Name: ……………………………………….. Index no. ………. Class………..

Bukit Batok Secondary School
GCE 'O' LEVEL PRELIMINARY EXAMINATIONS 2020
SECONDARY 4 EXPRESS

PHYSICS   **6091/01**

Paper 1 Multiple Choice   28 Aug 2020
                                                                    1130 - 1230
                                                                    1 Hour

Additional Materials: Multiple Choice Answer Sheet (OAS)

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 in the spaces provided at the top of this page.

There are **forty** questions in this section. 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 OAS.

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.

This Question paper consists of **21** printed pages including this cover page

1 Which pair contains vector quantities?

    A acceleration and distance

    B displacement and mass

    C speed and force

    D velocity and weight

2 A micrometer screw gauge is used to measure the thickness of ten metal sheets.

The diagram below shows the reading on the micrometer.
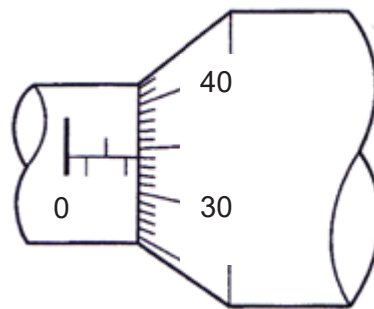
What is the thickness of one metal sheet?

    A 3.34 mm   **B** 1.84 mm   **C** 0.334 mm   **D** 0.184 mm

3 A ball is released from the top of an 80 m tall building.
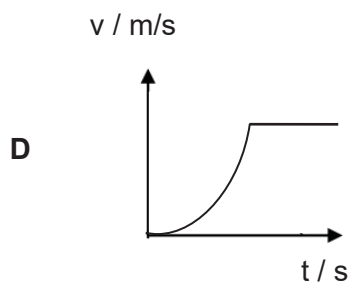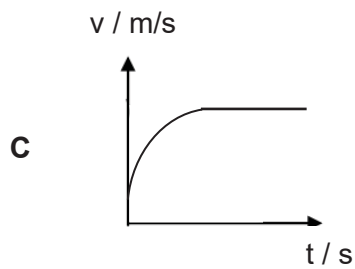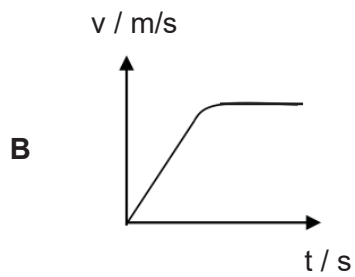Given that the gravitational field strength, g = 10 N / kg and ignoring the effects of air resistance.

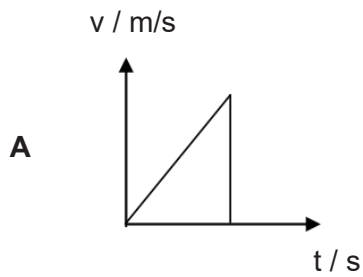What is the time taken for the ball to fall to the ground?

    A 0.26 s

    B 1.00 s

    C 4.00 s

    D 8.00 s

**4**   A trolley starts rolling down a sloping runway connected to a flat floor.
All the surfaces are smooth and the effect of air is negligible.
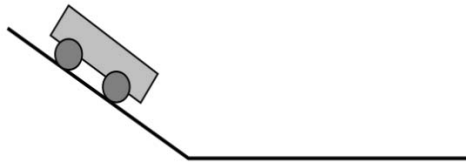
Which of the following velocity-time graphs best illustrates the motion of the trolley?

A

v / m/s

t / s

B

v / m/s

t / s

C

v / m/s

t / s

D

v / m/s

t / s

Applying past knowledge to new situations   3

5 The displacement-time graph shows the variation of displacement with time for three cars, X, Y and Z.

displacement / m

car Y

car X

car Z

time / s
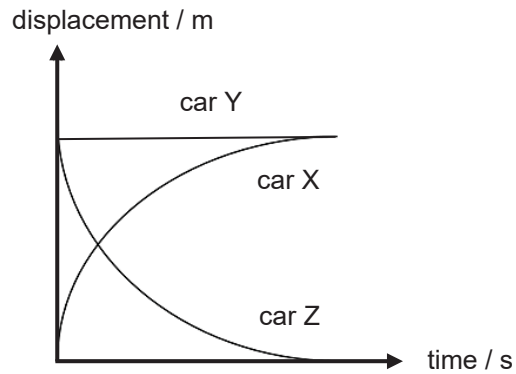
Which description about the motion of the cars is correct?

A Car X is moving with increasing velocity.

B Car Y is moving with uniform velocity.

C Car Y travelled the largest distance.

D Car Z is moving in the opposite direction to car X.

6 A block of iron is brought from Earth to the surface of the Moon with gravitational field strengths of 10 N / kg and 1.6 N / kg respectively.

statement	
1	Its inertia decreases.
2	Its weight decreases
3	Its density remains unchanged.

Which of the following statements are true about the iron block when it is on the Moon?

A 1 and 2

B 1 and 3

C 2 and 3

D 1, 2 and 3

7 A stone is falling through the air has reached terminal velocity.

Which row shows the acceleration and the velocity of the stone?

	acceleration of the stone	velocity of the stone
A	10 m / s^2	constant
B	10 m / s^2	increasing
C	zero	constant
D	zero	increasing

8 The diagram shows two blocks made from the same material.
The mass of the smaller block is M.
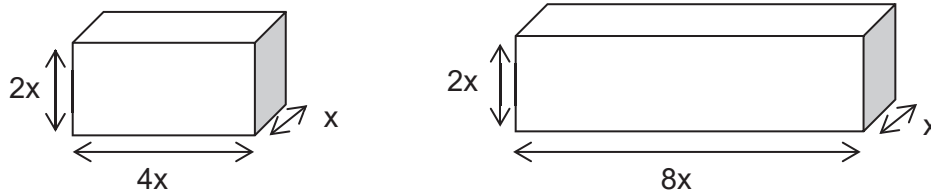
What is the mass and density of the larger block?

	mass	density
A	2M	$M / 8x^3$
B	2M	$M / 16x^3$
C	16M	$M / 8x^3$
D	16M	$M / 16x^3$

Applying past knowledge to new situations   5

9 A pendulum bob of weight 40 N is pulled horizontally to the left by a 30 N force, as shown in the diagram below.
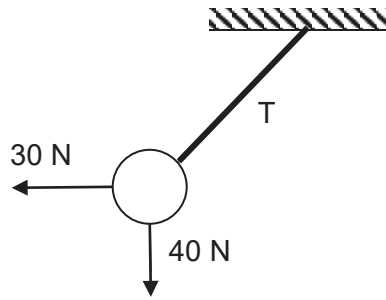
Which diagram, drawn to scale, represents the three forces in size and direction at equilibrium?

A

B

C

D
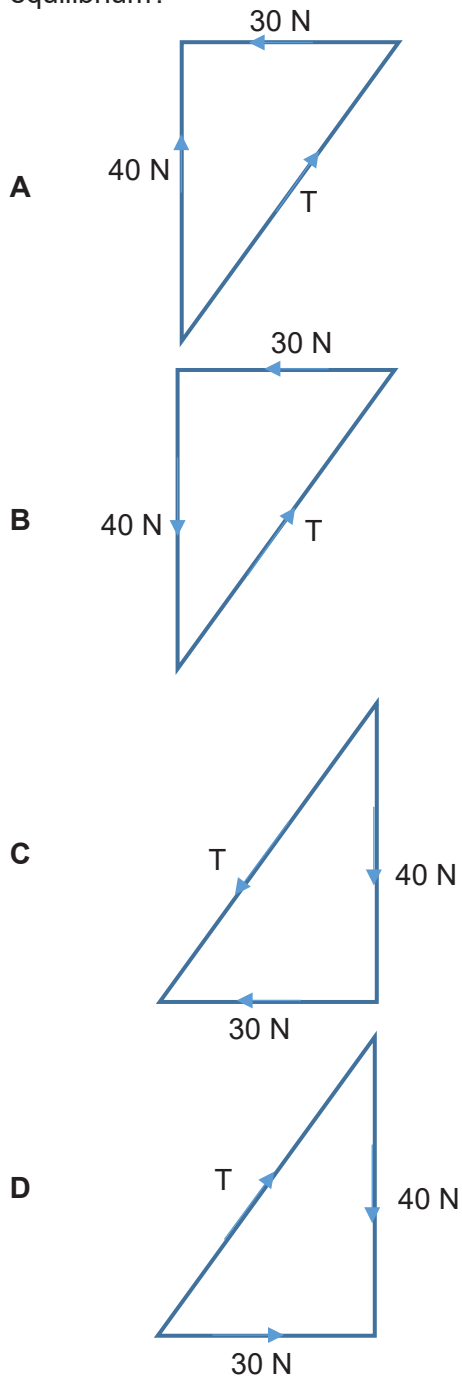
10 A non-uniform rod of unknown weight W is suspended by two strings as shown in the diagram. The tension in one of the strings is 5 N.
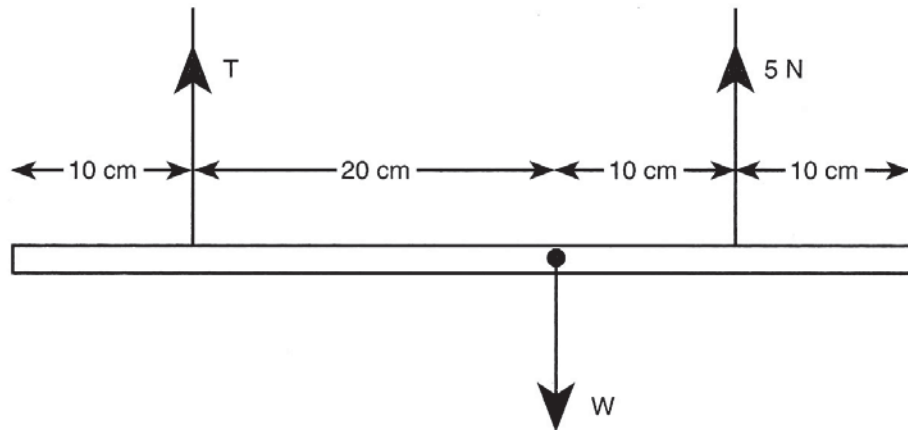
What is the tension T in the other string?

A   2.5 N

B   5.0 N

C   7.5 N

D   12.5 N

11 The diagrams shows four wooden blocks resting on a ground.
Block A and block C have the same area in contact with the ground.
Block D has lesser area in contact with the ground as compared to block B.

Which block is the least stable?
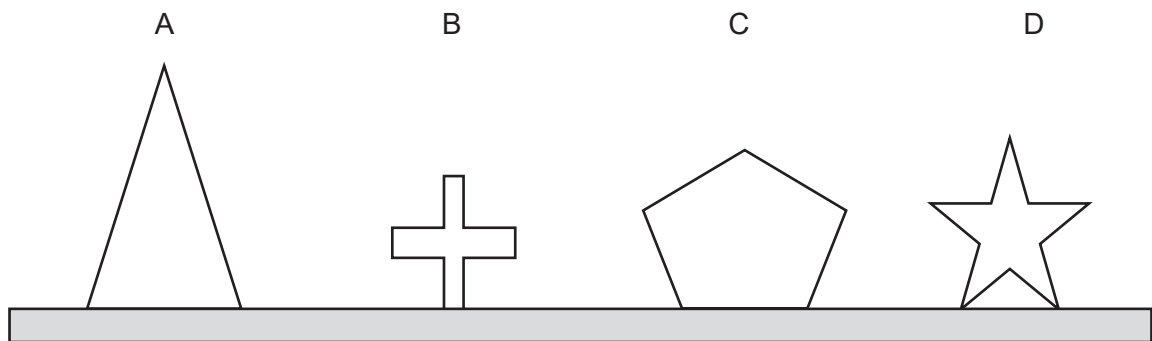
12 Four different blocks are resting on the ground. The gravitational field strength g is 10 N / kg.

Which block exerts the greatest pressure on the surface below it?
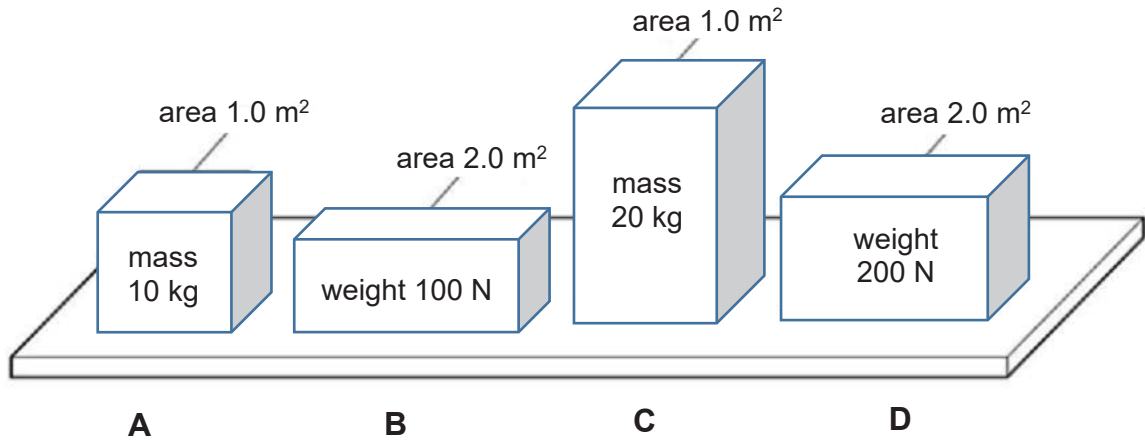
13 The diagram shows a manometer used to measure the pressure of the gas in a chamber. The density of mercury is 13.6 g / cm^3 and the gravitational field strength g is 10 N / kg.
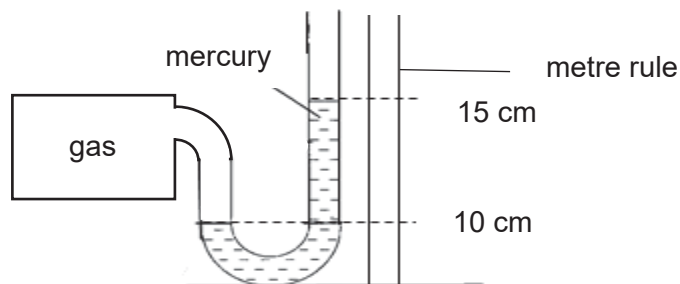
If the mercury is replaced by water (density = 1.0 g / cm^3), what is the change in height of the metre rule?

A 50 cm   **B** 68 cm   **C** 100 cm   **D** 136 cm

14 An object initially at rest is dropped from a tower of height 50 m.
Air resistance can be ignored. Assume that the potential energy of the object is zero when it is on the ground.

What is the ratio $\dfrac{\text{gravitational potential energy}}{\text{kinetic energy}}$ at the height of 20 m above the ground?

A 0.40   **B** 0.60   **C** 0.67   **D** 1.5

15 An inflated car tyre contains air at a constant volume. After the car has travelled on the road, the air inside the tyre was heated up and the air pressure increased.

Which option correctly describes the properties of the air molecules inside the tyre?

	number of air molecules in the tyre	force between air molecules and tyre wall	number of collisions per second between air molecules and tyre wall
A	increases	increases	decreases
B	increases	no change	decreases
C	no change	increases	increases
D	no change	no change	increases

16 The following objects all lose heat.

Which object loses all of its heat by radiation?

A concrete block with white surfaces at 100 °C, in an air conditioned room

B heating element of a kettle at 150 °C, in water

C metal hot plate with black surfaces at 200 °C, in contact with a metal pan

D shiny metal satellite at 30 °C, in space

17 The diagram shows a mercury-in-glass thermometer. The distance between - 10 °C and the 100 °C markings is 22.9 cm.
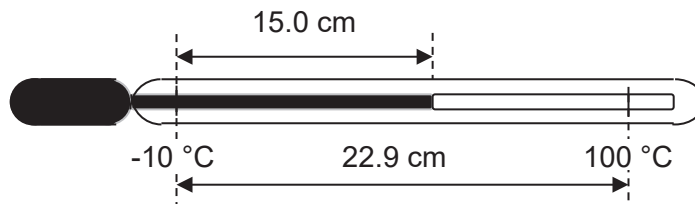
At which temperature is the end of the mercury thread a distance of 15.0 cm from the - 10 °C mark?

A 50 °C   **B** 60 °C   **C** 62 °C   **D** 72 °C

Applying past knowledge to new situations   9

18 A block of copper is at room temperature.

Which row describes a smaller block of copper at the same temperature?

	internal energy	heat capacity	specific heat capacity
A	same	less	same
B	same	same	same
C	less	same	less
D	less	less	same

19 Air is blown into ether through the glass tube as shown in the diagram.
After some time, it is observed that the film of water freezes into ice.

blown air

glass tube

a film of water   ether

wooden board
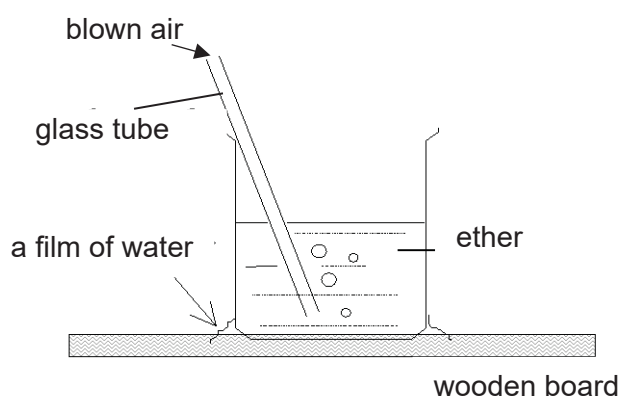
Which option best describes the processes that result from blowing the air?

	rate of evaporation of ether	temperature of ether	heat transfer
A	increases	rises	from water to ether
B	increases	falls	from water to ether
C	decreases	falls	from ether to water
D	decreases	rises	from ether to water

20 The graph shows the change in temperature when heat is supplied at 200 W to 1 kg of a substance.

temperature / °C
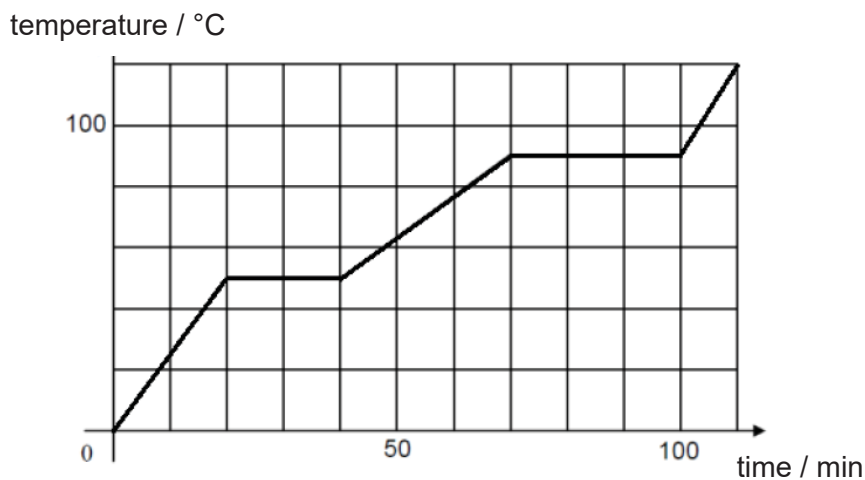
What is the specific latent heat of vaporisation of the substance?

A 4000 J / kg

B 6000 J / kg

C 240 000 J / kg

D 360 000 J / kg

21 A heater of the same power rating is used to heat 3 different liquids X, Y and Z.
The results are shown below.

liquid	mass of liquid / g	increase in temperature after 5.0 minutes / ° C
X	100	15
Y	200	12
Z	180	10

Which of the following correctly compares specific heat capacities c_X, c_Y and c_Z of liquids X, Y and Z respectively?

A $c_X > c_Y > c_Z$

B $c_X > c_Z > c_Y$

C $c_Z > c_Y > c_X$

D $c_Y > c_X > c_Z$

22 The diagram shows the water molecules on a water surface when a wave is created, moving from the left to right.

wave direction

In which direction will the water molecule labelled W move in the next instant?

A downwards

B towards the left

C towards the right

D upwards

23 A vertical stick is dipped in and out of the water at P. The wave takes two seconds to travel from P to Q.
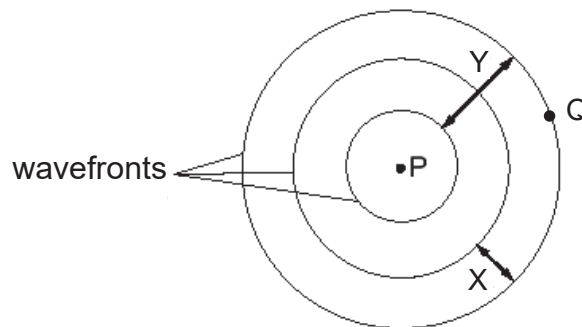
Which of the following statements is true?

A Distance X is the amplitude of the waves.

B Distance Y is the wavelength of the waves.

C The frequency of the waves is 1.5 Hz.

D The wave formed is a longitudinal wave.

24 A mirror is placed in the path of a ray of light.

normal

incident ray   reflected ray

path of light
without the mirror
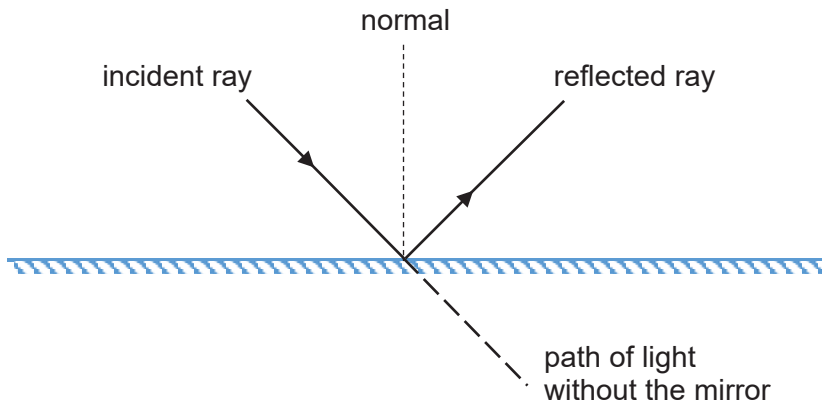
If the incident angle is 50°, through what angle does the direction of the ray of light change?

A 50°   **B** 80°   **C** 100°   **D** 130°

25 Two parallel rays of light pass through an isosceles glass prism with a refractive index of 1.5.

45°   45°
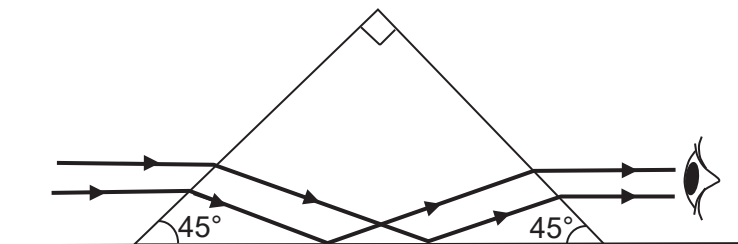
statement	
1	Total internal reflection occurs at the base of the prism.
2	An object viewed through this prism in this way will appear upside down.
3	The critical angle for the glass prism is more than 45°.

Which of the following combination of statements are **true**?

A 1 and 2

B 1 and 3

C 2 and 3

D 1, 2 and 3

26 Two parallel rays of light G and H passes through a converging lens as shown below.

Which point is the focal point of the lens?
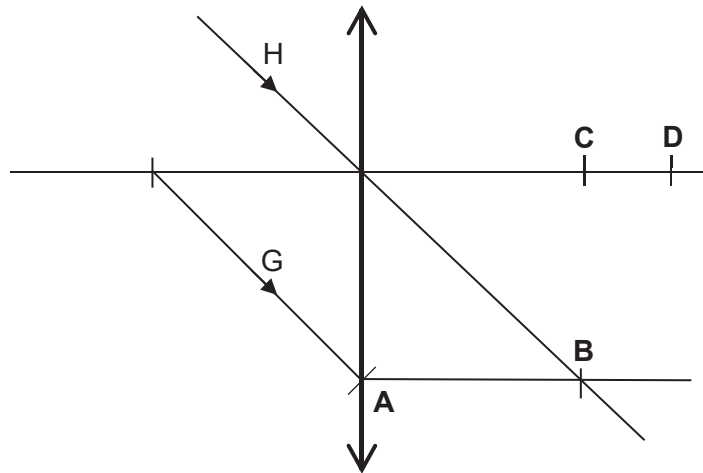
27 The diagram below shows different regions of the electromagnetic spectrum.

radio waves		Z	visible light			gamma rays

Which of the statements below is true of the radiation found in region Z?

A It can be used in a remote controller.

B It can be used for sterilisation.

C It can be used in high frequency communication.

D It can be used for radiation therapy.

28 Which of the following summarises the change in wave characteristics from infra-red to ultraviolet in the electromagnetic spectrum?

	frequency	speed in vacuum
A	increases	remains constant
B	increases	decreases
C	decreases	remains constant
D	decreases	increases

29 The diagrams show sounds waves produced by a microphone.

Which wave shows the sound that is both loudest and lowest-pitched?

A

B

C

D
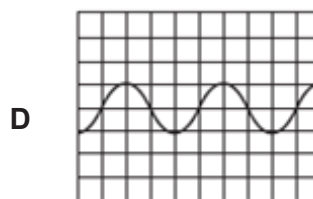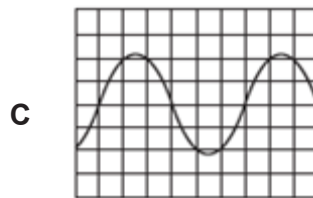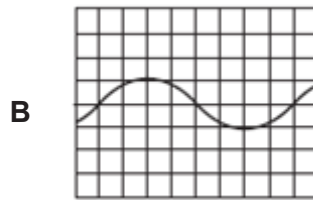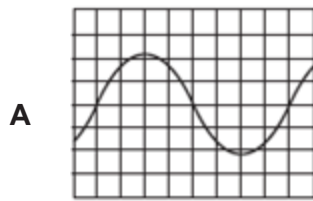
30 A pulse of sound is transmitted vertically downwards from an echo-sounder at the bottom of a stationary ship. The pulse is reflected from the seabed and returns to the ship. The time taken between transmitting and receiving the pulse is 0.30 s. The speed of sound in water is 1400 m / s.

What is the depth of water under the ship?

A 105 m

B 210 m

C 420 m

D 840 m

31 The diagram shows the electric field pattern between two isolated point charges, A and B.
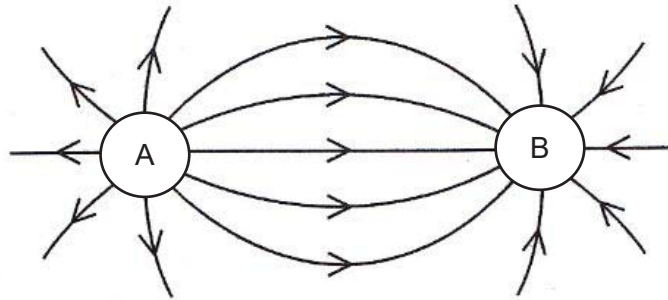
Which two point charges would produce this pattern?

	charge A	charge B
A	positive	positive
B	negative	positive
C	positive	negative
D	negative	negative

32 A piece of wire 0.50 m long has a cross-sectional area of 1.0 mm^2.

Which wire of the same material has twice the resistance?

	cross-sectional area / mm^2	length / m
A	2.0	0.50
B	2.0	0.25
C	1.0	0.25
D	0.5	0.50

33 Four identical lamps are connected as shown. P is the brightest. Q, R and S have the same brightness.
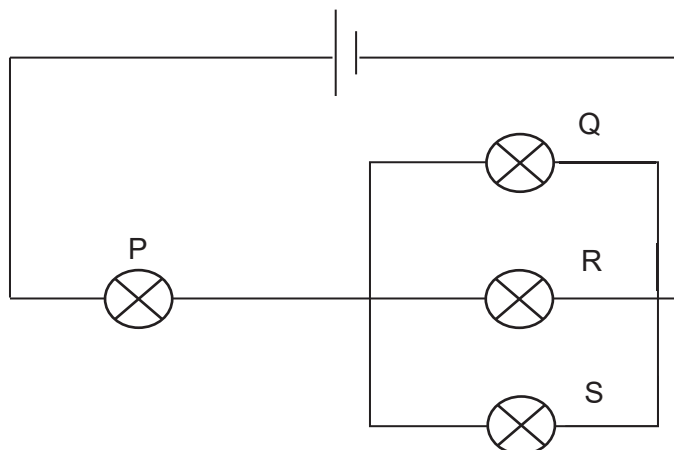
If R is removed, which of the following statements is correct?

A P, Q and S becomes brighter.

B P becomes brighter while Q and S becomes dimmer.

C P becomes dimmer but still brighter than Q and S.

D P becomes dimmer than Q and S.

34 The diagram shows a potential divider circuit including a light-dependent resistor (LDR) and a fixed resistor.
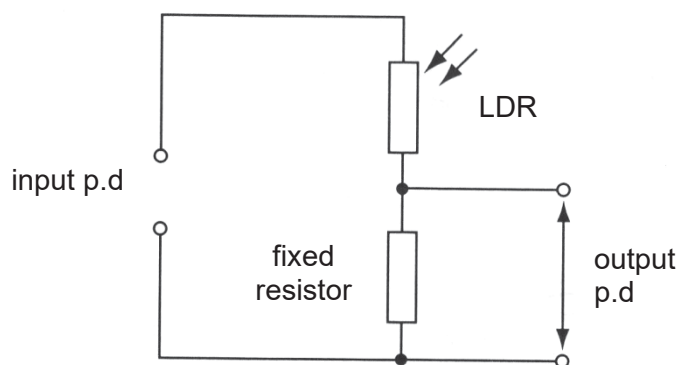
Which conditions will give a high output potential difference, (p.d.)?

	brightness of the light shining on the LDR	the p.d across fixed resistor
A	bright	high
B	bright	low
C	dim	high
D	dim	low

35 The following table shows the total number of hours for which two electrical appliances were used in a household in a month.

appliance	rating	duration
air-conditioner	230 V, 1.5 kW	200 hours
fan	230 V, 80 W	10 hours

If 1 kWh of electricity costs $0.20, what is the cost of electricity used in the household in a month?

A $ 60.16

B $ 61.60

C $ 66.36

D $ 220.00

36 When connecting a washing machine to the mains, which of the following is correct about the wires?

A   The earth wire is at high potential and is dangerous to touch.

B   The live wire should be connected to the case of the washing machine.

C   The neutral wire does not normally carry any current and is safe to touch.

D   With the earth wire disconnected, the washing machine can still operate.

37 An object X is brought near (but not touching) a bar magnet which is placed on an electronic balance as shown in the diagram.
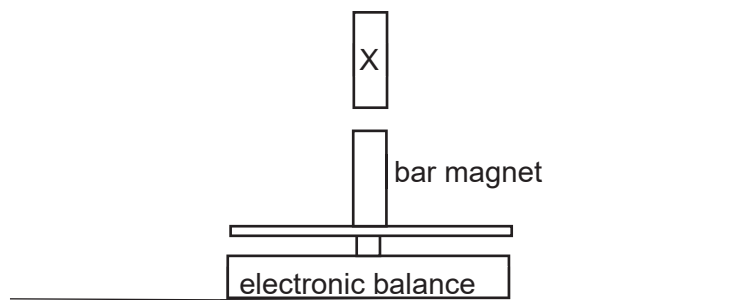
If the reading on the electronic balance decreases, what can X be?

A A bar magnet only.

B A copper bar and an iron bar.

C Both a bar magnet and a copper bar.

D Both a bar magnet and an iron bar.

38 The diagram shows a sphere which has a bar magnet hidden inside it. Compasses are placed around the outside and their needles point as shown.

Which diagram shows the position of the magnet inside the sphere?
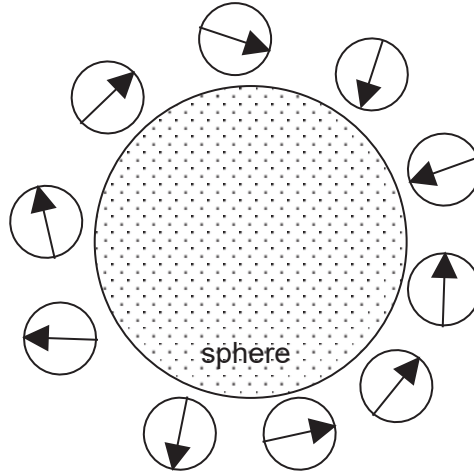
A

B

C

D

39 A steel nail is placed in a current-carrying solenoid.

solenoid

steel nail
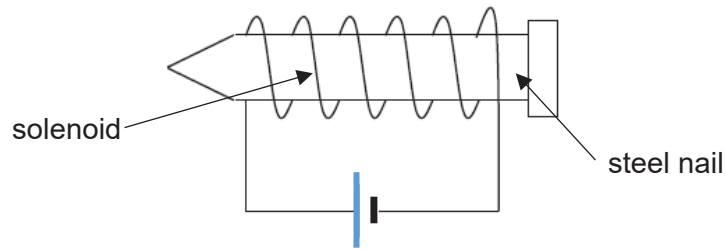
The nail is removed from the solenoid after some time.

Which diagram shows the direction of the pointers on the compasses placed near the ends of the nail?

A

B

C

D
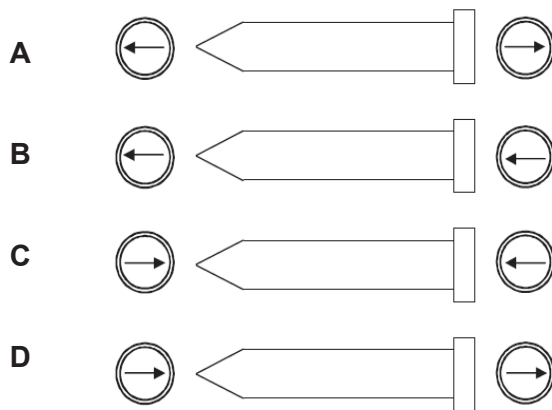
40 A beam of electrons is directed into a uniform magnetic field and deflects as shown in the diagram below.

magnetic field

electron flow
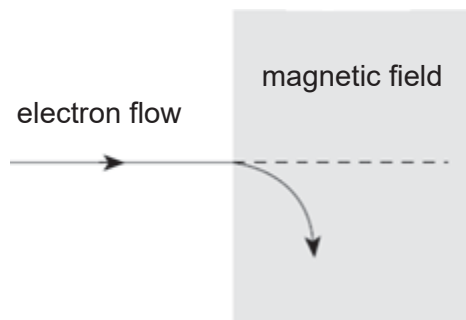
Which of the following correctly describes the direction of the magnetic field?

A into the page

B towards the bottom of the page

C towards the top of the page

D out of the page

End of Paper

EXTRA QNS

A series of compressions and rarefactions of a sound wave is shown below. The sound has a frequency of 1600 Hz and a speed of 320 m/s.

X   Y
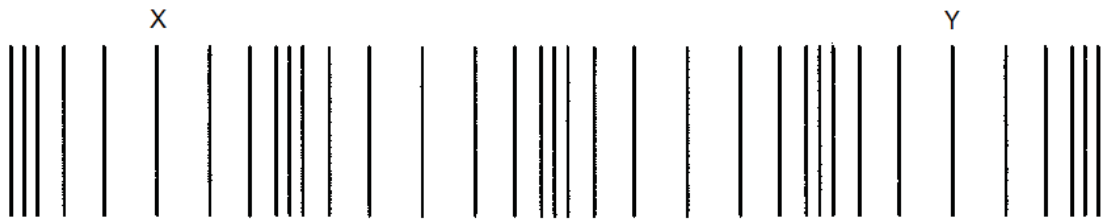
What is the distance between X and Y?

A   0.20 m

B   0.40 m

C   0.60 m

D   1.20 m

The diagram shows the different displacement-time graph of the musical notes played on a flute.

Which waveform, **A, B, C** or **D**, has the highest pitch?
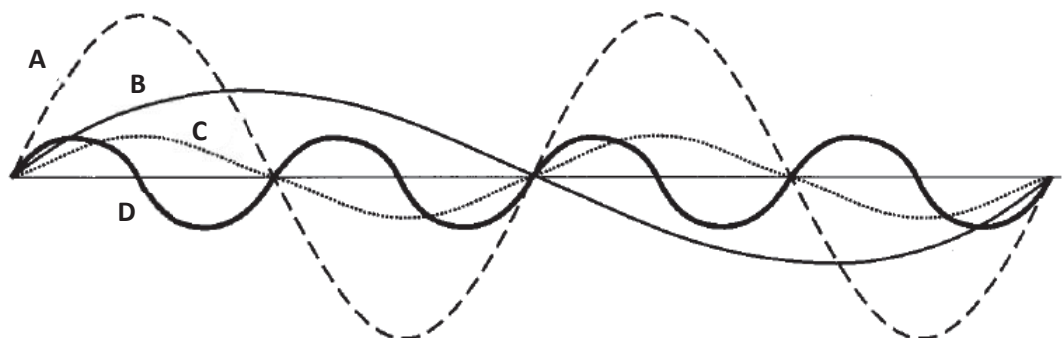
Applying pa

5 An engine pulls a truck at a constant speed on a level track.
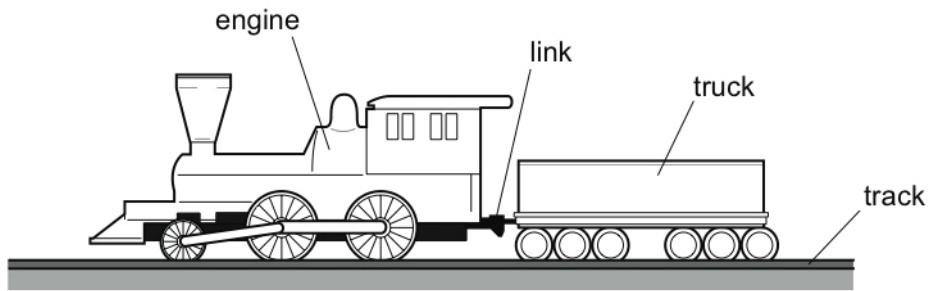
The link between the truck and the engine breaks. The driving force on the engine remains constant.

What effect does this have on the engine and on the truck?

	engine	truck
A	accelerates	slows down
B	accelerates	stops immediately
C	speed stays constant	slows down
D	speed stays constant	stops immediately

26 Five wavefronts are formed by a vibrating source S as shown below.
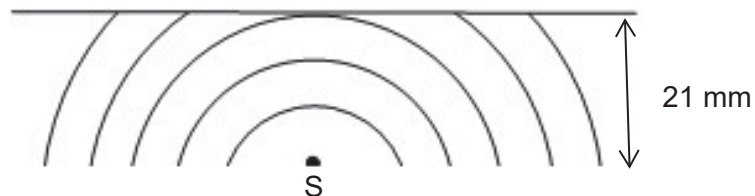
What is the wavelength and frequency of the wave if it is travelling at 84 mm/s?

	wavelength/ mm	frequency/ Hz
A	4.2	20
B	4.2	353
C	7.0	12
D	7.0	588

36 The diagram shows three pairs of parallel wires with the currents in the directions shown.
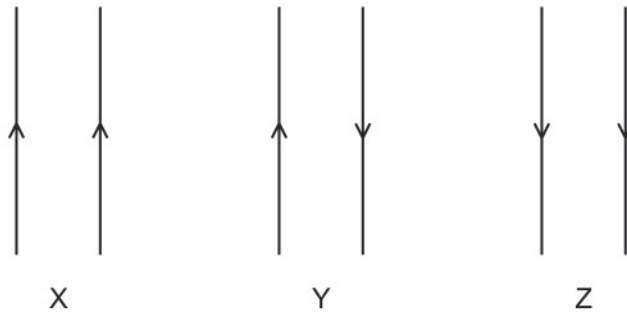
For each pair of wires, what are the forces between the wires?

	X	Y	Z
A	attraction	repulsion	attraction
B	attraction	attraction	attraction
C	repulsion	attraction	repulsion
D	repulsion	repulsion	repulsion

Name: …………………………………………. Index no. ……….   Class………..

Bukit Batok Secondary School
GCE O LEVEL PRELIMINARY EXAMINATION 2020
SECONDARY 4 EXPRESS

PHYSICS   **6091/02**
Paper 2 Theory   31 Aug 2020
                                                  1 hour 45 minutes
                                                0800 – 0945 h

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer all questions.

Section B and C
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, were 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 Examiner's Use	
Section A	
Section B	
Total	

This Question paper consists of 21 printed pages including this cover page

Section A

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

1 A rocket of mass 40 kg is launched from the surface of an unknown planet W. The rocket rises vertically upwards with constant acceleration and after 18 s, the rocket's engine is cut off. It reaches a maximum height at 50 s. The rocket falls to the ground 90 s after the launch.

Fig. 1.1 shows how the velocity of the rocket varies with time until it reaches ground. Assume that air resistance can be neglected.
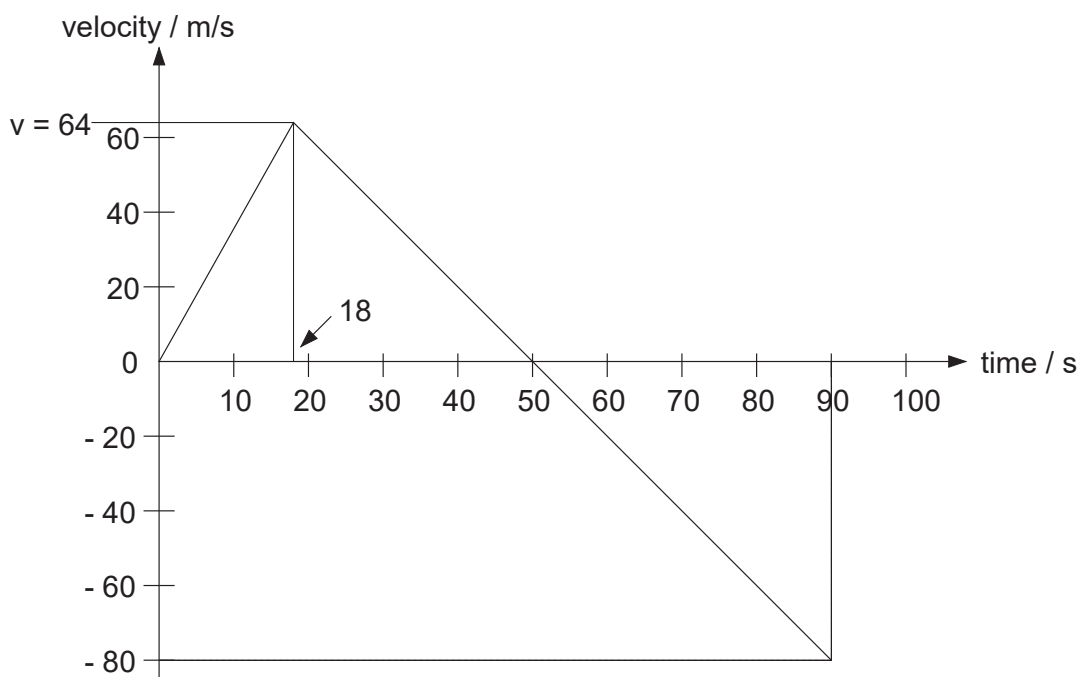
Fig. 1.1

(a) Describe the velocity and acceleration of the ball from time t = 0 s to t = 50 s.

....

....

....

....

....

....

....

.... [3]

(b) Calculate the acceleration of free fall on planet W.

acceleration of free fall on planet W = ………………… [2]

(c) On Fig. 1.2, sketch a graph to show the displacement of the rocket with time from t = 0 s to t = 50 s. Label all values of displacement.

[3]
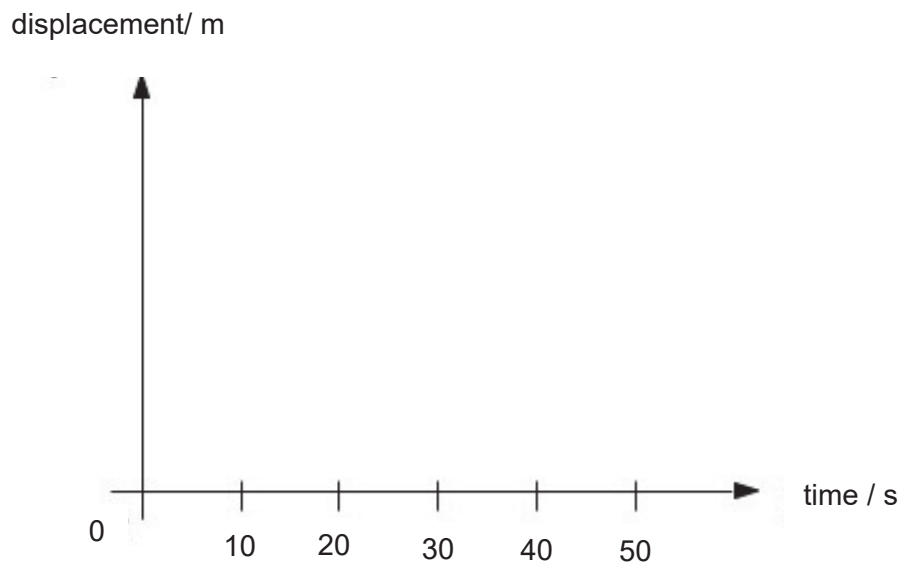
Fig. 1.2

2 In 1909, Robert Millikan did an experiment by observing how charged oil droplets behave between two charged plates. Fig. 2.1 shows the setup of this experiment. When current flows in the circuit, the oil droplet is stationary and suspended in mid-air.
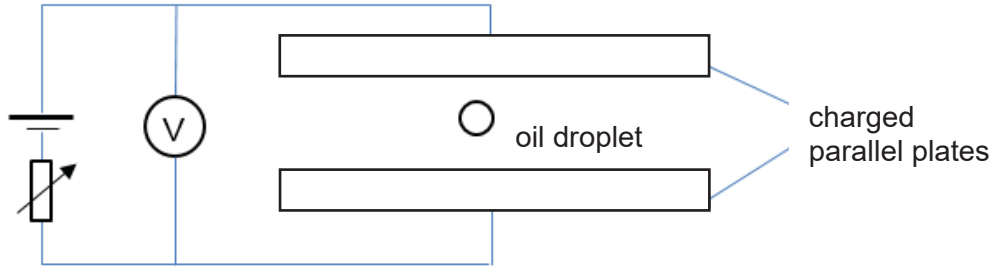
Fig. 2.1

(a) State whether the oil droplet is positively or negatively charged.

……………………………………………………………………………………………… [1]

(b) On Fig. 2.1, label the charges on the plates and draw the field lines between the two plates. [2]

(c) Explain in terms of forces why the oil droplet remained stationary.

………………………………………………………………………………………………

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………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………… [2]

3   Fig. 3.1 shows an electric motor being used on a building site to lift bricks. The motor lifts bricks of total mass 54 kg through a height of 2.5 m in 0.050 minutes. The gravitational field strength g = 10 N/kg.
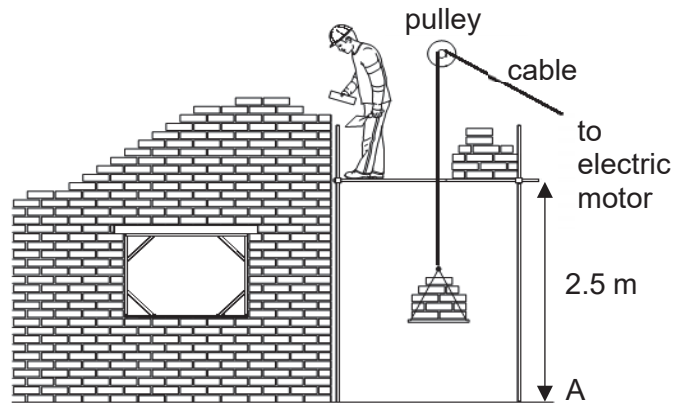
Fig. 3.1

(a)   At point A, the bricks have kinetic energy and gravitational potential energy.

State what is meant by *kinetic energy* and by *gravitational potential energy.*

kinetic energy ………………………………………………………………………

……………………………………………………………………………………..

gravitational potential energy …………………………………………………

……………………………………………………………………………….   [2]

(b)   Calculate the work done in lifting the bricks.

work done = ………………   [2]

(c)   Calculate the useful power output of the motor.

useful power output = ………………   [2]

Applying past knowledge to new situations   5

(d) In real life situation, the work done in lifting the bricks is higher than the value calculated in part (**b**).

Explain using the principle of conservation of energy why is it so.

....

....

....

....

....

....

.... [2]

4   Fig. 4.1 shows a manometer used to measure the pressure difference between the air inside a flexible plastic container and the atmosphere outside. Before force F is applied, the pressure in the flexible plastic container is in equilibrium with the atmospheric pressure. Atmospheric pressure is given as 1.0×10^5 Pa.
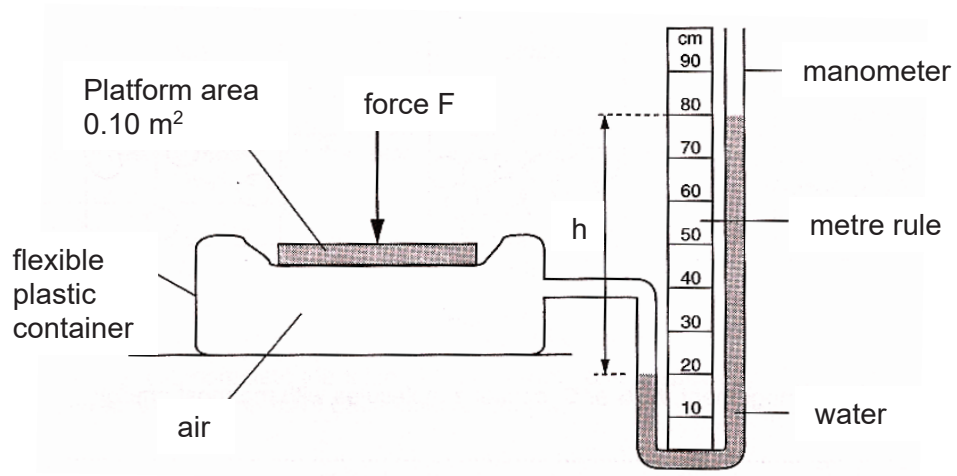
Fig. 4.1

(a)   Explain why the water level moves down on the left side of the manometer when force F is applied on the plastic container.

....

....

....

....   [1]

(b)   Calculate the pressure exerted by force F.

The gravitational field strength g is 10 N / kg.
The density of water is 1000 kg / m³

total pressure = ………………… [3]

(c) Given the platform area is 0.10 m^2, calculate force, F.

force, F = ………………… [2]

(d) Suggest how the manometer can be changed to measure greater pressure differences using a tube of the same length.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [1]

5 Fig. 5.1 shows the displacement-distance graph of a sound wave with a frequency 660 Hz passing through air.
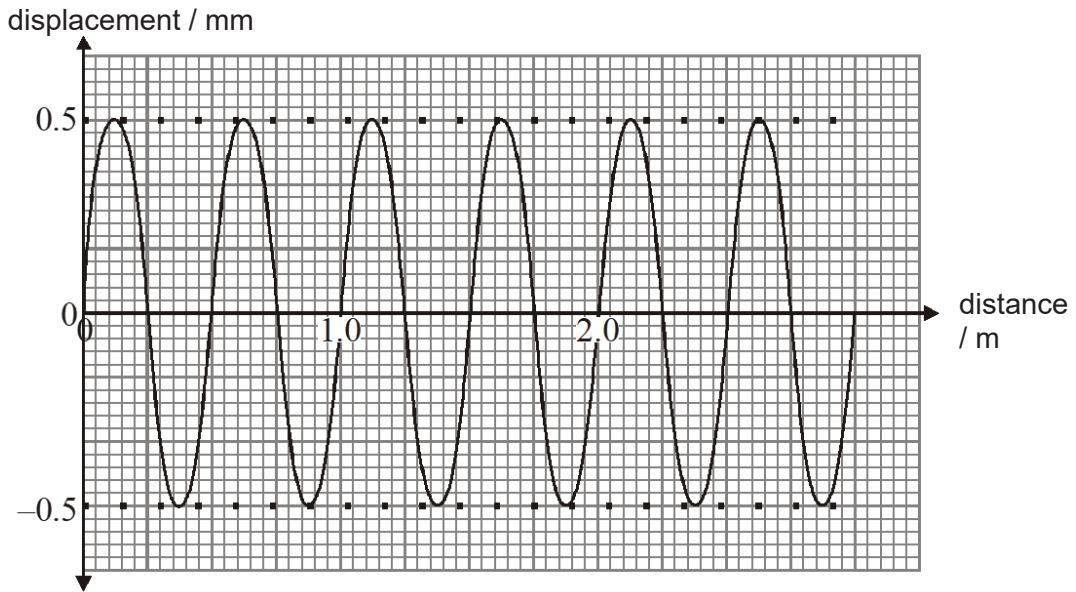
Fig. 5.1

(a) State the type of wave for sound.

………………………………………………………………………………………… [1]

(b) Explain what is meant by *frequency* of a wave is 660 Hz.

…………………………………………………………………………………………

………………………………………………………………………………………… [1]

(c) Using data from Fig. 5.1, determine the

(i) the wavelength, and

wavelength = ………………… [1]

(ii) the amplitude.

amplitude = ………………… [1]

(d) Calculate the speed of the wave.

speed of wave = ………………… [2]

6 Fig. 6.1 is drawn to scale. An object O is placed in front of a converging lens L. The lens forms an image of the object O.
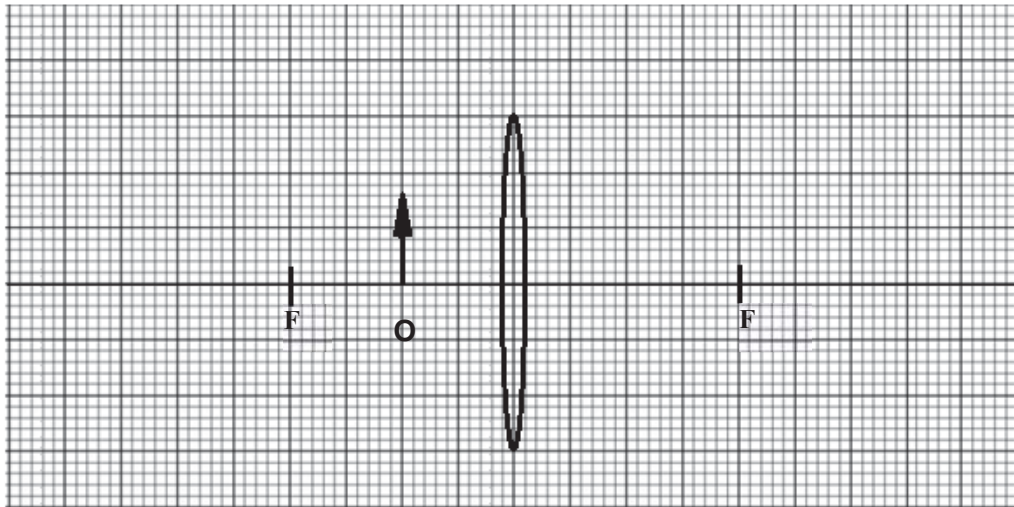
Fig. 6.1

(a) On Fig. 6.1,

    (i) draw two rays from the top of the object to locate the top of image. [2]

    (ii) draw and label the image **I** [1]

(b) State how the rays show that the image is virtual.

……………………………………………………………………………………… [1]

(c) The object is moved further away from the converging lens such that the distance between the object and the lens is more than one focal length.

State two changes to the image.

1. ………………………………………………………………………………………

………………………………………………………………………………………

2. ………………………………………………………………………………………

……………………………………………………………………………… [2]

7 Different colours of light take different paths through the glass prism. The effect can form a rainbow when white light strikes the prism.

Fig. 7.1 shows the path of a ray of white light incident on the prism and the path of blue light inside the prism.
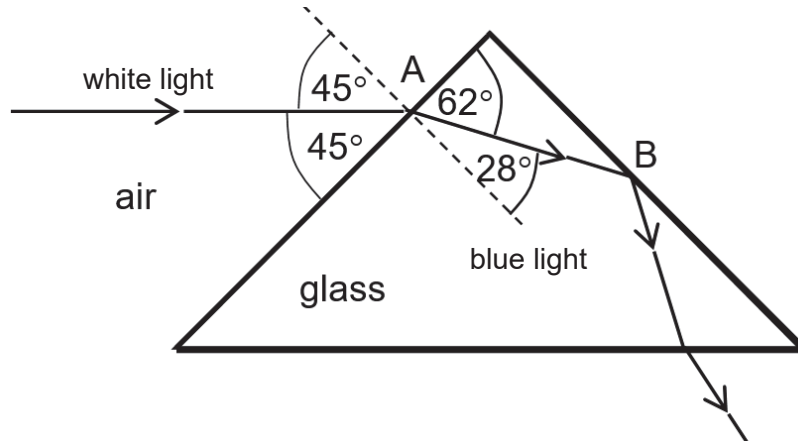
Fig. 7.1

(a) State the angle of incidence and the angle of refraction of the blue light at point A.

angle of incidence = …………………

angle of refraction = ………………… [1]

(b) The refractive index of glass for red light is slightly smaller than for blue light

State and explain how the angle of refraction at point A for red light compares with the angle of refraction for blue light.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(c) On Fig. 7.1, draw the path of a ray of red light inside the glass prism at point A. [1]

8 Fig. 8.1 shows a positively charged rod, an uncharged metal sphere mounted on an insulated stand and a connection to earth.
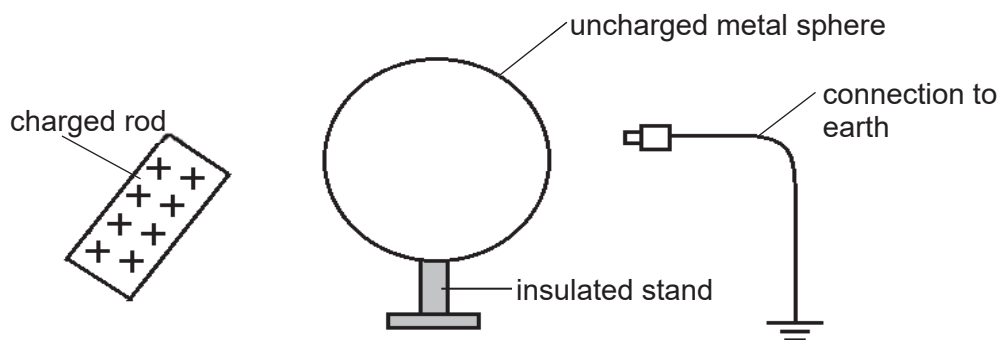
Fig. 8.1

(a) Describe how this apparatus is used to give the metal sphere a negative charge by induction.

....

....

....

....

....

.... [3]

(b) State and explain what happen to the charges in the metal sphere during the charging process.

....

....

....

.... [2]

(c) At the end of the charging process, the metal sphere has a negative charge of 1.2 nC. The charging process took 2.5 s.

Calculate the average current during this time.

current = ... [1]

Section B

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

9   Cappuccino is an Italian, coffee-based drink prepared with espresso (a type of coffee), steam milk and milk foam. To make steamed milk, hot steam is passed into the cold milk to heat up the milk.

Fig. 9.1 shows some of the specific heat capacities for different substances. You may assume that milk and water have the same specific heat capacity.

Substance	Specific heat capacity / J kg^{-1} °C^{-1}
Glass	837
Ice	2090
Water / Milk	4200
Steam	2010

Fig. 9.1

Fig. 9.2 shows the specific latent heat of fusion and vaporization of water.

Substance	Specific latent heat of fusion / J kg^{-1}	Specific latent heat of vaporization /J kg^{-1}
Water	3.3 x 10^5	2.26 x 10^6

Fig. 9.2

(a)   Define specific heat capacity.

……………………………………………………………………………………

……………………………………………………………………………………   [1]

(b)   300 g of milk is poured into a glass container of mass 100 g. Hot steam with an initial temperature of 120 °C is used to warm the 300 g of milk in the glass container.

Calculate

(i)   the thermal energy required to warm the 300 g of milk in a 100 g of glass container from 20 °C to 55 °C,

thermal energy required = …………………   [2]

(ii) the minimum mass of steam required to heat the milk and glass container from 20 °C to 55 °C.

minimum mass of steam = ………………… [2]

(c) The glass of heated milk was placed on a table for 5 mins and the temperature of the milk was recorded at every one min interval. The table below shows the recording of the temperature.

Time/ min	Heated milk temperature/ °C
0	55
1	52
2	50
3	48
4	45
5	42

(i) Using the data in the table, describe the relationship between the temperature of the heated milk and time.

………………………………………………………………………………………

………………………………………………………………………………………… [1]

(ii) A student claimed that the decrease in temperature is due to evaporation.

Explain how evaporation cause a drop in the temperature of the heated milk.

………………………………………………………………………………………

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………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………… [3]

Applying past knowledge to new situations   14

(iii) Describe other modes of heat transfer, which are responsible for the drop in the temperature of the heated milk.

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

……………………………………………………………………………… [3]

10   Fig. 10.1 shows a type of motor. PQ and RS are solenoids. The solenoids and the coil ABCD are connected in parallel to a battery. The coil ABCD is rotating between solenoids PQ and RS which act as an electromagnet with unknown poles. The coil has a width of 5.0 cm.

When the coil rotates, it produces a resulting moment, M, as shown in Fig. 10.2.
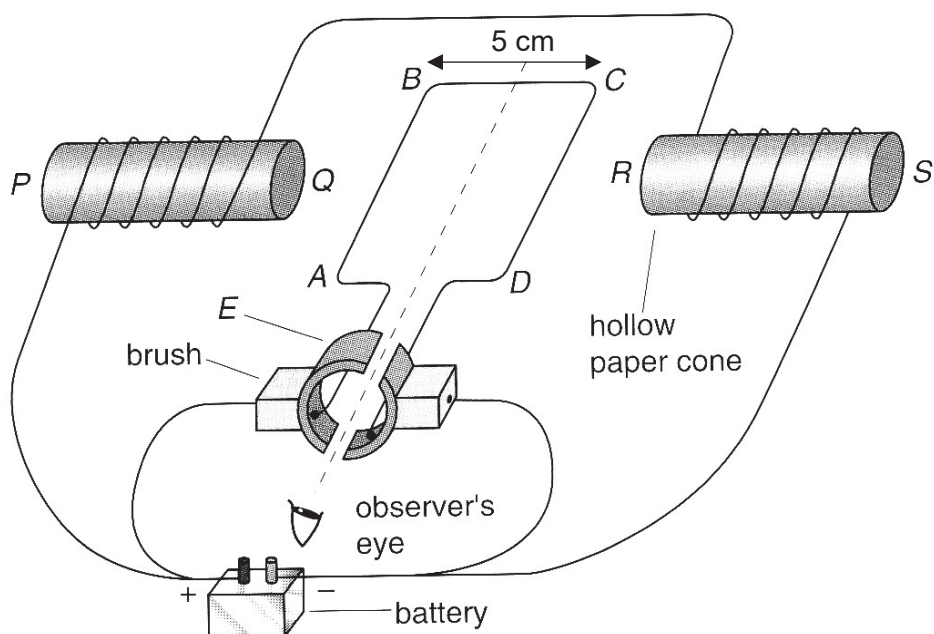
Fig. 10.1
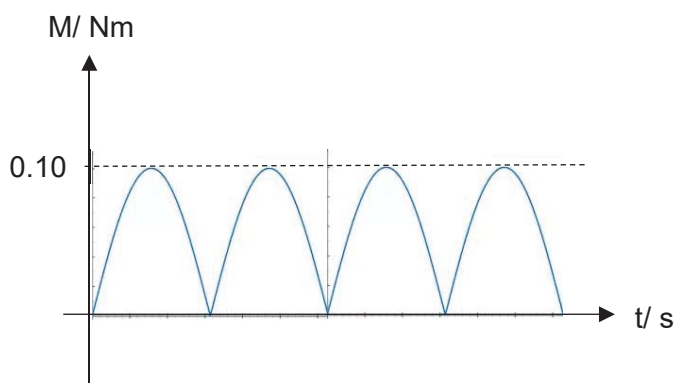
Fig. 10.2

(a) **(i)** State the polarity at end Q.

polarity at end Q = ………………… [1]

(ii) On Fig. 10.1, draw the direction of current at the side AB and CD.   [1]

(iii) Describe how you determined the direction of the forces on the sides AB and CD of the coil.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………… [2]

(b) **(i)** Using Fig. 10.2, calculate the maximum force F, on each side of the coil.

maximum force, F = ………………… [2]

(ii) Identify part E and explain how it ensures that the rotation continues.

……………………………………………………………………………………

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……………………………………………………………………………………

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……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………… [2]

11 EITHER

A thermistor is part of an electrical set-up shown in Fig. 11.1. The resistance of R1 is 50 Ω.

Fig. 11.1

The alarm bell will be activated only when the potential difference across it is 5.0 V and above. Assume that the alarm bell takes in negligible current.
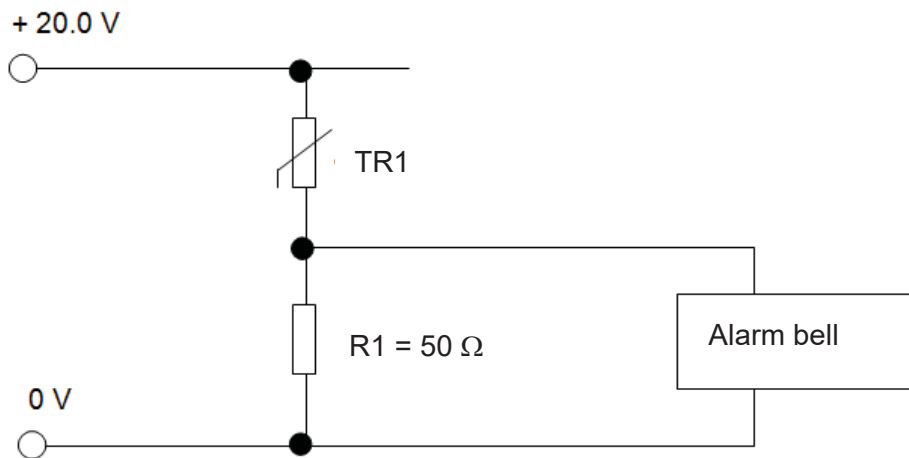
The characteristic of thermistors TR1 and TR2 are shown in Fig.12.2.

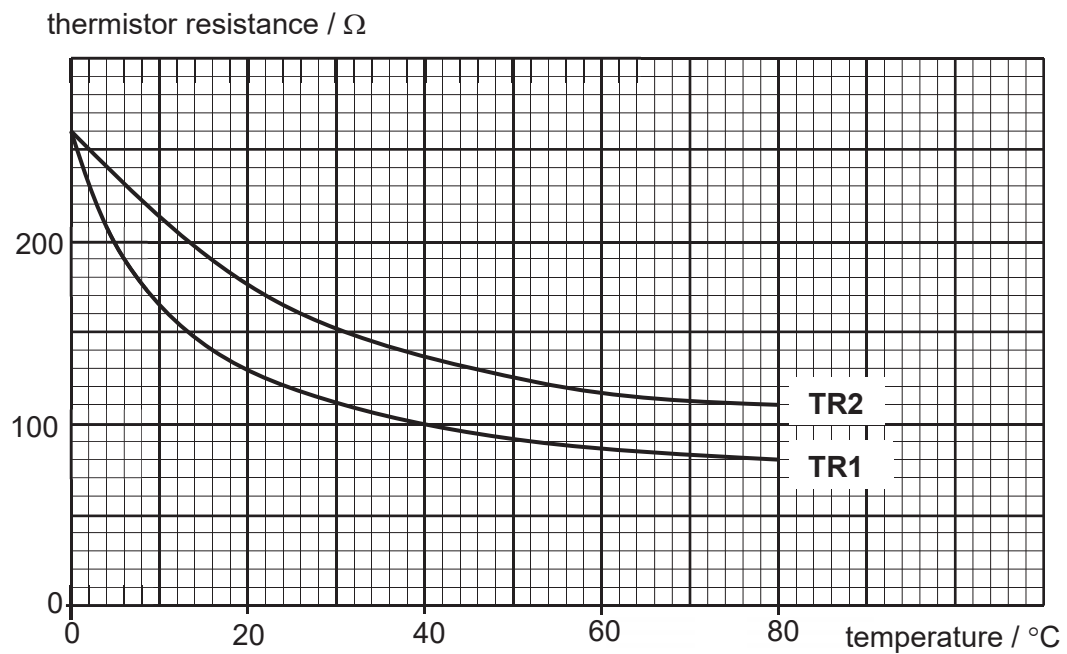**Fig. 11.2**

(a) Using Fig. 11.2, describe the relationship between the resistance of the thermistor and temperature.

....

.... [1]

(b) State the resistance of TR1 when the temperature is 45 °C.

resistance of TR1 = ………………… [1]

(c) Hence, calculate

    (i) the current flowing through TR1 at 45°C,

current flowing through TR1 = ………………… [2]

    (ii) the potential difference across TR1 at 45°C.

potential difference across TR1 = ………………… [2]

(d) Calculate the minimum temperature that will activate the alarm.

minimum temperature = ………………… [3]

(e) The characteristics of another thermistor TR2 is shown in Fig.11.2.
With the same operating condition, predict what will happen to the system if TR1 is replaced by TR2.

....

....

.... [1]

11 OR

Fig. 11.1 shows a hand-operated hydraulic jack. Piston P and the handle are linked through the same pivot. When a force is applied downwards at point X, piston P in the master cylinder is pushed down with a force of 50 N, causing oil to flow into the slave cylinder.
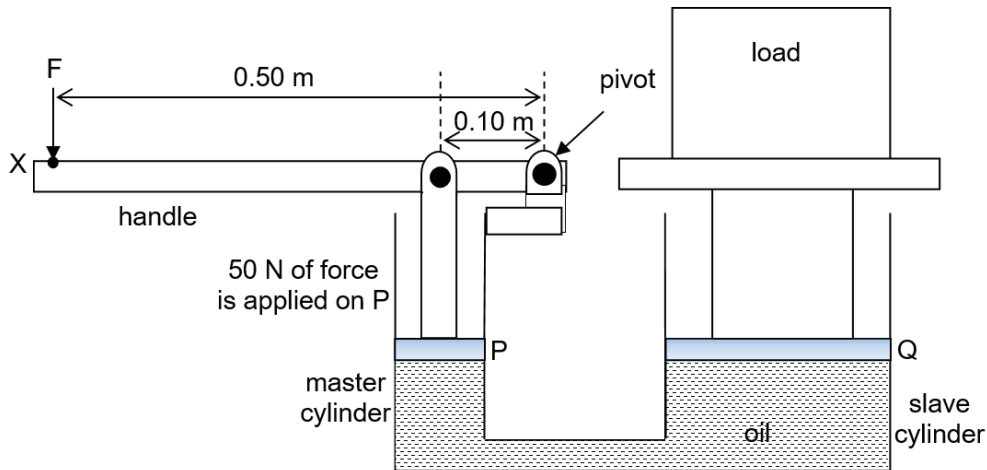
Fig. 11.1

(a) Determine the value of the force, F, that must be applied at X to exert a force of 50 N on piston P.

force, F = ………………… [2]

(b) The area of piston P is 20 cm^2 and that of piston Q is 800 cm^2.
Calculate the upward force exerted by piston Q on the load.

upward force, F = ………………… [2]

(c) If piston P moved a distance of 10 cm downwards, determine the distance moved by piston Q upwards.

distance moved by piston Q upwards = ………………… [2]

(d) Describe the action-reaction pair between piston Q and the load.

....

....

....

.... [2]

(e) State one way in which the action-reaction pair is identical and one way in which the action-reaction pair is different.

One way identical ....

....

One way different ....

.... [2]

END OF PAPER

BBSS Prelim 6091 Physics P1 2020 Answer

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

A:12   **B:9**   **C:10**   **D:9**

Name: ………………………………………. Index no. ……….   Class………..

Bukit Batok Secondary School
PRELIMINARY EXAMINATION 2020
SECONDARY 4 EXPRESS
MARK SCHEME

PHYSICS   **6091/02**
Paper 2 Theory
General marking instructions:
1. If students leave their answers in 1sf, penalise one mark for the **entire** question.
2. If students leave out the units, penalise one mark for **every** question.
3. Exercise ecf for calculation questions which require the answer from the previous section. Students will receive full marks if the substitution and calculation is correct based on the wrong value in the previous section(s).

Section A

1   **(a)**   From t= 0 s to t = 18 s, the velocity of the rocket is in the **upward positive direction** and the rocket is experiencing a **constant positive acceleration**. [1] [accept answer: rocket's velocity is constantly increasing]

From t = 18 s to t = 50 s, the velocity of the rocket continues to be in the **upwards positive direction** however the rocket is experiencing an acceleration in the **opposite direction (downwards)** causing the rocket to **decelerate constantly.** [1]

At t = 50s, the **instantaneous velocity of the rocket is 0 m/s** with an **acceleration in the downward direction** [1]
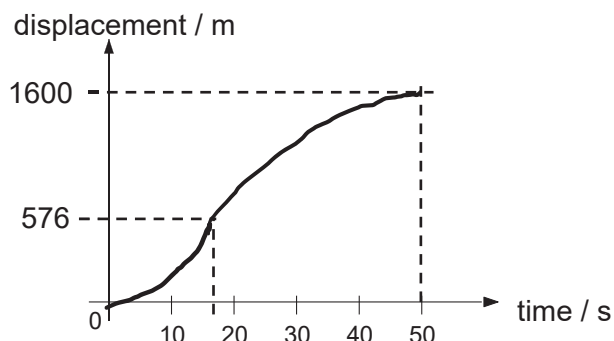
[no direction indicated deduct one mark]   [3]

(b)   Acceleration of free fall = $(v - u)/t$
$$= (- 80 - 0)/ 40 \text{ [1]}$$
$$= - 2.0 \text{ m/s}^2 \text{ [1]}$$

• Penalise 1 mark if students omit the negative sign   [2]

(c) Displacement for t = 0 to t = 18 s = 576 [1]
Displacement from t = 18 s to t = 50 s = 1024 [1]

- If students are able to show some form of calculation for displacement, award the marks.

- 1 mark awarded for correct shape and displacement values. If students indicate the value as 960 on the Y-axis. No mark awarded. [1] [3]

2 **(a)** negatively charged. [1]

(b) On Fig. 2.1, label the charges on the plates and draw the field lines between the two plates.
- Arrows direction [1]
- Curve field at the sides [1]

[2]
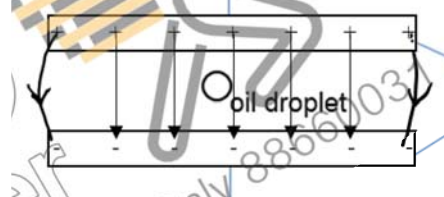
(c) The **sum of the upward repulsion and attraction forces** between the two charged plates and the **negatively charged oil droplet** is **equal** to the **weight of the oil droplet that is acting downwards** [1].

The **resultant force** acting on the oil drop is **0 N**. Since the initial velocity of the oil drop is 0 m/s, the oil drop remained stationary [1]. [2]

3 **(a)** Kinetic energy is the energy of an object when in motion and is directly proportional to the square of its velocity.

Gravitational potential energy is the energy an object possessed with respect to the vertical position or height of the object from a reference position. [2]

[no marks if students just stated the formulas]

(b) Work done = m x g x h
= 54 x 10 x 2.5 [1]
= 1350 J [1] [2]

**(c)** Power = WD/ t
= 1350/ (0.05 x 60) [1]
= 450 W [1] Allow ecf [2]

(d) In real life situation, there is friction in the pulley/ system which resulted in the generation of thermal energy as the cable is being pulled upwards [1]. Hence a greater amount of work done is needed to overcome the additional thermal energy generated [1] in order to lift the bricks to the same height. [2]

4 **(a)** Since the pressure on the LHS is higher than the pressure on the RHS, there is a resultant force on the LHS of the manometer [1] which pushes the liquid downwards. [1]

(b) Pressure due to force F = Pressure difference
= 1000 x 10 x 0.6 [1] + [1: conversion]
= 6000 Pa [1] [3]

(c) F = P x A
= 6 000 x 0.10 [1]
= 600 N [1] Allow ecf [2]

(d) Since liquid pressure is affected by the density of the liquid, for the same length of tube, the range of pressure difference could be measured greater using a denser liquid. [1]

5 **(a)** Longitudinal wave; Mechanical wave; Physical [1]

(b) There are 660 complete waves in 1 second. [1]

(c) **(i)** the wavelength = 0.50 m [1]

(ii) the amplitude = 0.50 mm [1]

(d) V = f x lambda
= 660 x 0.50 [1]
= 330 m/s [1] allow ecf [2]

6 Fig. 6.1 is drawn to full scale. An object O is placed in front of a converging lens L. The lens forms an image of the object O.
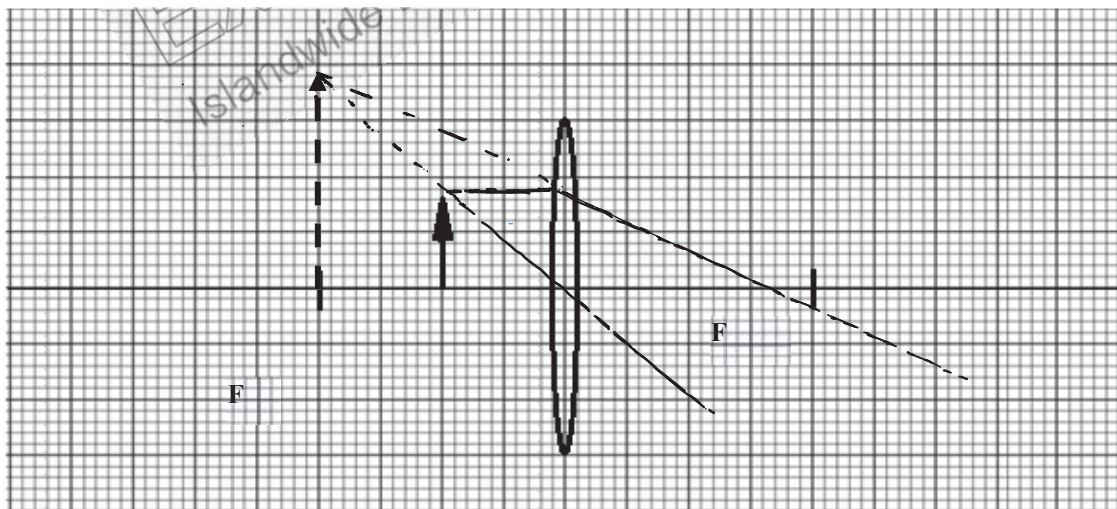
(a) **(i)** draw two rays from the top of the object to locate the top of image.
- Dotted line [1] and solid lines [1]
- If students did not draw the arrows, award the mark. [2]

(ii) draw and label the image **I** [1]
- Dotted image with an arrow head.

(b) By drawing the converging rays from the object to the image as dotted lines. [1]

(c) 1. Image will be real [1]
2. Image will be inverted [1]
3. Size of the image is also accepted depending on where the students played the image. To award this mark, students need to state the object distance with respect to focal lengths. [2]

7

Fig. 7.1
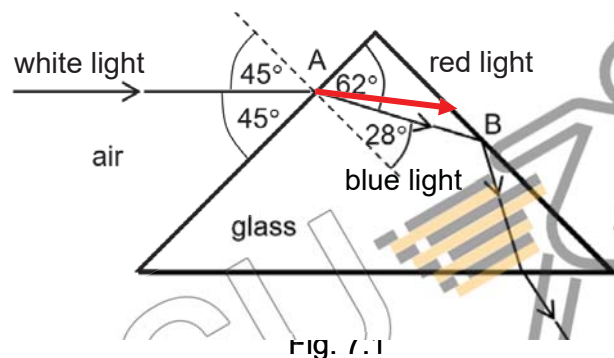
(a) angle of incidence = 45 º
angle of refraction = 28 º
- Both correct award 1 mark [1]

(b) Since the refractive index for red light is **small**er than blue light, the red light will **bend lesser towards the normal** than blue light. [1] Hence the angle of refraction for red light is larger than blue light. [1] [2]

(c) On Fig. 7.1, **draw the path** of a ray of red light inside the glass prism at point A. **[no ecf]** [1]

8 **(a)** Charge rod brought near to uncharged metal sphere but not touching it. [1]
The connection to earth is connected to the opposite end of the metal sphere. Once the metal sphere is charged, removed the connection to earth. [1]
The charged rod is now removed, the metal sphere becomes negatively charged. [1] [3]

(b) The negative charges are **initially attracted** by the positively charged rod when it is brought near to the metal sphere. When the connection to earth is connected, **the negative charges will move from the earth to the metal sphere**, resulting in excess electrons on the metal sphere. [1]
The metal sphere **remains negatively charged** after the connection to earth and rod are sequentially removed. [1] [2]

(c) Charge = 1.2 x 10^{-9} C, time = 2.5 s
Q = I x t => I = 1.2 x 10^{-9} / 2.5 = 4.8 x 10^{-10} A [1] [1]

Applying past knowledge to new situations 4

Section B

9   **(a)**   Amount of heat energy gained to increase in temperature by 1 °C or 1K or lost to decrease in temperature by 1 °C or 1K per unit mass of the substance.   [1]

     (b)   **(i)** $Q = mc\Delta\theta_{milk} + mc\Delta\theta_{glass}$

                  $Q = 0.300 \times 4200 \times (55 - 20) + 0.100 \times 837 \times (55 - 20) = 47029.50$

                  $Q = 47000 J$ [2]

           (ii) $Q = mc\Delta\theta_{steam} + ml_v + mc\Delta\theta_{water}$

                  $47029.5 = m[2010 \times (120 - 100) + 2.26 \times 10^6 + 4200 \times (100 - 55)]$

                  $m = 0.01889 = 0.019 kg$ [2]

     (c)   **(i)**   The temperature of the heated milk decreases as the time increases.   [1]

           (ii)   The **higher kinetic energy** milk molecules on the top surface of the cup **gained sufficient energy from the surrounding** to overcome the **force of attraction between the molecules and push against the atmosphere** to change to the gaseous state. [1]
The **remaining milk molecules** possess a **lower kinetic energy**.[1]
Since **kinetic energy is proportionate to temperature.** The temperature of the remaining milk molecules decreases. [1]   [3]

           (iii)   Heat loss due to:
Conduction between the glass of milk and the table [1],
Infra-red radiation from the sides of the glass cup [1],
Convection due to the convection current formed at the top surface of the cup. [1]   [3]

10   **(a)**   **(i)**   South pole   [1]

           (ii)   Current travels from A to B   [1]

           (iii)   Using FLHR, the interaction between the magnetic field produced by the solenoids and the magnetic field due to current in coil AB, produced a **resultant force in the upward direction** on the side AB [1] and a downward **direction on the side CD** [1]. The two forces produce a **resultant moment** which cause coil ABCD to rotate in the clockwise direction.

                  [if answer make direct reference to the application of FLHR – award marks]   [2]

     (b)   **(i)**   On each side
$M_{resultant} = F_{resultant} \times d$
0.10/2 = $F_{resultant}$ x 0.025 [1]
$F_{resultant}$ = 2.0 N [1]

                  •   Penalise one mark if students leave their answers as 1sf.   [2]

(ii) Part E is the split ring commutator. The split ring communicator changes the direction of the current flowing in the coil every half a rotation [1]. This caused a constant downwards resultant force on side AB and constant upward resultant force on side CD. Hence the coil continues to rotate in the anti-clockwise direction [1]. [2]

11 EITHER

(a) As temperature increases, resistance decreases at a decreasing rate. [1]

(b) 95 Ω [1]

(c) **(i)** Combined R = 50 + 95 = 145 Ω
$I = V \div R$
$= 20 \div 145$ [1]
$= 0.138$ A [1] Allow ecf from part b [2]

(ii) $V = I \times R$
$= 0.138 \times 95$ [1]
$= 13.1$ V [1]
Or
$V = (95 / [95+50]) \times 20$ V [1]
$= 13.1$ V [1] Allow ecf from part ci [2]

(d) $I = V / R$
$= 5$ V $/ 50$ Ω
$= 0.1$ A [1]
Resistance of TR1 = 15 V / 0.1 A = 150 Ω [1]
From graph, temp = 13.0 °C [1] [3]

(e) The minimum temperature to activate the alarm will increase. [1]

11 OR

(a) F × 0.50 m = 50.0 × 0.10 [1]
$F_{downward}$ = 10 N [1] [2]

(b) 50/20 = F_{upward}/800 [1]
F_{upward} = 2000 N [1] [2]

(c) (20)(10) = (800)d [1]
d = 0.25 cm [1] [2]

(d) The force of the load on piston Q [1] and the force of piston Q on the load [1].
- no mark awarded is students mentioned weight of load [2]

(e) One way identical: Both forces are of the same magnitude. [1]
One way different: Action-reaction pair is opposite in direction. [1] [2]
- accept any plausible answers

END OF PAPER