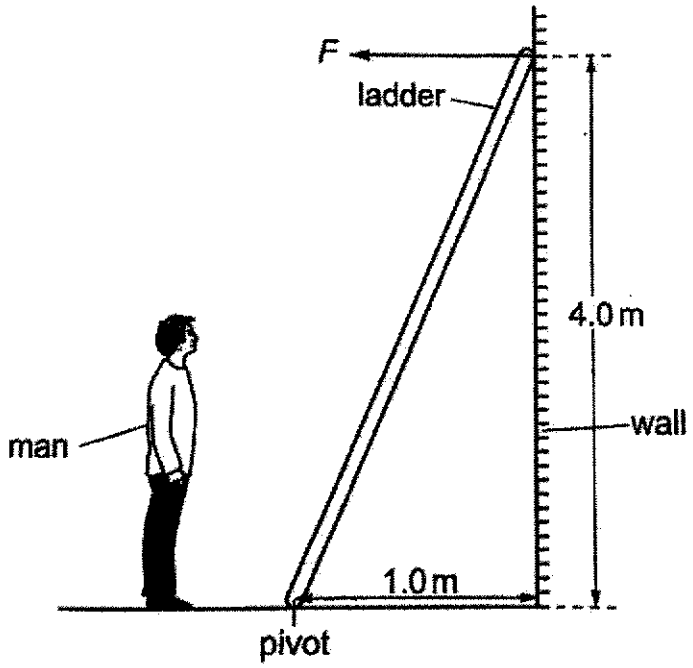


Fig. 11.1

The weight of the ladder is 200 N.

(a) On Fig. 11.1, draw the line of action of the weight of the ladder and determine the perpendicular distance between the line of action of the weight and the pivot.

distance = ... [2]

(b) Calculate the force, *F*, exerted by the wall on the ladder.

Force *F* = ... [3]

(c) There are frictional forces acting on this ladder.

(i) On Fig. 11.1, draw an arrow showing the direction and the line of action for these frictional forces on the ladder. [2]

(ii) Suggest how this force may be increased to make the ladder safer to use.

.....

..... [1]

(d) A man steps onto the ladder and slowly climbs to the top.

Suggest and explain how force *F* changes as the man climbs up the ladder.

.....

.....

.....

..... [2]

12 EITHER

(a) Fig. 12.1 shows a cup contains 1.8 kg of liquid ethanol at –100 °C. To warm it up, Alice places the cup in 2.0 kg of hot water at 50 °C. The system is left undisturbed, and reaches a final temperature.

Assume that no energy enters or leaves the system, and evaporation is negligible.

Assume that the cup has negligible mass.

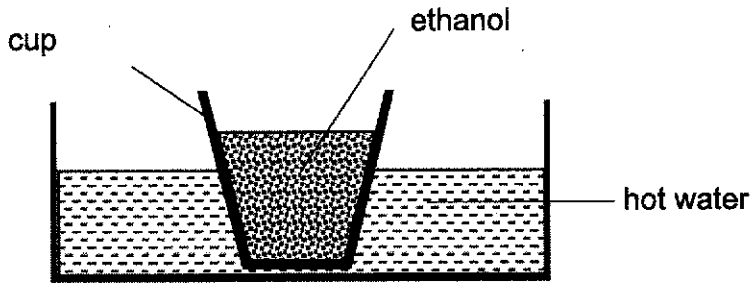


Fig. 12.1

Specific heat capacity of liquid ethanol = 2500 J / kg K

Specific heat capacity of water = 4200 J / kg K

Specific latent heat of fusion of water = 334 000 J / kg

Calculate the final temperature of the system.

final temperature of the system = ... [4]

(b) Fig. 12.2 shows a substance that is heated until it becomes a liquid. It is then left to cool in a room.

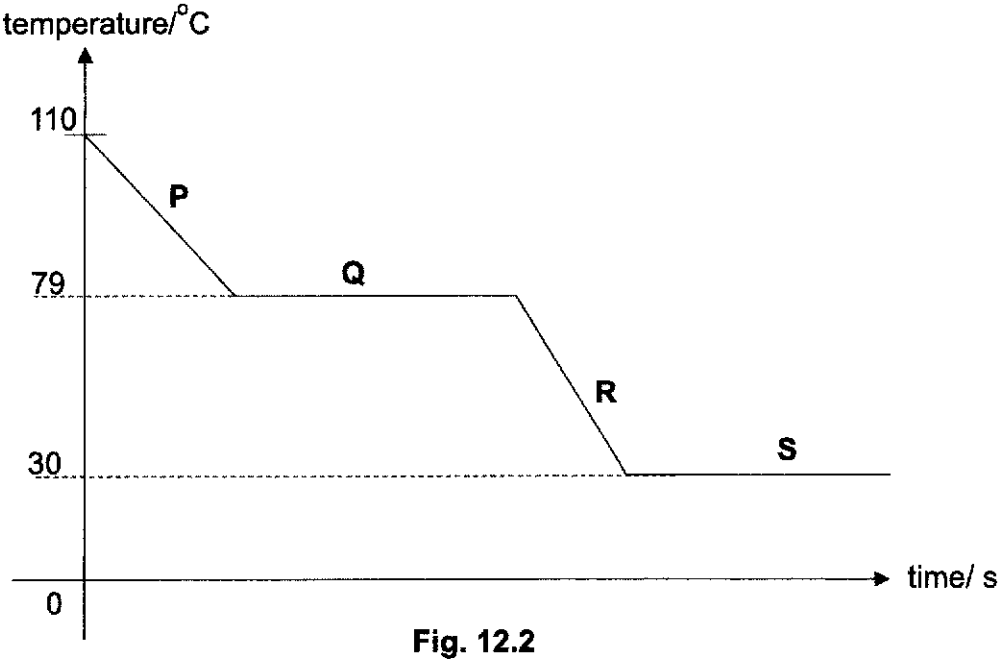


Fig. 12.2

(i) Describe the motion of particles in a liquid.

.....

..... [1]

(ii) Write down the state(s) of the substance in

stage **Q**: .....

stage **R**: ..... [1]

(iii) Determine the freezing point of the substance.

..... [1]

(iv) Heat is being lost in stage **Q**. Explain why the temperature of the substance remains unchanged.

.....

..... [2]

(v) Explain why the temperature of the substance is constant in stage **S**.

.....

..... [1]

12 OR

Fig. 12.3 shows the scaled diagram of an object **O** and its image, **I** formed by a thin converging lens.

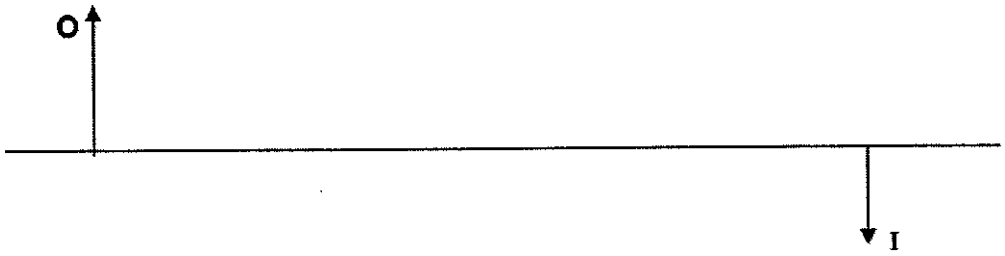


Fig. 12.3 (to scale)

(a) (i) Complete the ray diagram in Fig. 12.3 to show the position of the lens and principal focus. [2]

(ii) Label the optical centre, **C**, in Fig. 12.3. [1]

(iii) Indicate the position of the principal focus, **F**, in Fig. 12.3. [1]

(b) Object **O** is now shifted towards the lens until it is 1.5 times of its focal length away from the lens (u = 1.5 f), state one difference and one similarity to the image formed in Fig. 12.3.

difference: .....

.....

similarity: .....

..... [2]

(c) A converging lens can also be used by a watchmaker as a magnifying glass to observe a mechanical part of a watch as shown in Fig. 12.4.

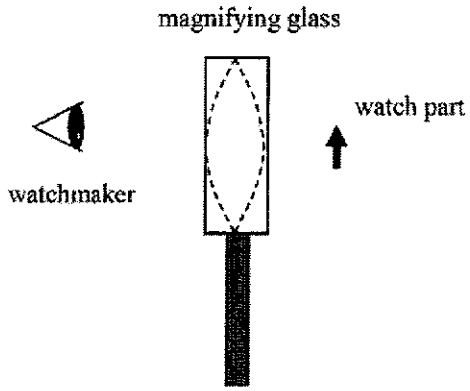


Fig. 12.4

Fig. 12.5 shows an incomplete ray diagram of the magnifying glass.

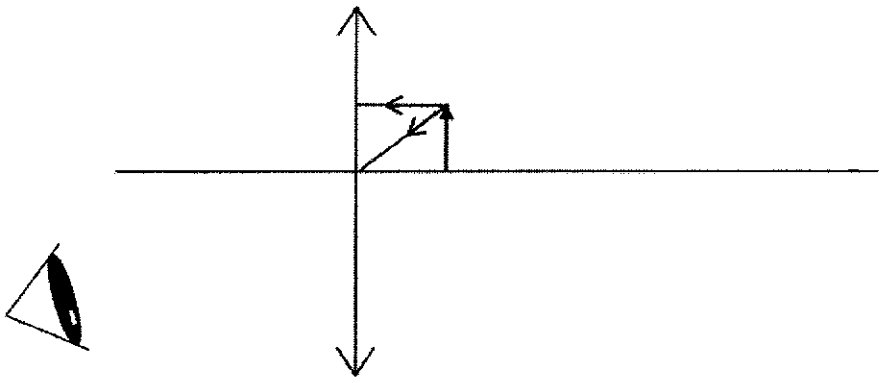


Fig. 12.5

(i) Indicate on Fig 12.5 a possible focal point on each side of the lens. Label each point as F. [1]

(ii) Complete the ray diagram in Fig. 12.5 to show how the magnified image of the watch part is seen by the watchmaker. Label the image as **I**. [1]

(iii) The image of the watch part is magnified. State two other characteristics of the image.

.....

..... [2]

END OF PAPER

Hillgrove Secondary School
Sec 4 Prelim Examination 2021

MCQ

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

Structured Questions

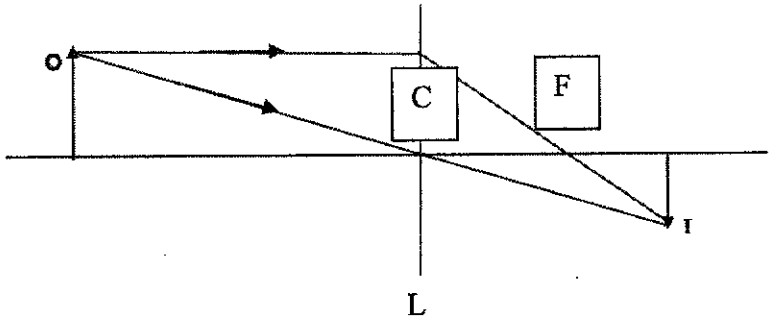
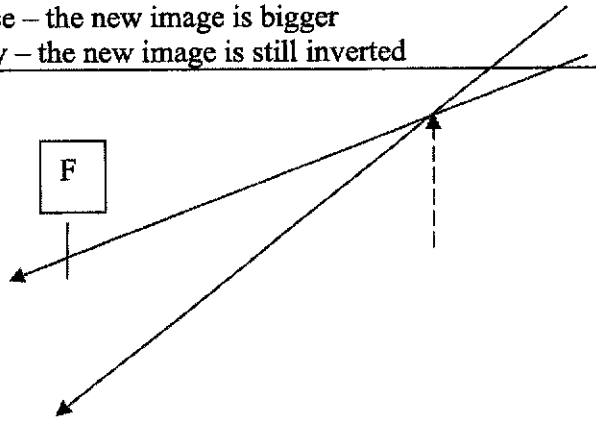
No.	Answer	Remarks
1a	0 N	1
1b	3.0 – 0.8 = 2.2 Area under graph = 2.2x50/2 = 55 m	1 1
1c	a = (v-u)/t = (0-50)/2.2 = -22.7 ms^{-2} Decel = 22.7 ms^{-2}	1 1
1d	F = ma = 850 x 22.7 = 19 300 N = 19 000 N	 1
2	Raw force lines fully drawn with 1 arrowhead. Working lines dashed. Resultant force line fully drawn with double arrowhead. Usage of the Fig. 2.1. Usage of ratio of 1 cm : 100 N. Force labels on raw forces and the resultant force. Angle is 73 degrees. Magnitude = +- 2.5% of 689 N (accept 672 N to 706 N) Angle = +- 2.5% of 44 degrees (accept 43 to 45 degrees)	1 1 1 1
3a	KE = ½ mv^2 = ½ x 2 x 1.5^2 = 2.25 J	1 1
3b	Using sin rule, Sin 30 = h/slope distance Slope distance = h/0.5 = 2h	 1 1

No.	Answer	Remarks
3c	GPE at P = mgh = 2(10)(h) = 20h Total energy at P = KE + GPE = 2.25 J + (20h) J Wd by friction = F (friction) x slope distance Wd = 2.5 x 2h = 5h (5h) J of energy was used to overcome friction. Total energy at Q = Total energy at P – Wd by friction = 2.25 + 20h – 5h = 2.25 + 15h 2.25 + 15h = 9 h = 0.45 m	1 1 1 1
4ai	Reduce loss of heat energy from conduction	1
4aii	Dark coloured has a higher rate of absorption of radiation OR Copper is a good conductor so it can pass the heat quickly to the water	1
4b	The copper particles vibrate faster when they are hotter. They collide with the adjacent particles of water and cause them to vibrate faster as well. There is also electron diffusion occurring in the copper, where activated electrons migrate to colder areas and pass the energy to copper particles.	1 1
4c	The cold water at the bottom will be heated by the warmer water flowing from the solar collector, and if it is still cold it will be more dense, and remain at the bottom and will not affect the warm water at the top. Hot water has lower density and rises up to the top. The top will have the warmest water, that is why the hot water tap is high up.	1 1
4d	This is so that in freezing temperatures it will not freeze solid and stop moving.	1
5a	X: metal 1 Y: metal 2 X: metal 1	1
5bi	Potential difference	1
		1
5c	Faster reaction speed Higher range Higher precision (any 2)	2

No.	Answer	Remarks
6ai	Visible light	1
6aii	Radio waves	1
6aiii	Ultraviolet, X-rays or Gamma rays	1
6aiv	microwaves	1
6b	Radio is transverse, sound wave is longitudinal Radio moves at the speed of light, sound moves at about 330 m/s in air. (any 1)	1
7a	There are 20 oscillations per second.	1
7b	V = f (wavelength) wavelength = v/f = 340/20 000 = 0.017 m	1 1
8a	Live wire has a fuse and switch on it, connected to the upper wire, all drawn correctly. Neutral wire connected to the lower wire Earth wire connected to the casing	1 1 1
8bi	P = VI I = P/V = 2500/240 = 10.4 A = 10 A	1
8bii	Energy = kW x h = 2.5 x 6 = 15 kWh	1
8biii	15 x 7 x 30 = 3150 cents	1 1
9ai	R = V/I R1 = 12/2 = 6 ohms R2 = 12/0.5 = 24 ohms R = $[1/R1 + 1/R2]^{-1}$ = 4.8 ohms	1 1
9aii	They could have different cross-sectional areas	1
9b	When switch S is closed, the current flows through the wire and the coil around the iron core. The causes a magnetic field to be produced due to the Right Hand Grip rule, and this pulls the iron armature on its pivot. The iron armature pushes the flexible contacts closed, allowing current to flow through H in a parallel connection, so H lights up.	1 1 1
10ai	P = VI = 8 x 1.5 = 12 W P = E/t E = Pt = 12 x 4 = 48 J	1 1
10aii	GPE = mgh = 0.15 x 10 x 0.8 = 1.2 J	1 1
10aii i	Energy is lost to overcome friction in the motor, or converted to waste heat energy.	1

No.	Answer	Remarks
10bi	The current passes at a right angle to the magnetic field. Based on Fleming's Left Hand Rule, this causes the left arm of the coil to experience a force downwards, and the right arm to experience a force upwards (cannot just say turn) When the coil reaches about 90 degrees of turn, the split ring commutator breaks the circuit. The coil continues to turn due to inertia. The split ring commutator connects again to the other arm of the coil, which keeps the coil rotating in the same direction, anticlockwise by reversing the current direction in the wire. (any 3 of 4)	1 1 1 1
10bii	Increase the current Increase the number of coils Soft iron core Use stonger magnets (any 2)	2
11a	Line drawn from exactly the middle of the ladder acting downwards. Perpendicular distance is 1 m / 2 = 0.5 m	1 1
11b	ACM = CM F1d1 = F2d2 F x 4 = 200 N x 0.5 F = 25 N	 1 1 1
11d	Force F increases. The man moves further away from the pivot and causes a higher clockwise moment, which requires a higher and higher anticlockwise moment from force F to keep in equilibrium.	1 1
11c	One arrow from the base of the ladder pointing right One arrow from the side of the ladder leaning on the wall, pointing up The ladder could have rubber ends	1 1 1

No.	Answer	Remarks
12E a	Water: J = mcT Temperature change from 50 degrees to 0 degrees (the freezing temperature of water) = 50 degrees. J = 2 x 4200 x 50 = 420 000 J Water loses 420 000 J to the ethanol to reach 0 degrees. Ethanol: J = mcT energy received from cooling of water = 420 000 J T = J/(mc) = 420 000 / (1.8 x 2500) = 93.3333 degrees The ethanol gained 93.333333 degrees, to reach - 6.67 degrees. Now the water is at 0 degrees, and the ethanol is at -6.67 degrees. To make the temperatures the same, the water cannot go lower in temperature, and needs to freeze. Complete freezing of the water to ice at 0 degrees will release J = mL = 2 x 334 000 = 668 000 J Changing the ethanol from -6.67 degrees to 0 degrees J = mcT = 1.8 x 2500 x 6.67 = 30 000 J. Some of the water will freeze into ice at 0 degrees, but not all the water will change to ice when the ethanol has reached 0 degrees. The final mixture will be of ice, water and liquid ethanol, all at 0 degrees.	1 1 1 1
12E bi	Sliding over each other in random motion	1
12E bii	Q: Partly liquid, partly solid R: solid	 1
12E biii	79 degrees	1
12E biv	The molecules of the substance are releasing energy by forming intermolecular bonds and reducing internal potential energy The internal kinetic energy does not change, so the temperature does not change.	1 1
12E bv	It has reached room temperature and is at thermal equilibrium with the room.	1

No.	Answer	Remarks
12O a	 Lines drawn correctly with arrows from O to I Lens drawn Focal point labelled Centre labelled	 1 1 1 1
12O b	Difference – the new image is bigger Similarity – the new image is still inverted	1 1
12O ci,ii		1 1
12O ciii	Upright and virtual	2