Name: ..... (  )  Class: Sec 4 SG 5 / 6

# Queenstown Secondary School

**Preliminary Examination 2024**
**Secondary Four Normal (Academic)**
**Science (Physics)**
**5105/01**

**30 July 2024**
**Tuesday**

**Time: 0800 – 0915h**
**Papers 1 and 2: 1 hour 15 minutes**

**Setter:**

**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 index number on the Answer Sheet in the spaces provided.

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

**Read the instructions on the Answer Sheet very carefully.**

Answers to Paper 1 and Paper 2 must be handed in separately.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
You are advised to spend no more than **30 minutes** on **Paper 1**.
You may proceed to answer Paper 2 as soon as you have completed Paper 1.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

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This document consists of 9 printed pages.

1 Which pair consists of two vector quantities?

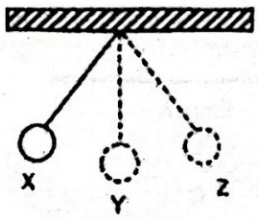
A pressure and work done

B density and force

C energy and speed

D acceleration and weight

2 The diagram shows a simple pendulum. The bob of the pendulum was pulled to position X and released.




If the pendulum takes 3.6 s to make one complete oscillation, what is the time needed for the pendulum to move from X to Y?

A 0.9 s B 1.8 s C 2.7 s D 3.6 s

3 A rocket experiences upthrust and weight acting on it as it travels upwards in the Earth's atmosphere.

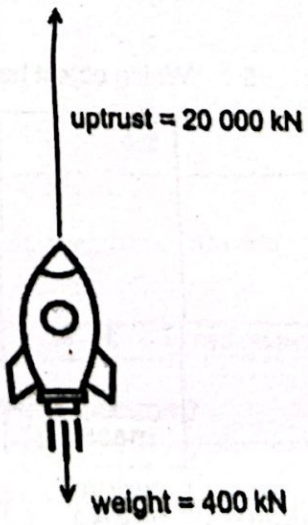
Which statement is correct?

A The rocket will move at a constant speed in a straight line.

B The rocket will accelerate upwards.

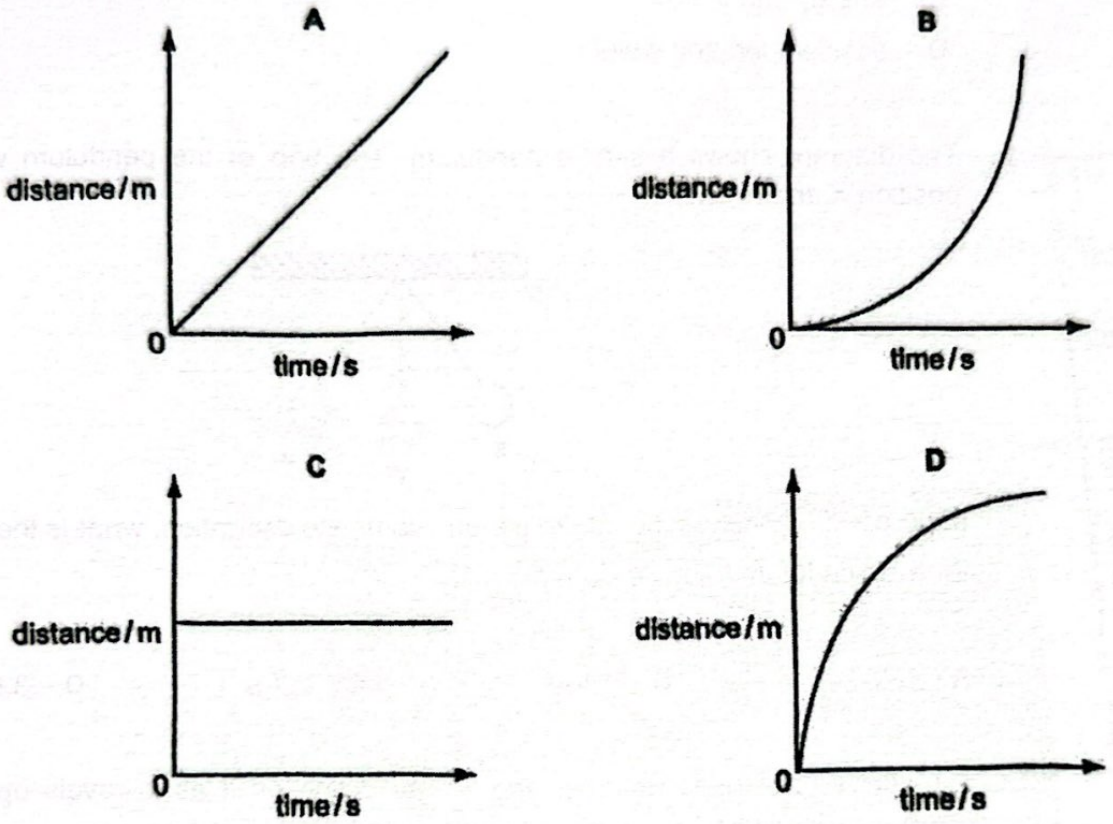
C The rocket will accelerate downwards.

D The rocket will decelerate upwards.

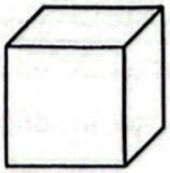


4 A car increases its speed for 60 seconds.

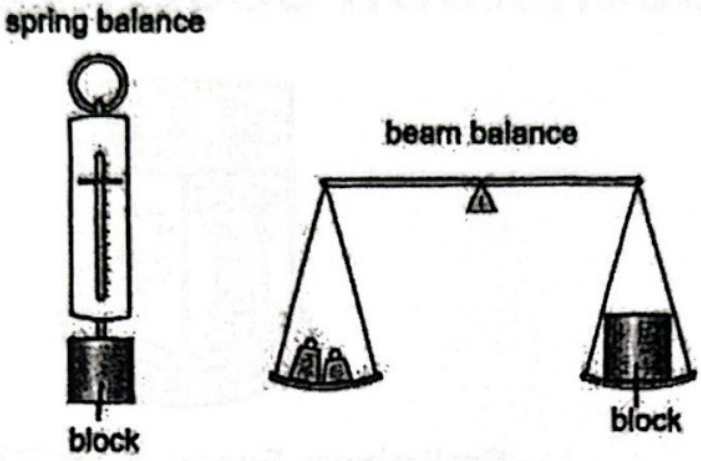
Which distance-time graph shows the car's motion?




5 Which object has the smallest density?

| | A | B | C | D |
|---|---|---|---|---|
| |  |  |  |  |
| mass / g | 15 | 60 | 20 | 60 |
| volume / $cm^3$ | 3 | 20 | 6 | 15 |

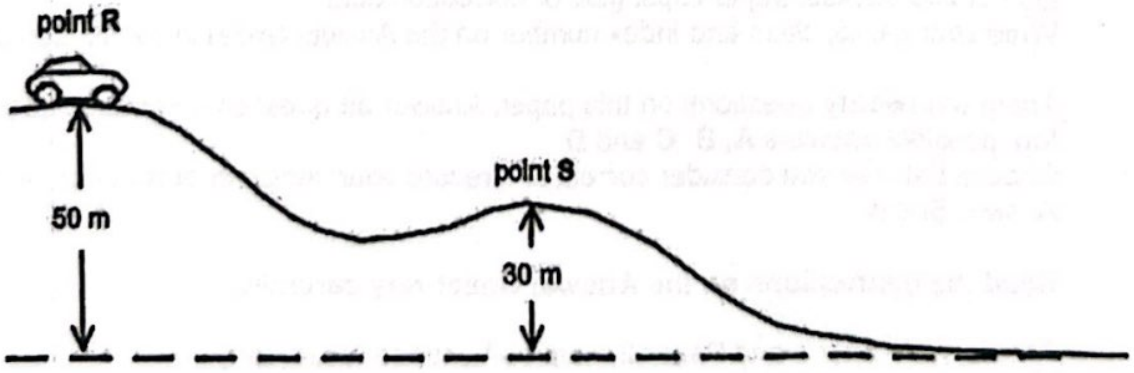
6 Two identical blocks are each placed on a spring balance and a beam balance on Earth as shown in the diagram below.




If the experiment is repeated on the surface of the Moon, what would happen to the readings on the balances?

| | reading of spring balance | reading of beam balance |
|---|---|---|
| A | no change | no change |
| B | decreases | decreases |
| C | decreases | no change |
| D | no change | decreases |

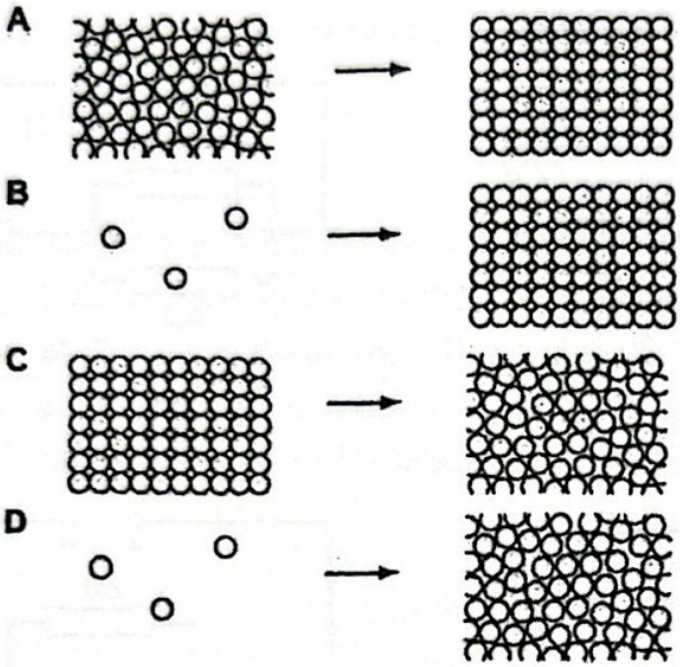
7 A car with a mass of 500 kg is moving at a constant speed of 28 m/s from point R to point S. The difference in height between both points are shown in the diagram below. Take gravitational field strength, $g$ = 10 N/kg.



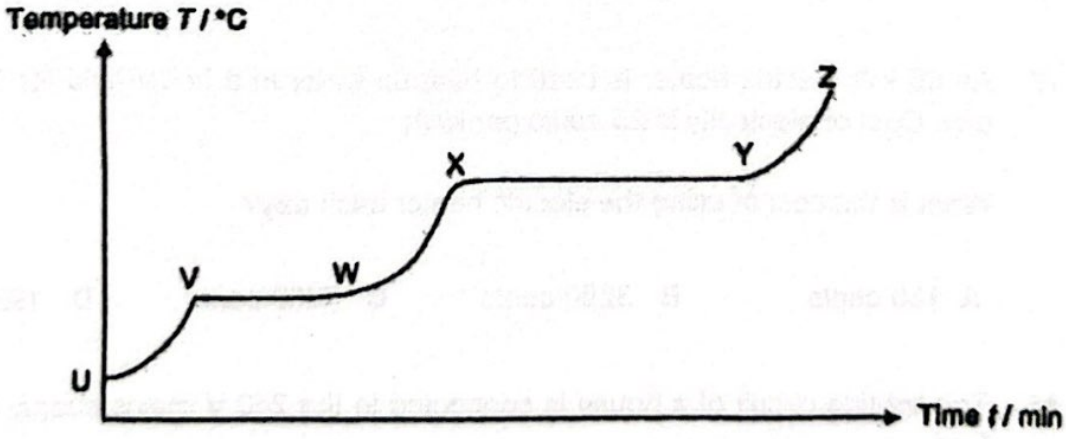

What is the energy in the kinetic store of the car when it reaches point S?

A 7000 J B 150 000 J C 250 000 J D 196 000 J

8 Which diagram best represents the change in arrangement of particles when a liquid freezes completely?




9 The following shows the heating curve of a solid substance.




How does the energies of the particles in the substance change with time?

| | part of heating curve | potential energy | kinetic energy |
|---|---|---|---|
| A | UV | no change | no change |
| B | VW | increases | increases |
| C | WX | no change | increases |
| D | XY | increases | no change |

10 Polar bears living in cold climates have thick coats of fur to keep them warm.

How do the thick coats of fur keep them warm?

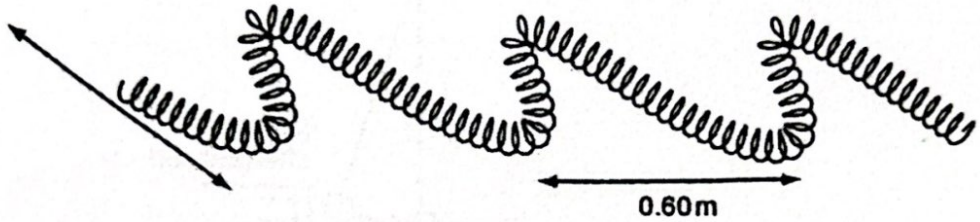
A Fur is a poor emitter of radiation.

B Fur is a good thermal conductor.

C Fur traps air, which is a poor thermal conductor.

D Fur traps air, which is a poor emitter of radiation.

11 The diagram shows part of a spring that is shaken from side to side to produce a wave.




The distance between successive peaks is 0.60 m and the frequency is 2.5 Hz.

What is the type of wave created in this spring and its speed?

| | type of wave | wave speed / $ms^{-1}$ |
|---|---|---|
| A | transverse | 0.75 |
| B | transverse | 1.5 |
| C | longitudinal | 1.5 |
| D | longitudinal | 4.2 |

12 The diagram shows the components of the electromagnetic spectrum. They are arranged in order of increasing wavelength.

| | | | | | | |
|---|---|---|---|---|---|---|
| P | X-rays | Q | light | R | S | radiowaves |

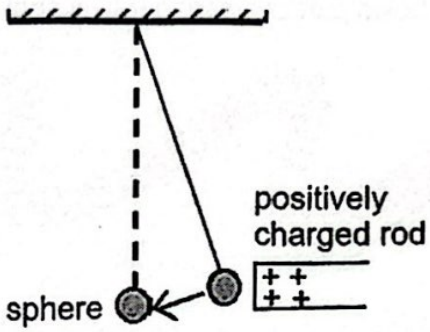
Which row lists the application of parts of the electromagnetic spectrum?

| | P | Q | R |
|---|---|---|---|
| A | intruder alarms | food sterilisation | treatment of cancer |
| B | optical fibres | treatment of cancer | food sterilisation |
| C | treatment of cancer | sunbeds | intruder alarms |
| D | intruder alarms | sunbeds | optical fibres |

13 Which of the following electromagnetic waves travel the slowest in outer space?

A visible light
B microwaves
C gamma rays
D all travel at the same speed

14 A small conducting sphere is suspended by an insulated thread. When a positively charged rod is brought near the sphere, the sphere moves away from the rod.

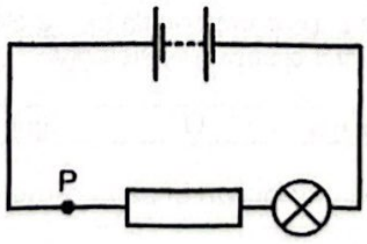



Which of the following is/are possible reasons for the observation?

1 The sphere may carry a positive charge.
2 The sphere may carry a negative charge.
3 The sphere may be neutral.

A 1 only B 1 and 3 C 2 only D 2 and 3

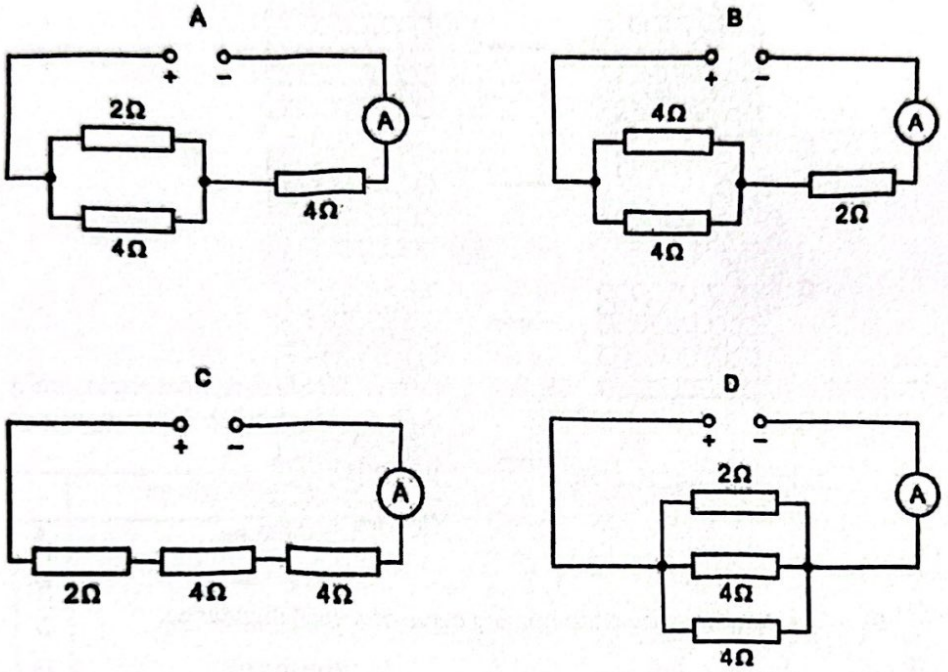
15 The diagram below shows a lamp in a circuit.




Which change to the circuit would decrease the current through the lamp?

A moving the lamp to point P in the circuit
B replace the wires with thicker connecting wires
C adding another resistor in parallel with the one in the circuit
D decreasing the electromotive force (e.m.f.) of the battery in the circuit

16 An ammeter is connected to the three resistors and a power supply.
Which arrangement of resistors will give the smallest ammeter reading?




17 An 65 kW electric heater is used to heat up water in a household for 120 minutes a day. Cost of electricity is 25 cents per kWh.

What is the cost of using the electric heater each day?

A 130 cents B 3250 cents C 7800 cents D 195 000 cents

18 The lighting circuit of a house is connected to the 240 V mains supply through a 5 A fuse.

If each lamp is rated at 110 W, what is the maximum number of lamps that can be used in this circuit?

A 3 B 5 C 10 D 11

19 The reading on a detector placed near a radioactive material is 500 counts per second. The background count rate is 40 counts per second. The half-life of the radioactive material is 30 hours.

What is the reading on the detector after 60 hours?

**A** 300 **B** 270 **C** 125 **D** 155

20 What are the possible dangers when dealing with radioactive materials?

**A** Beta-particles can pass through skin and damage body cells.

**B** Radioactive materials are safe to handle after two half-lives.

**C** Sources of gamma radiation are dangerous because they have long half-lives.

**D** Materials that emit only alpha-particles must be kept in thick lead containers.

Name: ..... (  )  Class: Sec 4 SG 5 / 6

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**Preliminary Examination 2024**
**Secondary Four Normal (Academic)**
**Science (Physics)**
**5105/02**

**30 July 2024**
**Tuesday**

**Time: 0800 – 0915h**
**Papers 1 and 2: 1 hour 15 minutes**

**Setter:**

**Additional Materials:** Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

Write your name, class and index 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. Write your answers in the spaces provided.

**Section B**
Answer one question. Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no longer than 30 minutes on Paper 1.
You may proceed to answer Paper 2 as soon as you have completed Paper 1.

At the end of the examination hand in your answers to Paper 1 and Paper 2 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

| Examiner's Use | |
|---|---|
| Section A | /22 |
| Section B | /8 |
| TOTAL | /30 |

This document consists of 10 printed pages.

## Section A

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

**1 (a)** Table 1.1 shows a list of apparatus used in the Science lab.
Record the corresponding physical quantity which the apparatus is used to measure and its SI unit.

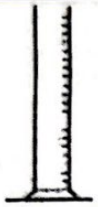
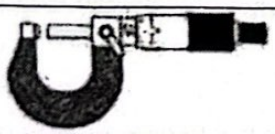
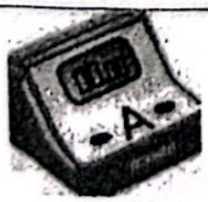
| apparatus | physical quantity to measure | SI Unit |
|---|---|---|
|  measuring cylinder | *e.g. volume* | *e.g. $cm^3$* |
|  electronic balance | ..... | ..... |
|  electronic stopwatch | ..... | ..... |
|  digital micrometer screw gauge | ..... | ..... |
|  ammeter | ..... | ..... |

**Table 1.1** [4]

**(b)** Two of the apparatus above have been used to measure the density of a marble. State the SI unit for density.

unit = ..... [1]

[Total: 5]

2 A magnetic crane with a strong electromagnet is used to scrap old cars for recycling as shown in Fig. 2.1 below.

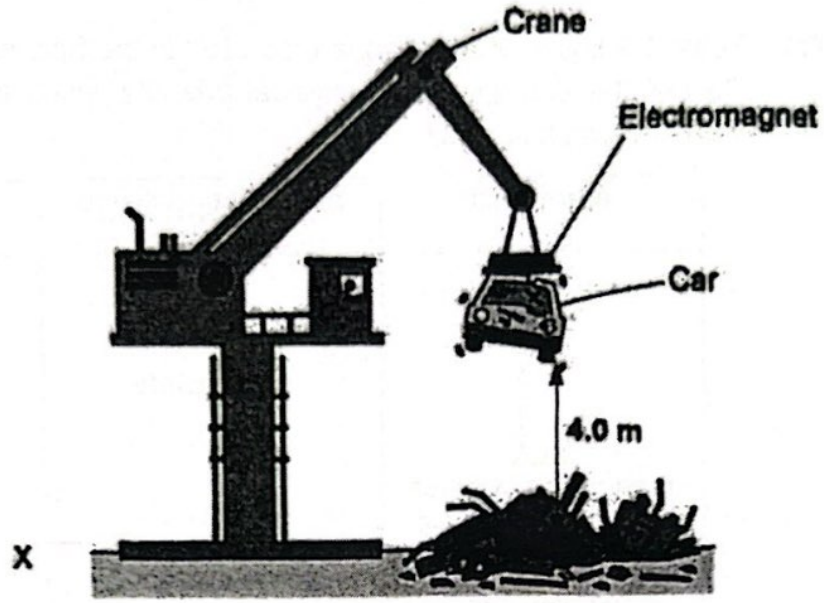



Fig. 2.1

(a) If the old car has a mass of 900 kg and is lifted to a height of 4.0 m, calculate the energy in its gravitational potential store.
(Assume g = 10 N/kg)

energy in gravitational potential store = ..... J [2]

(b) Calculate the power of the crane if it takes 9 seconds to lift the old car to the height shown in Fig. 2.1.

power = ..... W [2]

(c) The crane then moves the old car horizontally to a place above location X and releases the old car.

The statement below describes the transfer of energy due to the movement of the suspended old car by the crane.

Fill in the blanks below with the helping words given.

| | | | |
|---|---|---|---|
| *internal* | *kinetic* | *potential* | *heating* |
| *gravitational* | *electrically* | *chemical* | *mechanically* |

Energy is transferred ..... from the ..... potential store of the car to the ..... store of the car and the ..... store of the surroundings. [2]

[Total: 6]

3 The cover of a three-pin plug connected to a hair dryer is removed. Fig. 3.1 shows the inside of the plug.

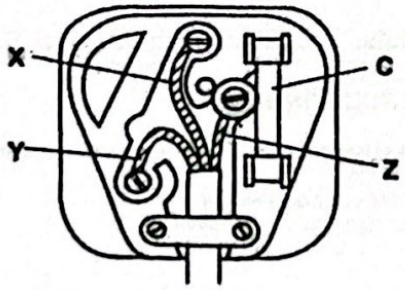



Fig. 3.1

(a) Name the wires and state the colour(s) of the wires.

| wire | name | colour(s) |
|---|---|---|
| X | | |
| Y | | |
| Z | | |

[2]

(b) Name component C. Explain why component C is connected to wire Z.

name of component C:.....

explanation: .....

..... [1]

(c) Some hair dryers have double insulation.

Explain how double insulation protects the user.

.....

..... [1]

[Total: 4]

4 Fig. 4.1 represents a transverse wave.

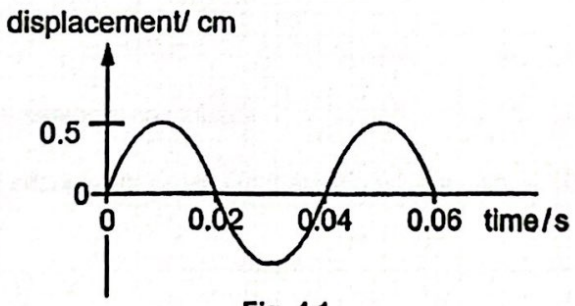



Fig. 4.1

(a) Determine the period of the wave.

period = ..... s [1]

(b) Calculate the frequency of the water wave.

frequency = ..... Hz [1]

(c) (i) State an example of a transverse wave.

..... [1]

(ii) Explain what is meant by *period* as applied to a transverse wave.

.....

..... [1]

[Total: 4]

5 When a skater skates in an ice rink, the blade of an ice skate cuts a groove into the ice.

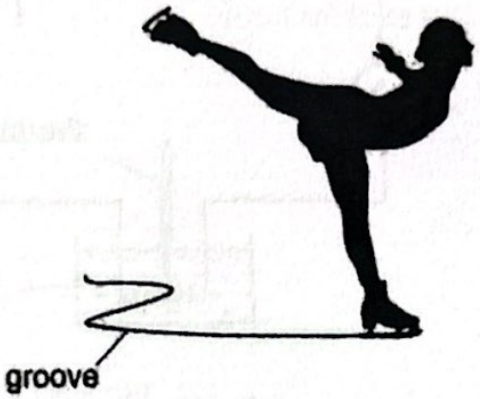



Fig. 5.1

(a) Explain in terms of pressure, how the grooves are cut into the ice by the ice skate.

.....

..... [1]

(b) When the skater is balancing on one leg as shown in Fig. 5.1, her ice skates exert an average pressure of 3 000 000 Pa on the ice. If the weight of the skater is 600 N, calculate the contact area of her ice skate on the ice.

contact area = ..... $m^2$ [2]

[Total: 3]

## Section B

Answer **one** question from this section.

**6** Fig. 6.1 shows the apparatus used by a student to heat a container of water.

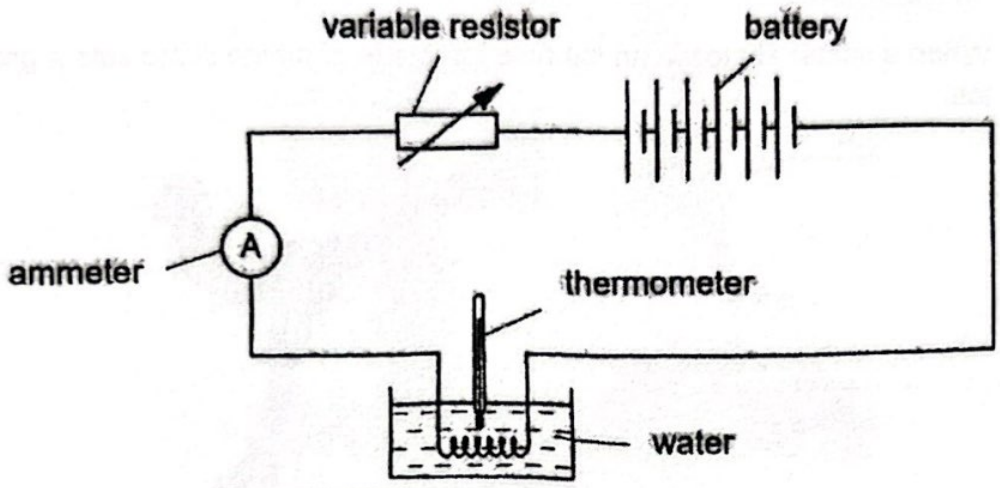



**Fig. 6.1**

**(a)** **(i)** The heating coil is placed near the bottom of the beaker.
Describe the process by which all the water in the container is heated up.

.....

.....

.....

..... [2]

**(ii)** The container holding the water is now painted black.
State and explain how this would affect the time taken for the water to be heated up.

state:.....

explanation: .....

.....

..... [2]

**(b)** The resistance of the coil of wire in the water is 60 Ω and the ammeter reading is 0.050 A.
The wire is replaced with another coil of wire of the same material but twice the length.

**(i)** Determine the resistance of the new coil of wire.

resistance of new wire coil = ..... Ω [1]

**(ii)** Determine the new reading on the ammeter.

reading on ammeter = ..... A [1]

**(iii)** Calculate the charge that passes through the ammeter in 8 minutes.

charge = ..... C [2]

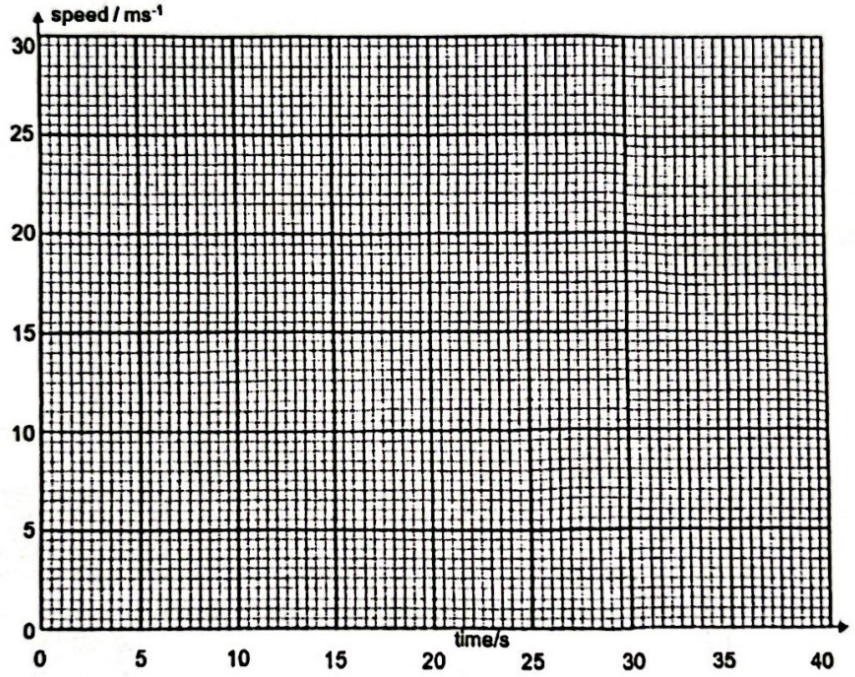
[Total: 8]

7 A car travels along a straight road.
The speedometer reading is recorded down every 5 seconds.

| speed/ms$^{-1}$ | 0 | 10 | 20 | 30 | 30 | 30 | 30 | 10 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| time/s | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |

(a) Plot a graph of the results, marking each point with a cross (x). [1]

(b) Draw the best-fit line or curve taking into account all the plotted points. [2]




(c) Describe the motion of the car between $t = 15$ s and $t = 30$ s.

..... [1]

(d) Determine the acceleration of the car over the first 15 seconds of its journey.

acceleration = ..... m/s$^2$ [2]

(e) Given that the car has a mass of 500 kg, calculate the resultant force acting on the car between $t = 0$ s and $t = 15$ s.

resultant force = ..... N [2]

[Total: 8]

**2024 QTSS Preliminary Examination**
**Sec 4NA Science(Physics)**

**Marking Scheme**

**Section A (20 Marks)**

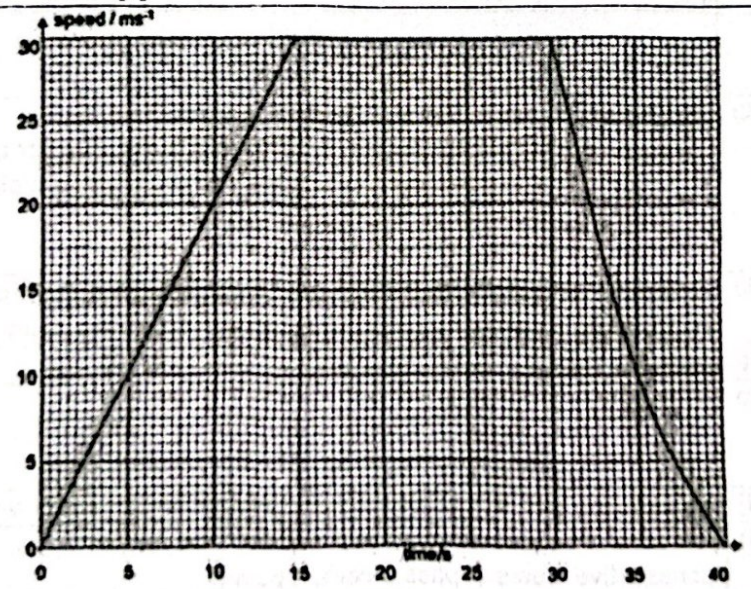
| | | | |
|---|---|---|---|
| 1 | D | 11 | B |
| 2 | A | 12 | C |
| 3 | B | 13 | D |
| 4 | B | 14 | A |
| 5 | B | 15 | D |
| 6 | C | 16 | C |
| 7 | D | 17 | B |
| 8 | A | 18 | C |
| 9 | C and D | 19 | D (all mark correct) |
| 10 | C | 20 | A |

**Section B (22 Marks)**

| | | | | |
|---|---|---|---|---|
| 1a | apparatus | physical quantity to measure | SI Unit | 4m (0.5m for each blank) |
| |  measuring cylinder | *e.g. volume* | *e.g. $cm^3$* | |
| |  electronic balance | **mass** | **kg or g** | |
| |  electronic stopwatch | **time** | **s** | |
| |  digital micrometer screw gauge | **length** | **mm** | |
| |  ammeter | **current** | **A** | |

| | | |
|---|---|---|
| 1b | SI unit for density = $g/cm^3$ or $kg/m^3$ | 1m |
| 2a | Energy in its gravitational potential store = mgh<br>= 900 x 10 x 4 [1]<br>= 36000 J [1] | 2m |
| 2b | Power = Energy / time<br>= 36000 / 9 [1]<br>= 4000 W [1] | 2m<br>(allow marks for ecf) |
| 2c | Energy is transferred **mechanically** from the **gravitational** potential store of the car to the **kinetic** store of the car and the **Internal** store of the surroundings. | 2m<br>(0.5m for each blank) |
| 3a | wire / name / colour(s)<br>X – Earth wire – Green and Yellow<br>Y – Neutral wire – Blue<br>Z – Live wire – Brown | 2m<br>3 blanks correct – 1m<br>6 blanks correct – 2m<br>*no ½ marks given |
| 3b | **Fuse**. [1]<br>When an electrical fault occurs and a large current higher than the fuse rating flows in the fuse, it melts and breaks the circuit, [1] protecting the user from an electric shock. | 1m |
| 3c | Some hair dryers which are double insulated have its casing made of an insulator which insulates the internal circuit. | 1m |
| 4a | Period = 0.04 s | 1m |
| 4b | Frequency = 1 / Period<br>= 1 / 0.04<br>= 25 Hz | 1m<br>(allow marks for ecf) |
| 4c(i) | Electromagnetic waves, Water waves, Light waves, Rope waves | 1m |
| 4c(ii) | Period of a transverse wave refers to the time taken for consecutive crests to pass a certain point. | 1m |
| 5a | Since P = F/A, the weight of the skater exerted over a small contact area of the ice skate results in high pressure on the ice which cut grooves into the ice. | 1m |
| 5b | P = F/A<br>3 000 000 = 600 /A [1]<br>A = 0.0002 $m^2$ [1] | 2m |

**Section C (8 + 8 Marks)**

| | | |
|---|---|---|
| 6ai | Water around the heating coil gains heat, becomes **less dense and rises.**<br>**Cooler denser water** near the top of the container **sinks.**<br>This **forms convections currents** which heats up all the water eventually. | 2m |
| 6aii | State: **Longer time taken** to heat up water [1]<br>Explanation: Black is a **good emitter of radiation.** Water **loses heat quickly** through the container by radiaton, resulting in a longer time for the water to be heated up. [1] | 2m |
| 6bi | Longer wire, higher resistance.<br>New resistance of wire = 60 x 2 = 120 Ω | 1m |
| 6bii | Higher resistance, smaller current.<br>New current in wire = 0.050 / 2 = 0.025 A | 1m |
| 6biii | Charge, Q = It<br>Q = 0.025 x (8 x 60) [1]<br>Q = 12 C [1] | 2m |
| 7a,b |  | 3m<br><br>(last 5s should be a curve) |
| 7c | Moving at constant speed | 1m |
| 7d | Acceleration = (v – u)/ t<br><br>= (30 – 0)/ (15 – 0) [1]<br><br>= 2 m/s² [1] | 2m |
| 7e | F = ma<br>F = 500 x 2 [1]<br>F = 1000 N [1] | 2m<br>(allow marks for ecf) |