Bukit Batok Secondary School
GCE O–Level Preliminary Examination 2016
Secondary 4 Express

PHYSICS
Paper 1 Multiple Choice

5059 / 01
18th August 2016
1 hour
0745 hrs – 0845 hrs

Additional Materials: Multiple Choice Answer Sheet

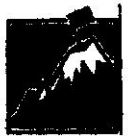
READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class, and class register number on the answer sheet in the spaces provided unless this has been done for you.

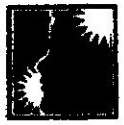
There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.
Choose **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

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.



PERSISTING



ANSWER WITH CLARITY

This document consists of 16 printed pages

1. A micrometer is used to measure the thickness of a piece of gold bar. With the jaws closed, the micrometer reading is as shown in Fig. 1.1. With the gold bar, the micrometer reading is as shown in Fig. 1.2.

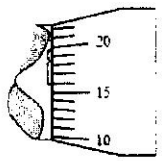


Fig. 1.1

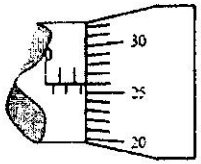
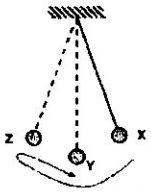


Fig. 1.2

What is the thickness of the gold bar?

A 2.60 mm
B 2.92 mm
C 3.00 mm
D 5.10 mm

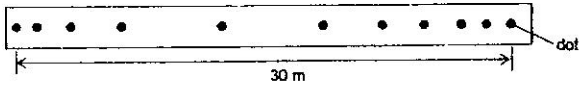
2. A pendulum starts to oscillate from point X. The time taken for the pendulum to move from point X to Z and then to point Y as shown below is 0.60 s.



What is the time taken for the pendulum to make 20 oscillations?

A 4.0 s
B 12.0 s
C 16.0 s
D 24.0 s

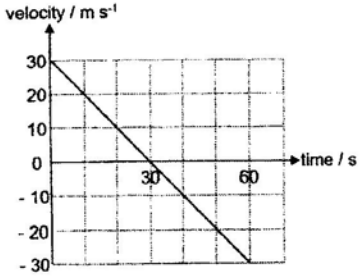
3. The diagram shows a strip of paper tape that has been pulled under a vibrating arm by an object that is in motion. The arm makes 40 dots in 2.0 seconds.



What is the average speed of the object?

A 15.0 m/s
B 54.5 m/s
C 60.0 m/s
D 64.5 m/s

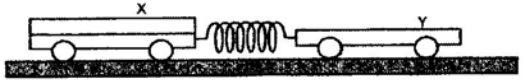
4. The diagram shows a velocity-time graph of an object being thrown vertically upwards.



At time t = 30 s, the object has _____.

A reached the highest point of its motion and the acceleration is –10 m/s^2
B reached the highest point of its motion and the acceleration is 0 m/s^2
C reached terminal velocity and the acceleration is –10 m/s^2
D reached terminal velocity and the acceleration is 0 m/s^2

5. Trolley X and trolley Y are joined together by a compressed spring.
The mass of trolley X is twice that of trolley Y. Both trolleys are initially at rest.
When the trolleys are released, trolley Y accelerates to the right at 1.0 m/s^2.



What is the acceleration of trolley X?

A 0.50 m/s^2 to the left
B 0.50 m/s^2 to the right
C 2.0 m/s to the left
D 2.0 m/s^2 to the right

6. A passenger lift of mass 300 kg is moving upwards at an acceleration of 2.0 m/s^2.

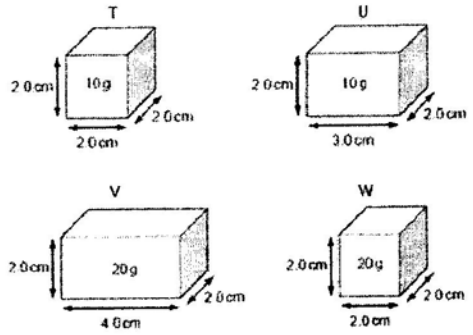
What is the tension in the cable of the lift?

A 600 N
B 2400 N
C 3000 N
D 3600 N

7. Which statement about gravitational fields is correct?

A It is the gravitational force per unit mass.
B It is the region in which a mass experiences a force due to gravity.
C It is the amount of gravitational force acting on an object.
D It is the amount of force acting on an object.

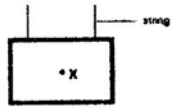
8. Four rectangular blocks, T, U, V and W are shown. Each block is labelled with its size and mass.



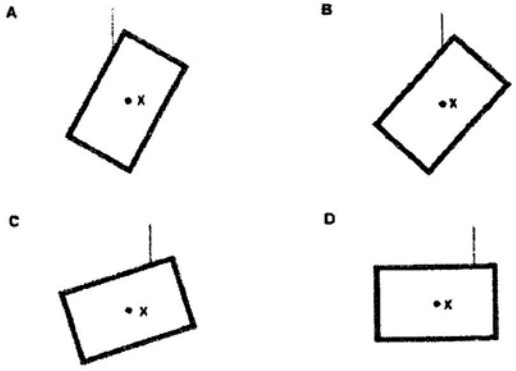
Which two blocks have the same density?

A U and V
B V and W
C T and U
D T and V

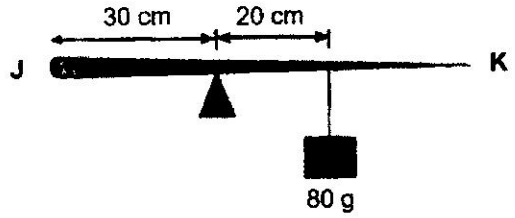
9. The diagram shows a rectangular card with centre of gravity X hanging from two strings.



Which of the diagrams below shows how the card hangs when one of the strings is cut?



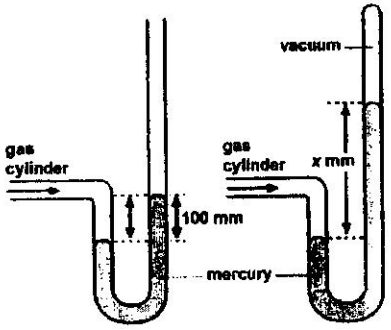
10. A non-uniform rod is balanced as shown below.
The centre of gravity of the rod is 14.0 cm from the end marked J.



What is the mass of the rod?

A 53 g
B 100 g
C 120 g
D 280 g

11. The diagram shows an open-ended manometer (on the left) and a closed tube manometer (on the right) connected to the same gas cylinder with the same volume of mercury. The atmospheric pressure is 760 mm Hg.



What is the height x of the mercury in the closed tube manometer?

A 560 mm
B 660 mm
C 760 mm
D 860 mm

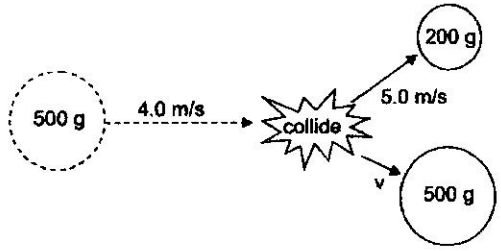
12. A diver deep underwater exhales an air bubble. The air bubble is observed to increase in size as it rises to the surface.

Which of the following explanations may be used to describe this phenomenon?

I The volume increases because the pressure underwater decreases with decreasing depth.
II The volume increases because while there is no pressure underwater, there is atmospheric pressure at the surface of the water.
III The pressure is constant regardless of depth because the temperature of the water is lower with greater depth.

A I only
B I and II
C II and III
D III only

13. A large ball of mass 500 g and an initial velocity of 4.0 m/s, hits a smaller ball of mass 200 g initially at rest. During the collision, 1.0 J of energy is lost as thermal energy. The smaller ball moves away at 5.0 m/s.



What is the final velocity, v of the 500 g mass after the collision?

A 1.00 m/s
B 1.41 m/s
C 2.45 m/s
D 2.82 m/s

14. Eisha has a mass of 50 kg. She runs to the top of a flight of 20 steps in 0.50 minutes. Each step is 0.20 m in height and 30 cm in width.

What is the power she develops?

A 6.7 W
B 67 W
C 400 W
D 4000 W

15. Brownian motion is observed in smoke particles.
Some students made the following statements during a discussion:

I It is due to the bombardment of air molecules.
II It is faster if the particles are smaller.
III It is faster if the temperature of the air is lower.
IV It is at random.

Which of the above statements are correct?

A I and II only
B I, II and IV only
C I, III and IV only
D I, II, III and IV

16. As air is sucked from a straw out of a sealed packet drink, the packet shrinks in volume.

Which of the following explains why the packet drink shrinks in volume?

A The internal surface area of the packet drink exposed to the collision of air molecules has decreased.
B The internal surface area of the packet drink exposed to the collision of air molecules has increased.
C The number of air molecules per unit volume in the packet drink has decreased and the force for each collision has decreased.
D The number of air molecules per unit volume in the packet drink has decreased and the frequency of collisions of the air molecules and packet wall has decreased.

17. A resistance thermometer reads 5.0 Ω at ice point and ***R*** Ω at steam point.
At 20 °C, it reads 8.0 Ω. What is the value of R?

A 15 Ω
B 20 Ω
C 40 Ω
D 45 Ω

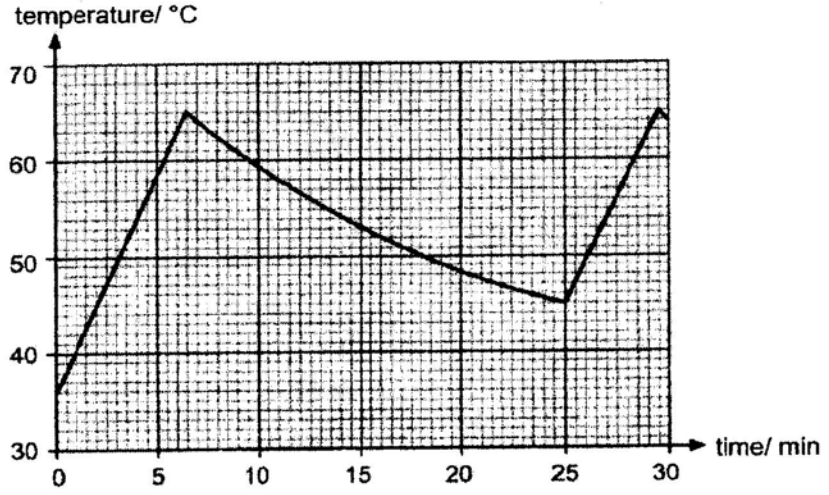
18. Three liquids with their respective boiling and freezing points are shown in the table below.

	Mercury	Alcohol	Pentane
Melting point / °C	– 39	– 112	– 130
Boiling point / °C	357	78	36.5

Which of the above liquids is suitable to be used in a thermometer that can measure a temperature of – 50 °C to 38 °C?

A alcohol
B mercury
C pentane
D any of the above

19. A tank containing 8.0 kg of water is kept warm by an electrical heater placed at the bottom of the tank. The heater is turned on when the temperature of the water in the tank is below 45 °C and turned off when the temperature reaches 65 °C. The variation of the temperature of the water with time for the first 30 minutes is shown in the graph.



The specific heat capacity of water is 4200 J/(kg °C).

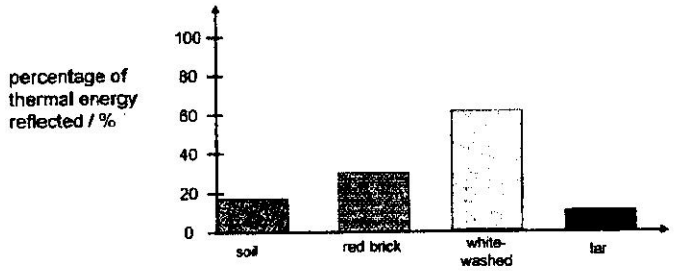
Assuming there is no heat loss due to evaporation and all the energy from the heater is used to increase the temperature of the water, what is the power of the heater?

A 370 W
B 540 W
C 910 W
D 2500 W

20. Latent heat of vaporisation is the energy required to _____.

A separate the molecules of the liquid greatly.
B increase the average kinetic energy of the molecules.
C separate the molecules and to increase the kinetic energy of the molecules.
D separate the molecules and to force back the atmosphere.

21. Different surfaces reflect different proportions of the Sun's radiant energy. The diagram shows the percentage of thermal energy which is reflected by some surfaces.



Which is the best way to treat a flat roof so as to reduce the amount of heat absorbed by the roof?

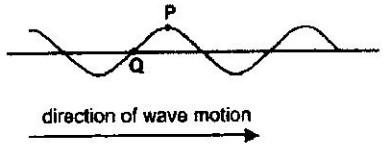
A cover it with a layer of red brick dust
B cover it with a layer of soil
C paint it with tar
D paint it with white-wash

22. At the end of a marathon, runners are sometimes issued with a thermal blanket to keep them warm as they are losing heat at a very fast rate.

Which of the following is a suitable material and colour for the blanket?

	material	colour
A	plastic	silver
B	metallic foil	silver
C	plastic	black
D	metallic foil	black

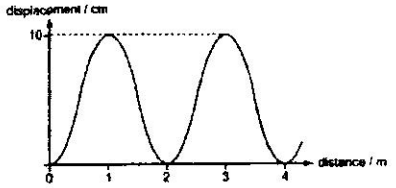
23. The diagram shows a transverse wave travelling from left to right.



What is the direction of vibration of points P and Q at this instant?

	P	Q
A	downwards	upwards
B	upwards	upwards
C	downwards	downwards
D	upwards	downwards

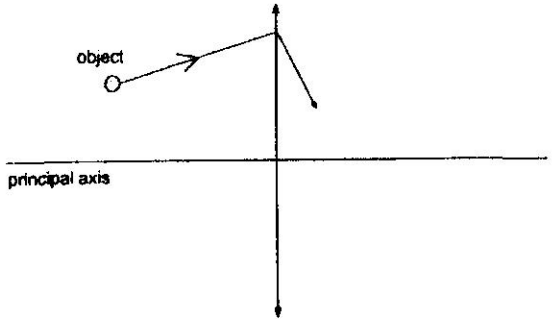
24. The graph below shows the motion of a water wave (at the surface) as it travels from left to right. The speed of the water wave is 25 cm/s.



What is the period of the wave?

A 0.080 s
B 0.125 s
C 8.00 s
D 12.5 s

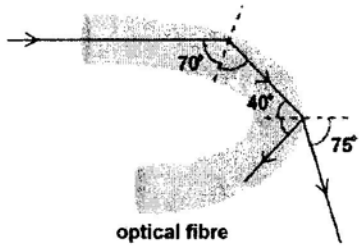
25. The figure below (drawn to scale) shows an object placed in front of a thin converging lens with one ray of light from the object drawn.



How would the image produced by the lens be described?

A real and upright
B real and inverted
C virtual and upright
D virtual and inverted

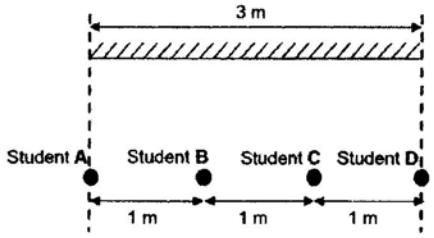
26. The diagram shows a light beam entering a piece of optical fibre.



Which of the following could be the value of the optical fibre's critical angle?

A 40 °
B 42 °
C 70 °
D 75 °

27. Four students stand in a row 1 m apart and parallel to a plane mirror that is 3 m long as shown below.



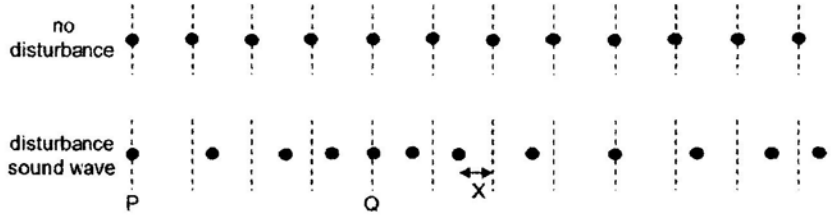
How many images can student B see?

A 1
B 2
C 3
D 4

28. Which of the following groups of electromagnetic waves is in the order of increasing wavelength?

A gamma ray → ultra-violet → radio wave
B gamma ray → visible light → ultra-violet
C microwave → ultra-violet → X-ray
D visible light → infrared → X-ray

29. The figures below show the positions of air molecules when there is no disturbance and when there is a disturbance due to a sound wave. The dotted lines represent the rest positions of the molecules.



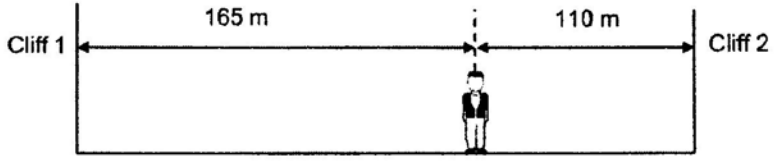
A list of statements is given below:

I Particle Q is always at the rest position.
II X represents the amplitude of the sound wave.
III The distance between P and Q is half the wavelength of the sound wave.

Which of the above statement(s) is(are) correct?

A II only
B III only
C I and II only
D II and III only

30. A man stands between two cliffs as shown in the diagram and claps his hands once.



Assuming that the velocity of sound in air is 330 m/s, what is the time interval between the 2 loudest echoes?

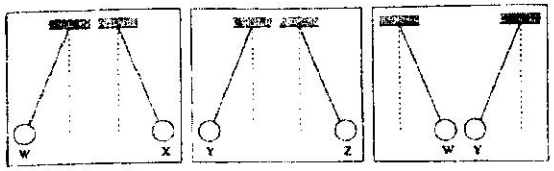
A 0.17 s
B 0.33 s
C 0.67 s
D 0.83 s

31. David attempts to charge a metal rod by rubbing it with a piece of cloth while holding the metal rod with his bare hands. After some time, the metal rod remains neutral.

What could be the reason that the rod remains neutral?

A Metal rod cannot be charged by friction.
B Metal rod need to be rubbed more vigorously with a cloth to be charged.
C David's hand conducted the excess charges away.
D The cloth absorbed all the excess charges.

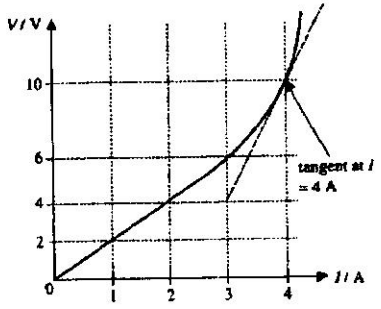
32. Four aluminium-coated plastic spheres, W, X, Y and Z, are attached to insulating threads. The following observations are made when some of the spheres are brought near each other.



Given that sphere Z is positively charged, which one of the following statements is true for sphere X?

A X is positively charged.
B X is negatively charged.
C X is either positively charged or neutral.
D X is either negatively charged or neutral.

33. The V-I graph of a wire is given below.
What is the resistance of the wire at V = 2 V and V = 10 V?



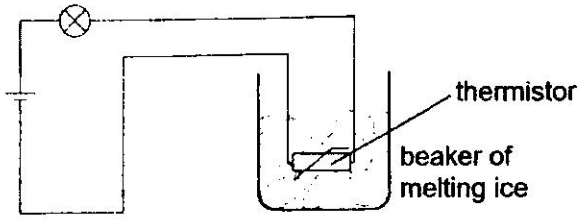
	resistance at 2 V / Ω	resistance at 10 V / Ω
A	0.50	0.40
B	0.50	0.20
C	2.0	2.5
D	2.0	6.0

34. A resistor of length L and cross-sectional area A has a resistance of R.
A second resistor of resistance 3R is made from wire of the same material but of cross-sectional area 2A.

What is the length of the second resistor?

A 0.67 L
B 1.5 L
C 3.0 L
D 6.0 L

35. A filament lamp connected in series with a thermistor is initially lit at room temperature.



What will happen to the lamp as the thermistor is completely immersed in a beaker of melting ice as shown in the figure?

A The brightness of the lamp remains unchanged.
B The lamp becomes brighter.
C The lamp becomes dimmer.
D The lamp starts to flicker on and off continuously.

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 When the earth wire is disconnected, the washing machine can still operate.

Class	Register Number	Name

Bukit Batok Secondary School
GCE O–Level Preliminary Examination 2016
Secondary 4 Express

PHYSICS
Paper 2 Theory

5059 / 02
12th August 2016
1 hour 45 minutes
0745 hrs – 0930 hrs

Candidates answer on the Question Paper.
Additional Materials: No additional materials needed

READ THESE INSTRUCTIONS FIRST

Write your name, class, and class register number on all the work you hand in.
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
Answer **all** questions. Question **12** 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 examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Apply your Habits of Mind

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **18** printed pages, inclusive of this cover page.

Section A [50 marks]
Answer **all** the questions in this section.

1. Water is transported to a village in a tank pulled by a tractor. The combined mass of the tractor and the tank is 4100 kg when the tank is empty and the combined mass is 6500 kg when the tank is full of water. Fig. 1.1 shows the tank being pulled by a tractor.

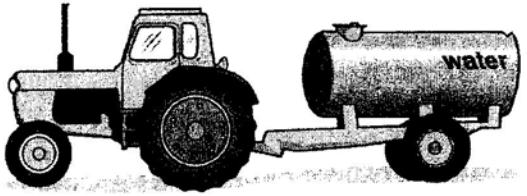


Fig. 1.1

(a) The density of water is 1000 kg/m^3. Calculate the volume of water in the tank when it is half-full.

volume =..... [2]

(b) At the start of the journey, the tractor and full water tank accelerate uniformly from rest along a straight, horizontal (flat) road. As their velocity increases, one form of energy is decreasing.

(i) Explain what is meant by *accelerate uniformly*.

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

(ii) Identify the form of energy that is decreasing and hence explain what happens to it.

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

(iii) A village is located on a mountain at a vertical height of 0.850 km above the source of water supply. Calculate the gravitational potential energy gained by the water as it is transported from the source of water supply to the village.
The gravitational field strength g is 10 N/kg.

gravitational potential energy =..... [2]

2. Fig. 2.1 shows the velocity-time graph of a 150 kg unmanned rocket *Explorer* launched from the surface of a planet Z. Planet Z has no atmospheric layer. The rocket rises vertically upward and after some time, a malfunction causes the rocket's engine to cut off suddenly.

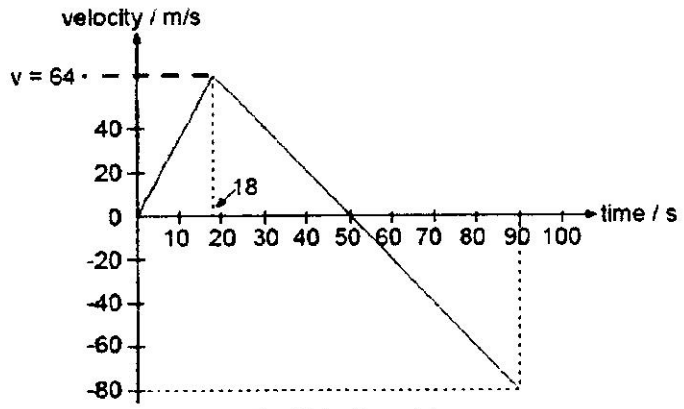


Fig. 2.1 (not to scale)

(a) Describe the motion of the unmanned rocket from t = 50 s to t = 70 s.

.....

..... [1]

(b) Determine the maximum height above the surface of planet Z in which the unmanned rocket rose to.

maximum height =..... [2]

(c) Explain, using newton's laws, the motion of the rocket for the first 10 seconds.

.....

.....

.....

..... [2]

(d) Determine the weight of the rocket after malfunctioning.

weight =..... [2]

3. (a) Fig. 3.1 shows a screwdriver of mass 120 g resting horizontally on a pivot. The screwdriver is 27.0 cm long.

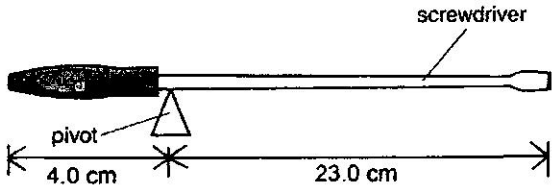


Fig. 3.1

Mark on Fig. 3.1, an 'X' to show the centre of gravity of the screwdriver. [1]

(b) Fig. 3.2 below shows a long uniform ladder **AB** resting against a smooth vertical wall. Horizontal distance **OA** is 3.0 m, while vertical distance **OB** is 6.0 m. The weight of the ladder is 0.50 kN.

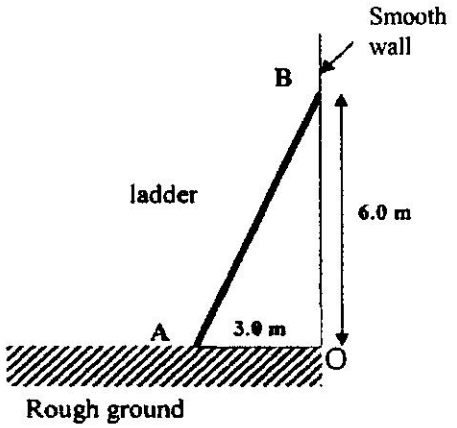


Fig. 3.2 (not to scale)

(i) The ladder does not slide down due to the rough ground.
Draw and label on Fig. 3.2 all the four forces acting on the ladder. [2]

(ii) Taking moments about point **A**, calculate the size of the reaction of the wall on the ladder.

size of reaction force =..... [2]

4. Double boil cooking is a process by which food (broth) is cooked by indirect heating.
Fig. 4.1 below shows a cross-sectional view of how it is done.

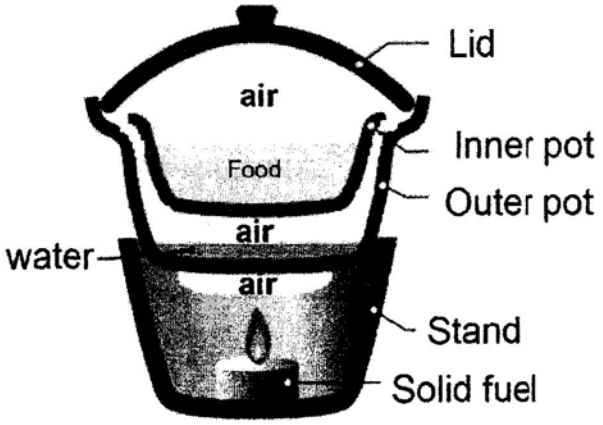


Fig. 4.1

The double boil system consists of 2 ceramic pots, one contained within the other.
There is no direct heat applied to the food contained in the inner pot.

(a) Explain how is thermal energy transferred from the water in the outer pot to the food in the inner pot.

.....

.....

.....

..... [3]

(b) As the water in the outer pot boils, the lid is observed to be vibrating.
Explain this in terms of the kinetic molecular theory.

.....

.....

..... [2]

(c) Water (both in the inner and outer pots) is used to slowly cook the food. Other than water being a poor thermal conductor, what property of water makes it possible to do so?

.....

..... [1]

(d) The temperature of the broth is measured at regular intervals of time.
Fig. 4.2 shows how the temperature varies with time t.

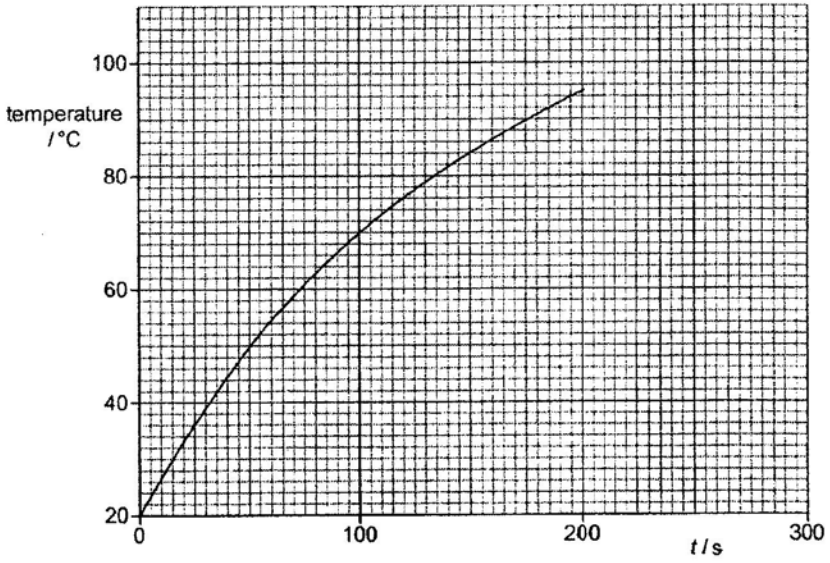


Fig. 4.2

(i) Explain why the increase in temperature is different for the first 100 s (0 s to 100 s) and the second 100 s (101 s to 200 s).

.....

.....

..... [1]

(ii) The 2.0 kW heater supplies 78 kJ of thermal energy (heat) to the broth (of mass 720 g) and the temperature of the broth changes from 50 °C to 73 °C.
Calculate the specific heat capacity of the broth.

specific heat capacity of broth =..... [2]

5. Fig. 5.1 shows straight wavefronts that are produced by a wave generator in a ripple tank. The wave generator dips the surface of the water 900 times in 3 minutes. A distance of 10.0 cm is measured with a metre rule between a few wave fronts.

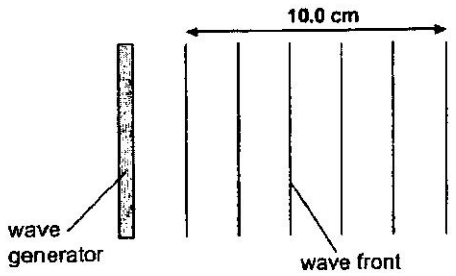


Fig. 5.1

(a) Explain what is meant by a *wave front*.

.....

..... [1]

(b) Determine the speed of the wave.

speed =..... [2]

(c) To study the effects of depth of water on the wave properties, the wave is made to enter a region of greater depth. State and explain the change to the speed, frequency and wavelength of the wave as it enters this region.

.....

.....

.....

..... [2]

6. Fig. 6.1 shows a diagram of an X-ray machine capturing an image of the chest of a person. The distance between the X-ray tube and the X-ray receiver is 1.0 m.

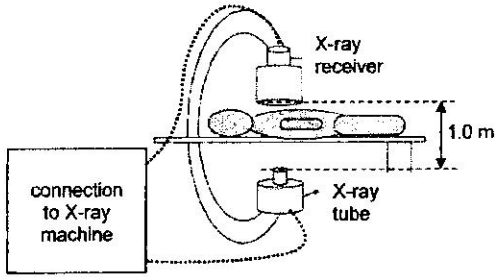


Fig. 6.1

(a) Calculate the time taken for the X-ray receiver to receive the signal from the X-ray tube. State any assumptions made.

time taken = ... [2]

(b) Explain whether X-rays are suitable to be used to obtain images of the unborn foetus in the womb.

.....

.....

..... [1]

(c) State an electromagnetic wave that has a frequency higher than X-ray and describe a practical use of this wave.

.....

.....

..... [1]

7. Parallel rays of light coming from an object travel towards a polystyrene plastic converging lens as shown in Fig. 7.1. The focal points of the lens are labelled as F.

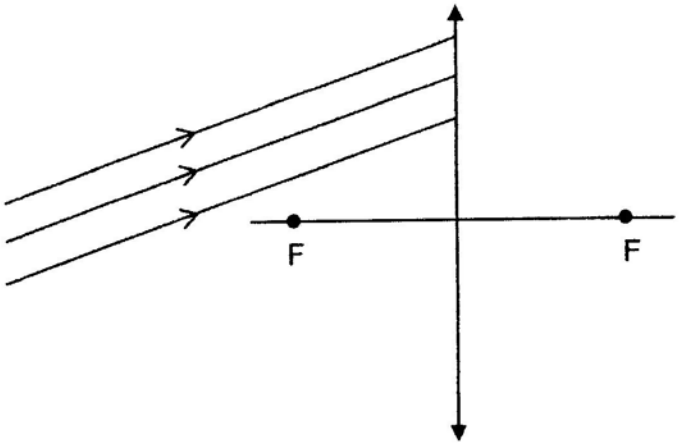


Fig. 7.1

(a) Continue the paths of light in Fig. 7.1 to show how the rays bend after passing through the lens. Include any working lines in your answer. [2]

(b) The polystyrene lens is now placed in water. The rays of light strike the lens at the same angle. The refractive indices of various materials are shown in Fig. 7.2.

Material	Refractive index
Vacuum	1.00
Air	1.00
Water	1.33
Glass	1.52
Polystyrene plastic	1.59

Fig. 7.2

Determine the critical angle of polystyrene plastic.

critical angle = ... [2]

8. During an experiment, an insulated copper wire is coiled around the middle of the soft iron rod and connected to a cell as shown in Fig. 8.1.

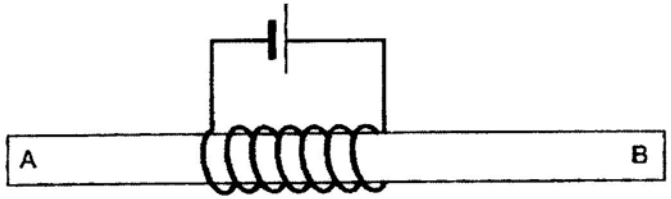


Fig. 8.1

(a) Deduce the polarity of end A of the rod, explaining your answer.

..... [2]

(b) End B of the rod was used to pick up steel paper clips. Suggest two other methods of increasing the number of steel paper clips that can be attracted off the ground.

..... [2]

9. Fig. 9.1 shows an electric kettle, which has a label with "230 V, 1.1 kW" marked on it. The kettle is connected to a 230 V mains supply by the live, neutral and earth wires.

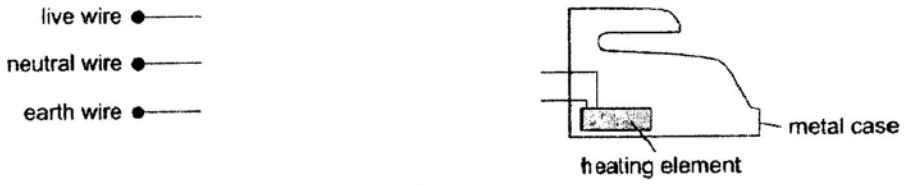


Fig. 9.1

(a) Complete the diagram by drawing suitable wires to connect the kettle to the mains supply. Include a fuse and a switch for the kettle, showing where they should be connected. [3]

(b) Suggest a suitable fuse rating, explaining your answer.

fuse rating = ... [2]

Section B [30 marks]

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

Answer only one of the two alternative questions in **Question 12**.

10. (a) Under the Environmental and Protection and Management Act, all refrigerators sold in Singapore must carry energy labels which will show the number of "Green Ticks" awarded to them. A refrigerator with more Green Ticks is more energy efficient than one with fewer Green Ticks. The table in Fig. 10.1 below shows some data of refrigerators and the number of Green Ticks that they carry. The Annual Energy Consumption is the amount of energy the refrigerator would consume if it is used continuously for an entire year (of 365 days).

Refrigerator	Cost / S$	Green Ticks	Volume / litres	Exterior Colour	Annual Energy Consumption / kWh
A	1600	2	200	White	530
B	1650	3	200	Silver	480
C	1700	2	400	Black	720
D	1900	3	400	Red	550

Fig. 10.1

Using information from Fig. 10.1,

(i) calculate the average power consumed by Refrigerator **A**.

average power =..... [2]

(ii) John is deciding whether to buy a 400-litres refrigerator. Assuming that the lifespan of each refrigerator is 10 years and that the average cost of electricity is S$0.20 per kWh over the 10 years, determine which refrigerator he should buy and estimate the amount of money that he would save.

Refrigerator =.....

amount of money saved =..... [3]

(b) John places a bottle of orange drink in a freezer and records the temperature of the orange drink every five minutes. His results are shown in Fig. 10.2 below.

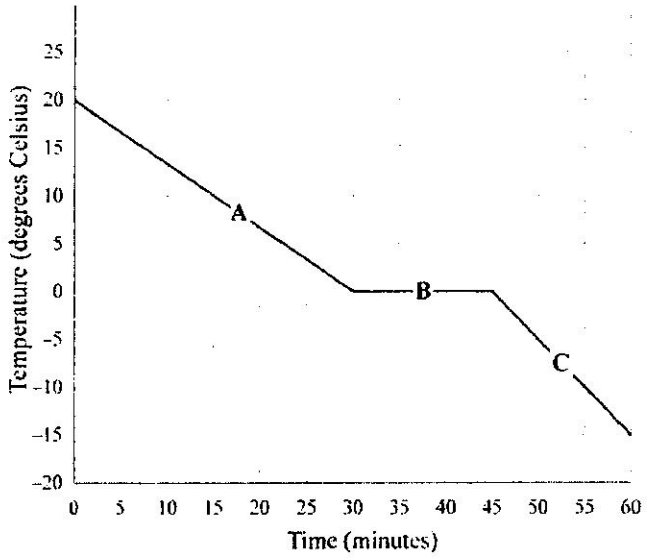


Fig. 10.2

(i) The mass of the orange drink is 0.150 kg. Calculate the amount of thermal energy lost by the orange drink during section **B** of the graph.
The specific heat capacity of the orange drink is 4.2 J / (g °C) while the specific latent heat of fusion is 334000 J / kg and the specific latent heat of vaporisation is 2260000 J / kg.

amount of thermal energy =..... [2]

(ii) Explain why there is no temperature drop during section **B**, even though the orange drink is continuously cooled.

..... [2]

(iii) State the difference in molecular arrangement for Sections **A** and **C**.

..... [1]

11. Thin copper wire, covered in plastic insulation, is used to make a solenoid. The solenoid is connected to a sensitive centre-zero ammeter. Fig. 11.1 shows the North-pole of a steel magnet placed next to the solenoid. Point X and point Y are on the centre axis of the solenoid, near to the right-hand end of the solenoid.

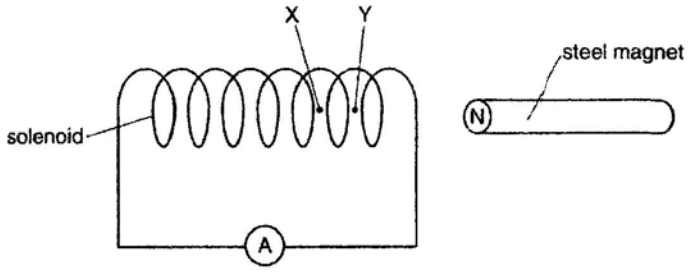


Fig. 11.1

(a) In one experiment, the magnet in Fig. 11.1 is moved to the left and passes into the solenoid. The North-pole of the magnet moves into the solenoid at a constant speed.

(i) Explain why there is a current in the solenoid when the magnet is moving from Y to X.

.....

.....

..... [1]

(ii) State the polarity of Y when the steel magnet approaches it, explaining your answer.

.....

.....

.....

..... [2]

(iii) The North-pole travels from Y to X in 0.14 s. As it moves, the current shown on the ammeter is 0.045 mA. The resistance of the solenoid is 1.2 Ω.

Calculate

1. the potential difference (p.d.) across the solenoid,

potential difference =..... [2]

2. the charge that passes through the solenoid as the N-pole moves from Y to X.

charge =..... [1]

(b) In a second experiment, the speed of the North-pole is greater than its speed in the first experiment. It now takes only 0.070 s to travel from Y to X. A current in the same direction is shown on the centre-zero ammeter.

The same quantity of charge passes through the coil in both the first and second experiments. Explain, comparing the magnitude of current in both situations, why this is the case.

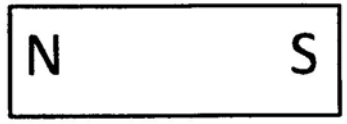
.....

.....

.....

..... [2]

(c) Draw the magnetic field around the steel magnet shown below. [2]



EITHER

12. Fig. 12.1 shows high voltage cables used to transmit electrical energy. The cables are hung on tall transmission towers. Fig. 12.2 shows the typical voltage levels used for transmission.

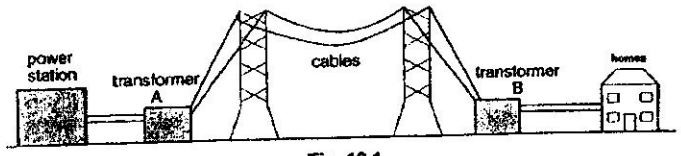


Fig. 12.1

Voltage level	Range of voltage / kV	Maximum length of cable / km
High voltage	100 to 230	320
Extra-High voltage	230 to 800	640 to 800
Ultra-High voltage	Above 800	Above 800

Fig. 12.2

(a) Using information from Fig. 12.1 and 12.2, explain why higher voltages are used to transmit electrical power over very long distances.

.....

.....

..... [2]

(b) The 980 MW power station produces 50 Hz alternating electricity at a voltage of 20 kV. Transformer A in Fig. 12.1 is ideal, with 48000 turns in the secondary coil and it produces an output voltage of 280 kV. Transformer B takes in 900 MW and change the voltage before providing electricity to homes.

(i) Explain whether or not the transformer will work with a direct current power supply.

.....

.....

..... [2]

(ii) Calculate the number of turns in the primary coil of transformer A.

number of turns =..... [2]

(iii) Determine the efficiency of power transmission in the cables.

efficiency =..... [1]

(c) In one part of the homes, a long transmission line is connected to the output of transformer B.

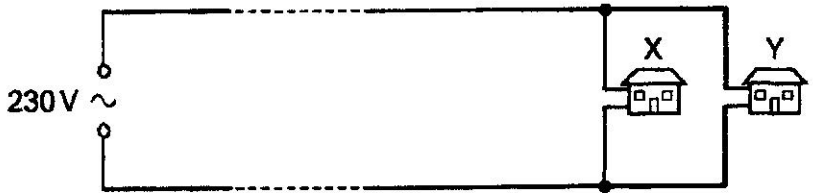


Fig. 12.3

The occupier of house X switches off the water heaters and air-conditioners in his house.

(i) Would the voltage supplied to house Y increase, remain the same, or decrease? Explain.

.....

.....

..... [2]

(ii) An electrician measures the voltage-time properties of the mains supplied to houses X and Y. On Fig. 12.4, mark out the values on the axes. [1]

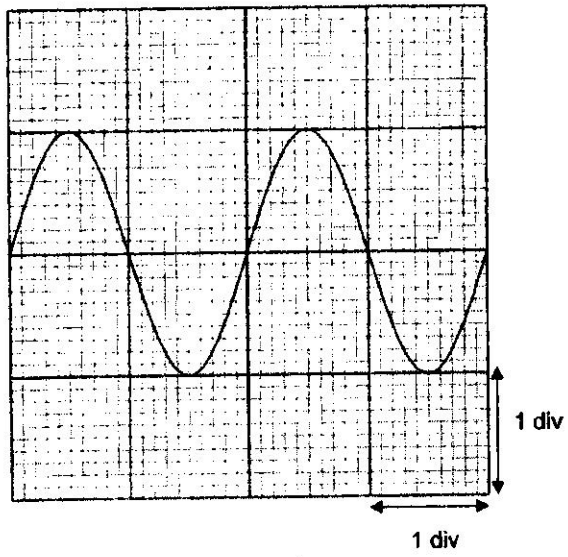


Fig. 12.4

OR

12. (a) Fig 12.5 shows a simple D.C. motor. An observer stands in front of the split-ring commutators.

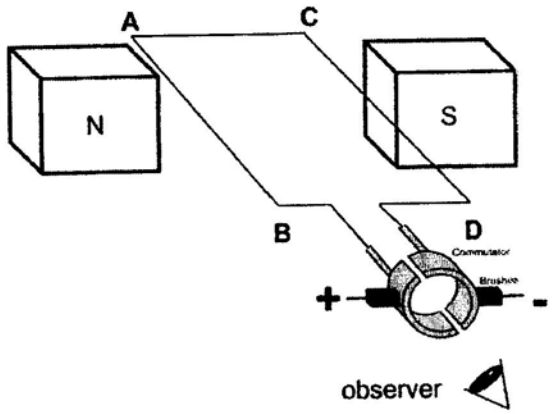


Fig. 12.5

(i) Explain why there is a force acting on part **AB** of the rectangular coil.

.....

.....

..... [1]

(ii) State and explain the direction of the force acting on part **AB** of the rectangular coil.

.....

.....

.....

..... [2]

(iii) The set-up was assembled wrongly by a student with no split-ring commutators. Describe the motion of the coil without the use of split-ring commutators.

.....

.....

.....

..... [2]

(b) Fig. 12.6 shows a hydraulic press that is activated by exerting a force of 50 N on the end of an arm 30 cm from the hinge. The arm transfers the moment to an input piston 5.0 cm from the hinge which then transfers the pressure to push the output piston with a force F.
The area ratio of the output piston to input piston is 5:1.

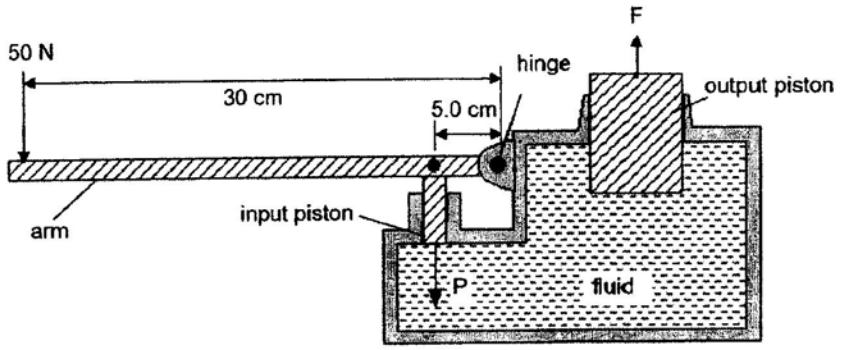


Fig. 12.6

(i) The output force **F** is always greater than the force at the arm.
Explain why, using ideas of energy.

.....

.....

.....

..... [2]

(ii) Calculate

1. the force **P** due to the input force of 50 N, stating the principle involved and hence,

force **P** =.....

2. the force **F** produced.

force **F** =..... [3]

—— End of Paper ——
When you come to the end of the rope, tie a knot and hang on.
Do not let go! Persist!

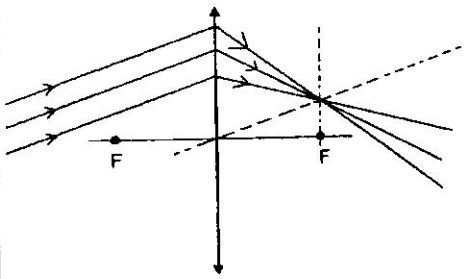
BUKIT BATOK SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS WITH SPA (5059)
GCE O-LEVEL PRELIMINARY EXAMINATIONS
SUGGESTED ANSWERS AND COMMON MISTAKES FOR STUDENTS – PAPER 2

Question	Suggested Answer
1a	Mass of water = (6500-4100)/2 = 1200 kg Volume = mass / density = 1200 / 1000 = 1.20 m^3 **Common mistakes:** • Did not write formula • Did not halve (divided by two) the mass • Wrong units used for volume
1b(i)	• Velocity increases (or changes) constantly (or steadily) per unit time • Constant rate of change of velocity **Common mistakes:** • Wrote rate of change of velocity per second • Wrote rate of change of velocity per unit time • Wrote speed instead of velocity • Did not explain uniform
1b(ii)	• Chemical energy (accept chemical potential energy) • Converted to heat (or thermal energy) and light energy in the combustion engine (burning) • Converted to kinetic energy of the tractor and tank **Common mistakes:** • Did not mention burning or combustion • Wrote about forces decreasing instead of energy decreasing • Mixed up energy with friction (a force) • Did not describe where the energy was converted to
1b(iii)	GPE = mg Δh = (2400) (10) (850) = 20400000 J **Common mistakes:** • Did not write formula • Mixed up the mass to be the mass of the tractor • Mixed up the full mass with half the mass • Did not convert 0.850 km to 850 m
2a	It falls vertically at uniform acceleration **Common mistakes:** • Did not mention the shape of the graph – uniform/constant/steady • Did not mention change in velocity (used speed instead)

Question	Suggested Answer
2b	Maximum height = area under graph = ½ (50) (64) = 1600 m **Common mistakes:** • Did not identify the time period of t = 0 s to t = 50 s • Wrote distance = speed x time • Did not halve (divided by two) the mass • Used the area of triangle of t = 0 s to t = 18 s
2c	• The upward thrust is larger in size than downwards weight • Net force is upwards • By F = ma, rocket accelerates upwards **Common mistakes:** • Did not mention net force • Did not mention upthrust and weight • Did not mention acceleration • Memorised and stated first law blindly • Assumed no resultant force
2d	Weight = m g = (150) (80 ÷ 40) = 300 N **Common mistakes:** • Assumed g = 10 due to no atmospheric layer • Assumed g = 10 (= on earth) • Used the acceleration for t = 0 s to t = 18 s
3a	X marked out on screwdriver directly above the pivot **Common mistakes:** • Marked out the middle of the rod • Marked out the middle of the handle • Left the question blank
3b(i)	• Downward weight at geometrical centre of ladder • Upward surface reaction force at A • Frictional force at A to the left along ground • Surface reaction force at B to the left **Common mistakes:** • Did not draw the arrow of weight in the middle of the ladder • Did not consider the smooth nature of the vertical wall • Did not consider that the ladder did not slip and slide down due to rough ground with friction • Did not draw a total of 4 forces
3b(ii)	Taking moments about A, for equilibrium, Clockwise moments = anti-clockwise moments (500)(1.5) = (F)(6.0) F = 125 N **Common mistakes:** • Wrongly assumed distance of weight = 3.0 m • Wrongly assumed distance of force = 3.0 m • Did not write the principle of moments properly – used shorthand

Question	Suggested Answer
4a	• Hot steam from the boiling water in outer pot rises up due to smaller density to reach the bottom of inner pot as well as to the top of the food. • Heat is conducted through the inner pot into the food. • Thermal radiation (transfer of infrared radiation) from hot water toinner pot. **Common mistakes:** • Overly wrote on convection • Focused on convection of water in outer pot • Did not consider conduction • Did not consider radiation
4b	• Steam (gas particles) move randomly at high speeds • The change from liquid state to gaseous state also involves a large increase in volume. • Steam particles collide against inner walls of lid, exerting a force onit to push it out **Common mistakes:** • Did not consider the huge increase in volume upon vapourisation • Focused on convection in boiling water • Focused on how water heats up via convection
4c	• Water has a high specific heat capacity **Common mistakes:** • Focused on convection of water • Focused on properties of fluid (liquid) • Repeated poor conductor of heat for water
4d(i)	• The higher the temperature difference of the water with the surroundings (20 °C), the larger the rate of heat loss to the surroundings. **Common mistakes:** • Stated but did not explain the trend of the graph • Stated that the initial 100 s rose more in temperature than the second 100 s
4d(ii)	$Q = m\ c\ \Delta\theta$ 78000 = (0.720) (c) (23) c = 4710 J / (kg K) [accept 4.71 J / (gK)] **Common mistakes:** • Wrong units • Missing units • Used the wrong data
5a	Imaginary line connecting points on a wave that are in phase **Common mistakes:** • Wrong definition • Many left blank

Question	Suggested Answer
5b	$V = f\lambda$ = (900 / 180) (2.0 cm) = 10.0 cm/s [accept 0.100 m/s] **Common mistakes:** • Wrongly determined frequency • Wrongly determined wavelength (use 10 ÷ 6 or used 10 cm) • Wrote the wrong units as m/s
5c	Speed increases as there is less friction Frequency remains the same as the source is the same Wavelength increases as by $V = f\lambda$, speed increases **Common mistakes:** • Wrongly assumed that speed decreases • Wrongly assumed that frequency changes • Stated but did not explain
6a	Speed of X-rays in air ~ 3.0×10^8 m/s Time = distance / speed = 1.0 / 3.0×10^8 = 3.33×10^{-9} s = 3.33 ns **Common mistakes:** • Did not use the correct speed for X-rays • Left blank • Did not use calculator to check answer • Wrote 3.0×10^{-9} s • Did not write the formula
6b	Not suitable X-rays are highly energetic and ionizing, killing the cells in the foetus. **Common mistakes:** • Unable to bring out idea of highly ionising
6c	• Gamma rays • Used to kill cancer cells in treatment of cancer • Use in the sterilization of canned food or medical equipment in hospitals or surgical equipment • Used to detect cracks in metals or cement • Used to kill bacteria in vegetables and fruits **Common mistakes:** • Did not mention the use • Incomplete answer

Question	Suggested Answer
7a	All 3 rays converge at the same point vertically above the focal point F on the right side of lens Two working lines to guide the rays to the correct position to intersect  **Common mistakes:** • All rays converged to focus point (F) on the principal axis • Incomplete answer
7b	$n = \frac{1}{\sin c}$ $\sin c = \frac{1}{1.59}$ $c = 39.9^{o}$ **Common mistakes:** • Used the wrong refractive index • Mixed up with water • Tried to use water and plastic together
8a	• North pole • Solenoid is magnetized to have a North pole on the left side by Right-hand Grip rule, with the thumb pointing to the North pole direction and the fingers curling in the direction of current in the solenoid. [accept Maxwell corkscrew rule explanation] **Common mistakes:** • Confused Maxwell corkscrew rule with right hand grip rule • Unable to verbalise right hand grip rule • Did not mention fingers or thumb or both • Applied right hand grip rule wrongly
8b	• Increase current in the coil by increasing e.m.f. of cell or using more cells connected in series • Use thicker wire (coil) with lower resistance so as to increase the current flowing in the coil • Increase number of turns of coil per unit length **Common mistakes:** • Wrote number of coils (= number of wires) instead of number of turns of coil • Did not mention connecting more cells in series • Wrongly identified cell of diagram as battery • Used voltage instead of e.m.f. (electromotive force) • Went on to explain when they wanted stating

Question	Suggested Answer
9a	• Correct connection of live and neutral wires to heating element • Correct connection of earth wire to metal casing • Correct symbol and placement of fuse and switch along live wire **Common mistakes:** • Drew fuse as fixed resistor (rectangle) • Did not draw switch and did not draw fuse • Short-circuited live and neutral by joining them together • Crisscrossed wires • Drew fuse inside the kettle
9b	P = I V 1100 = (I) (230) I = 4.78 A Fuse rating = 5A, 6A, 7A **Common mistakes:** • Confused fuse rating with power • Used 2 d.p. or 3 s.f. for fuse rating – fuse rating should be whole number • Did not write units for final answer in working • Did not use 3 s.f. for final answer in working • Did not convert 1.1 kW to 1100 W
10a(i)	P = energy / time = (530 x 1000 x 3600) / (365 x 24 x 3600) = 60.5 W **Common mistakes:** • Confused kWh as power – kWh is energy • Did not use seconds – used number of days
10a(ii)	kWh savings per year for D compared to C = 720 – 550 = 170 kWh Electricity cost savings for 10 years for D compared to C = 170 x 10 years x $0.20 = $340 Savings = $340 – $200 = $140 He should buy D as he will save $140. **Common mistakes:** • Did not consider total cost of using D and C • Did not identify D and C as 400-litre refrigerators • Got ridiculously large numbers of more than $10000
10b(i)	Q = m l_f = 0.150 x 334000 = 50100 J **Common mistakes:** • Apply Q = mcΔθ and got zero joules • Did not identify region B properly • Used specific latent heat of vaporisation

Question	Suggested Answer
10b(ii)	• Energy is released by particles as they come closer to stronger intermolecular forces of attraction • Solidification (liquid to solid state) • Same average KE of particles **Common mistakes:** • Wrote one point and gave a one-mark answer • Did not write about freezing • Did not mention forming stronger bonds or stronger intermolecular forces of attraction (IMFA) • Did not write same/constant average KE of particles
10b(iii)	• In A, particles are randomly arranged and closely packed (slightly farther apart than solid state). • In C, particles are orderly arranged and VERY closely packed. **Common mistakes:** • Did not compare the same thing for A and C • Did not compare randomness and packing of particles • Wrote closely packed for both A and C without any difference that solid is VERY closely packed
11a(i)	The coil experiences a change in magnetic flux (of magnet) linked to it, inducing an e.m.i in the coil, leading to an induced current. **Common mistakes:** • Did not mention the linking to the coil • Thought that the solenoid has a magnetic field initially • Wrote that the steel magnet cut its own magnetic field lines
11a(ii)	• North-pole (accept N-pole) • By lenz's law, solenoid tries to oppose the incoming N-pole of magnet by inducing a North pole to repel it • As like poles repel **Common mistakes:** • Unable to verbalise lenz law • Confused with the magnetic fields present • Did not write that like poles repel
11a(iii)	V = I R = (0.000045) (1.2) = 0.000054 V **Common mistakes:** • Unable to convert 0.045 mA to 0.000045 A • No formula given
11a(iii)	Q = I t = (0.000045) (0.14) = 0.0000063 C **Common mistakes:** • Unable to convert 0.045 mA to 0.000045 A • No formula given • Wrong formula used • Wrong or missing units

Question	Suggested Answer
11b	• The current in the second experiment has a larger size than that in the first experiment • due to a larger rate of change of magnetic flux linked to the coil as the magnet moves faster **Common mistakes:** • Unable to link to current in second experiment being larger • Tried to prove using Q = It when it is already told that Q is the same • Unable to link to Faraday's law • Unable to use the right terms (rate of change) for Faraday's law • Missed out on the "linked to coil" part
11c	• Correct shape and symmetrical and sufficient (at least 6) field lines • Correct magnetic field lines direction • Increasing gap between field lines • Field lines originate from poles (near to the ends of bar) **Common mistakes:** • Equal gap • Insufficient lines drawn • Lines drawn out the paper or out of answer space – try not to • Wrong arrow directions • Lines intersecting
12-E	**12-EITHER**
12E-(a)	• The higher the voltage, the longer the maximum length of cables that can be used. • For same power P = IV, a higher voltage implies a lower current, and that leads to a smaller I^2R heating loss. **Common mistakes:** • Unable to use the table of numbers • Unable to mention maximum length of cable and unable to use data • Unable to verbalise loss and heating loss with the formula I^2R
12E-b(i)	• It will not work. • Direct current gives a constant magnetic field. • Secondary coil would not experience continuous change in magnetic flux linked to it, hence no continuous induced e.m.f. **Common mistakes:** • Unable to link to secondary coil (where the output is) • Did not mention change in magnetic flux linkages • Did not mention continuous (time-frame)
12E-b(ii)	Ns / Np = Vs / Vp Np = (48000 x 20000) ÷ 280000 = 3428.6 ~ 3430 turns **Common mistakes:** • Used power values (900 MW and 980 MW) instead of voltages • Used 4 s.f. = 3429 instead of 3 s.f. or 2 s.f.
12E-b(iii)	Efficiency = useful output power / total input power = 900 000000 / 980 000000 = 0.918 (accept 91.8 %) **Common mistakes:** • Did not write formula

Question	Suggested Answer
12-E	**12-EITHER**
12E-c(i)	• Increases. • Smaller current (**without X**) is drawn from the supply, and for the same power supplied by transformer source, P = IV, voltage V increases. **Common mistakes:** • Not aware of how transformer works • Did not take into account long transmission lines • Used parallel circuit connections as error-carried-forward
12E-c(ii)	• Period = 0.020 s • Amplitude = 230 V **Common mistakes:** • Did not calculate the Period (= time for one sine curve) • Did not bring in 230 V • Some used 240 V from memory • Did not draw the vertical and horizontal axis • Did not mark out (0,0) for sine curve
12-OR	**12-OR**
12OR-a(i)	• Current in AB creates a magnetic around AB that interacts with the magnetic field of the magnets. • A (perpendicular) force is produced on AB (due to catapult effect). **Common mistakes:** • Directly applied fleming's left hand rule • Wrote that the current interacted with the magnetic field
12OR-a(ii)	• Vertically downwards • By Fleming's left hand rule, with middle finger pointing in direction of current from B to A, index finger pointing in direction of magnetic field from N-pole to S-pole, the thumb points in the direction of induced force downwards. **Common mistakes:** • Unable to identify the conventional current flow • Unable to verbalise fleming's left hand rule • Unable to link to the fingers and thumb of fleming's left hand rule
12OR-a(iii)	• It will rotate 90 degrees until it reaches the vertical position, • and start to oscillate about the vertical position with decreasing amplitude until it comes to a stop. **Common mistakes:** • Unsure if it started to rotate clockwise or anti-clockwise • Thought that it will rotate in one direction (= normal operation!) • Wrote about use of split-ring commutator merely • Did not write about it stopping eventually • Wrote that it would rotate 180 degrees (half a round) before anything happens to it

Question	Suggested Answer
12-OR	**12-OR**
12OR-b(i)	By conservation of energy, work done by input force downwards is equal to work done by F upwards. Since the end of arm (where 50 N is) will move down much more (larger distance) than the piston moving up (smaller distance), the size of 50 N input force will be smaller than size of F. **Common mistakes:** • Did not apply the conservation of energy • Merely wrote the principle of conservation of energy without the local context • Used Pascal's law of pressure in enclosed liquid • Tried to compared force P and force F • Did not use nor mention force of 50 N at end of arm
12OR-b(ii)	By principle of moments, for equilibrium, clockwise moments = anti-clockwise moments (50) (30) = (P) (5.0) P = 300 N **By newton's 3rd law, the oil has a force of 30 N acting on the piston P in the upward direction.** **Common mistakes:** • Wrongly assumed that distance of 50 N from pivot (hinge) is 25 cm • Did not write down principle of moments properly
	Pressure at input piston = Pressure at output piston Force at P / Area of piston P = Force at F / Area of piston F F = 5 x 300 N = 1500 N Allow e.c.f. of F from P. **Common mistakes:** • No formula and no working • Did not use answer from earlier part

SECONDARY FOUR EXPRESS PHYSICS WITH SPA (5059)
GCE O-LEVEL PRELIMINARY EXAMINATIONS
SUGGESTED ANSWERS – PAPER 1

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