# CANBERRA SECONDARY SCHOOL

## 2020 Preliminary Examination

### Secondary Four Express / Five Normal Academic

**SCIENCE PHYSICS**
5076/02

14 Aug 2020
1 hour 15 minutes
0830h – 0945h

**Name:** _____ (  ) **Class:** _____

**READ THESE INSTRUCTIONS FIRST**

Do not open this booklet until you are told to do so.

Write your full name, class and index number in the spaces provided on the question paper and on any separate writing papers used.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

**Section A**
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

**Section B**
Answer any **two** questions
Write your answers in the spaces provided in the question paper.

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 MARKER'S USE | | |
|---|---|---|
| | Marks Awarded | Max Marks |
| Section A | | 45 |
| Section B | | 20 |
| Total | | 65 |

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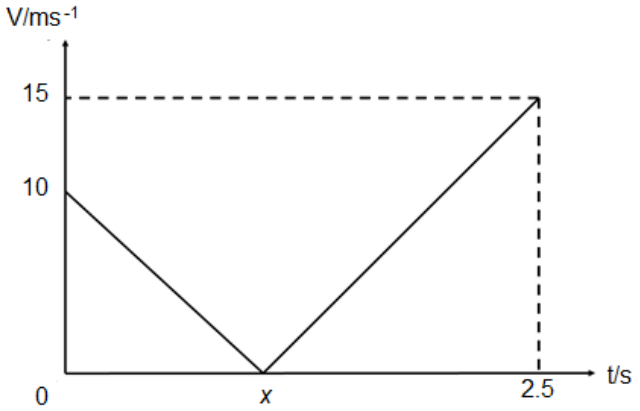
**This question paper consists of 15 printed pages including the cover page.**

**Setter: Mrs Olivia Ho**

## Section A [45 marks]

Answer **all** the questions.
Write your answers in the spaces provided in the question paper.

**1** A marble is tossed up vertically at an initial speed of 10 m/s. It moves up to the highest point at $t = \boldsymbol{x}$, before falling down and hitting the ground after 2.5 s.
The speed-time graph of the marble is shown below.




The air resistance is negligible, and the gravitational field strength is 10 N/kg.

**(a)** Describe the motion of the marble from $t = 0$ to $t = 2.5$ s.

……..

……..

…….. [2]

**(b)** Calculate the value of ***x***.

***x*** = ……. s [1]

**(c)** Calculate the distance travelled by the marble before it reaches the highest point.

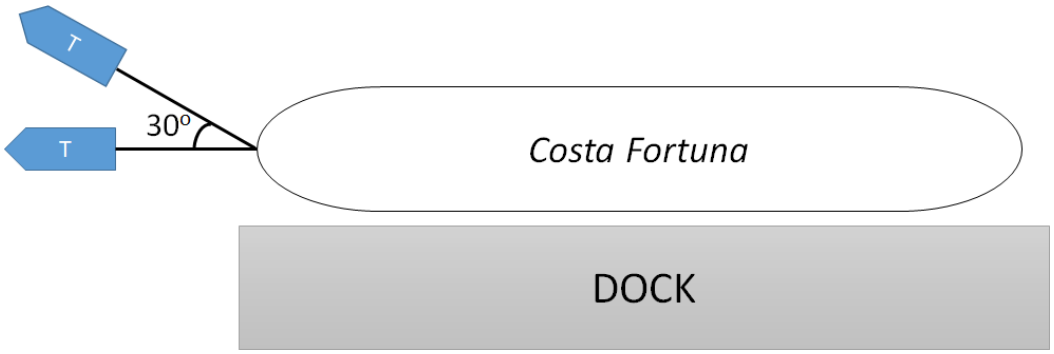
[1]

distance = …… m

**(d)** Hence or otherwise, calculate the height above the ground from which the marble is tossed.

height = …… m [2]

**2** The cruise ship Costa Fortuna has a mass of 50379000 kg. When it is embarking on a journey, tugboats (T) are needed to move it out of the port. The diagram below (not to scale) shows the arrangement of two tugboats. Each tugboat pulls with a force of 600 kN.




**(a)** By drawing a scaled diagram, determine the magnitude and direction of the resultant force of the two tugboats. [2]

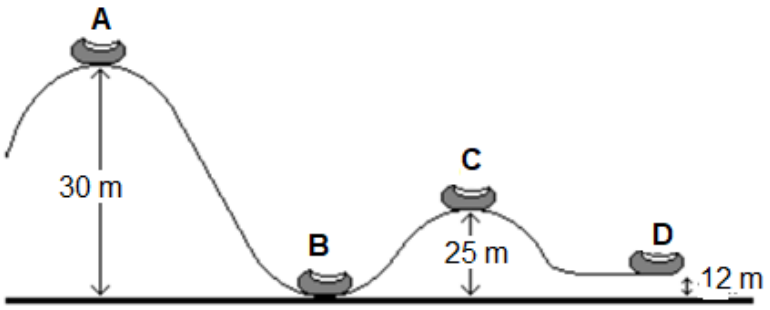
magnitude = …… N [1]

direction = …… [1]

**(b)** Hence, calculate the acceleration of Costa Fortuna as it leaves the dock.

acceleration = …… m/s$^2$ [1]

**3** The diagram below shows a rollercoaster. The cart, when fully loaded, has a mass of 500 kg.




At position **A**, the roller coaster has a speed of 2 m/s.

**(a)** Calculate the gravitational potential energy of the cart at **A**.

gravitational potential energy = …… J [1]

**(b)** Calculate the kinetic energy of the cart at **A**.

kinetic energy = …… J [1]

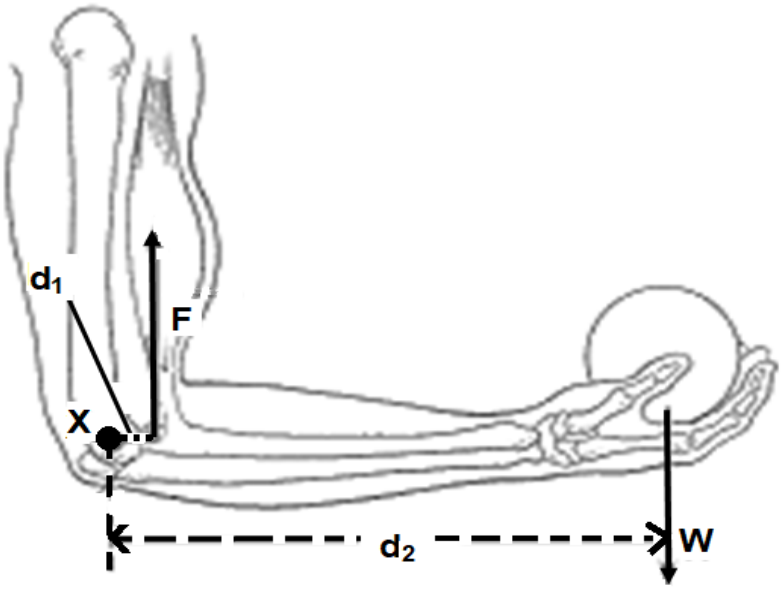
**(c)** Calculate the speed of the cart at **B**.

speed = …… m/s [2]

**(d)** A brake is applied at **B**. Given that the length of the track from **B** to **C** is 150 m, calculate the force needed for the cart to stop at **C**.

force = …… N [2]

**4** The diagram below shows a man holding an iron ball in his hand.




The elbow, **X**, is the pivot. **F** is the force exerted by the bicep muscle, while **W** is the weight of the iron ball. $\mathbf{d_1}$ and $\mathbf{d_2}$ are the perpendicular distance of forces **F** and **W** from the pivot respectively. $\mathbf{d_1}$ is 2.0 cm while $\mathbf{d_2}$ is 35.0 cm.

**(a)** Explain why the force **F** is much greater than **W** when the iron ball is held at the indicated position.

……..

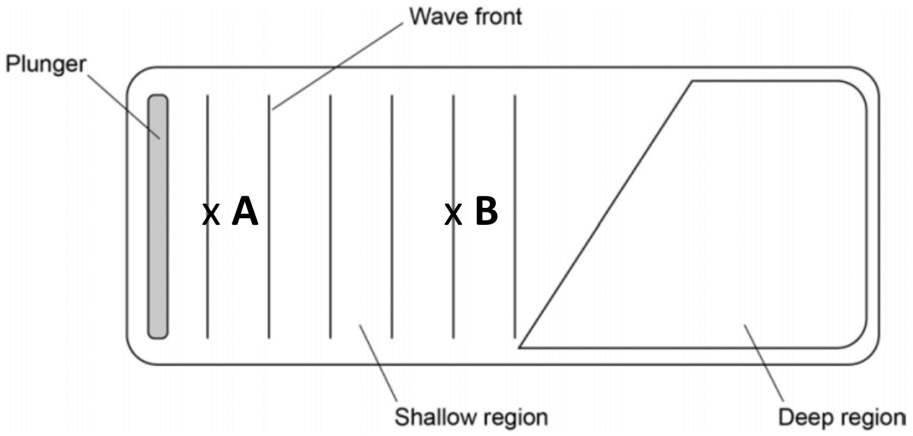
……..

…….. [1]

**(b)** Calculate the greatest weight of the iron ball if the maximum force exerted by the bicep is 1000 N.

weight = …… N [2]

**5** The diagram below shows the wave fronts produced in a ripple tank




The plunger moves up and down 3 times per second to produce a transverse wave.

**(a)** Describe the difference between transverse and longitudinal waves.

……..

……..

…….. [1]

**(b)** Given the distance between point **A** and **B** is 20 cm, calculate the speed of wave in the shallow region.

speed = …… cm/s [2]

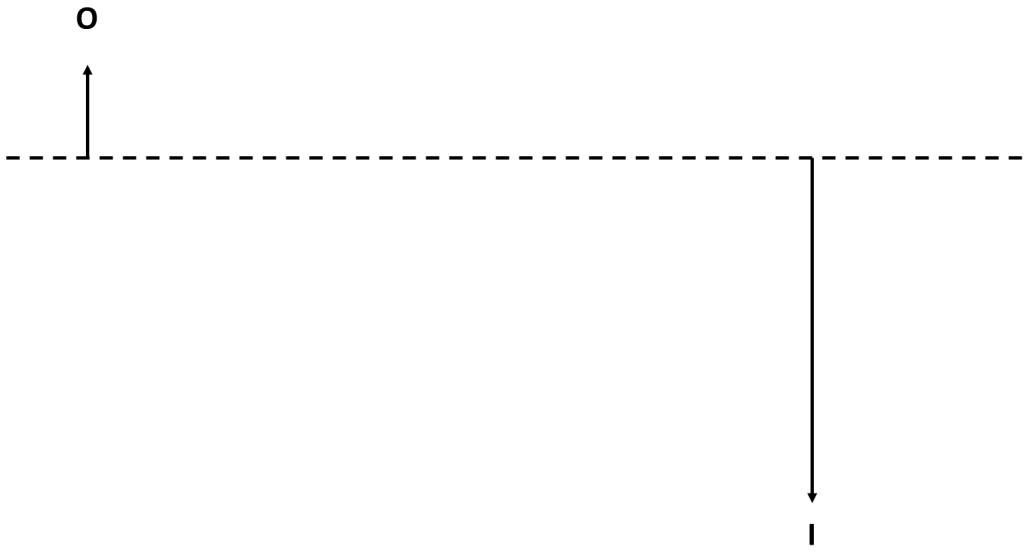
**(c)** Given that the wavelength of the wave in the deep region is 7 cm, state and explain how the speed of the wave changes.

……..

……..

…….. [2]

**6** The diagram below shows the image (**I**) of an object (**O**) formed by a thin converging lens.




**(a)** State two properties of the image formed.

…….. [1]

**(b)** Locate and label the position of the lens (**L**) and principal focus (**F**) by drawing suitable rays on the diagram. [3]

**(c)** Describe what happens to the properties of the image formed as the object is shifted until it is very close to the lens.

……..

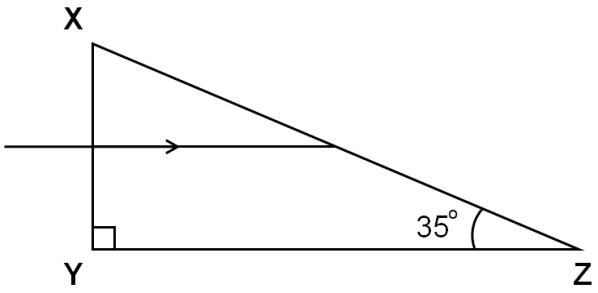
……..

……..

……..

…….. [2]

**7** The figure below shows a light ray incident on a triangular glass prism.




**(a)** Explain why the light ray does **not** bend at surface **XY**.

……..

…….. [1]

**(b)** If the refractive index of the glass prism is 1.51, calculate the critical angle of glass.

critical angle = …….° [1]

**(c)** Describe and explain what happen to the ray incident on surface **XZ**.

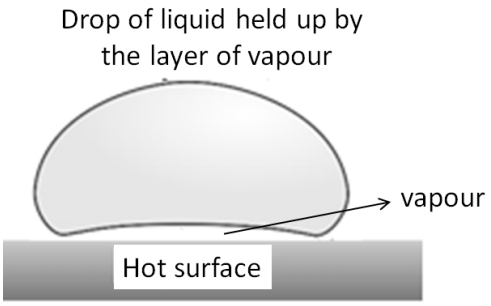
……..

……..

……..

…….. [2]

**8** Leidenfrost effect takes place when a water droplet falls on to a very hot surface. As shown in the diagram below, a thin layer of steam forms beneath the water droplet.




**(a)** Explain, using kinetic theory of matter, why a spherical liquid droplet is able to change its shape as shown in the diagram.

……..

……..

…….. [1]

**(b)** State what happen to the internal energies of the water droplet as the temperature remains at 100°C.

……..

……..

…….. [2]

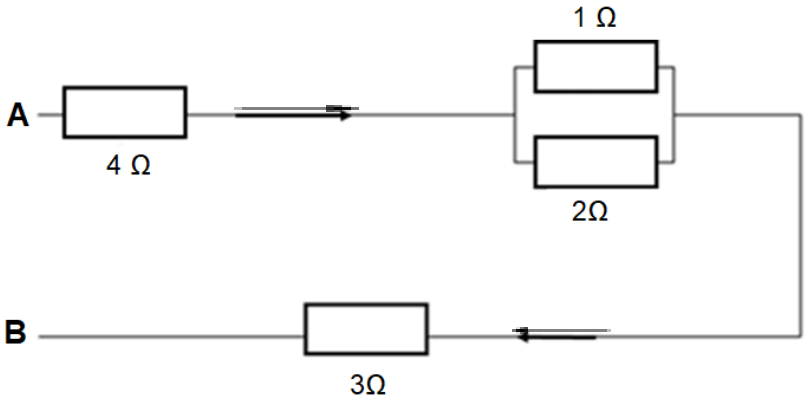
**(c)** Explain, in terms of thermal transfer, why the heating is much slowed down due to Leidenfrost effect.

……..

……..

…….. [1]

**9** The incomplete circuit diagram below shows how several fixed resistors are connected.




Point **A** and **B** are connected to a 9 V cell. The arrows indicate the direction of the flow of electrons.

**(a)** Complete the circuit diagram above by drawing the cell. [1]

**(b)** Calculate the effective resistance of the whole circuit.

resistance = ..... Ω [2]

**(c)** Hence, calculate the power dissipated by this circuit.

power = ..... W [2]

**(d)** The 2 Ω resistor is removed. State what happen to the current flowing though the 3 Ω resistor.

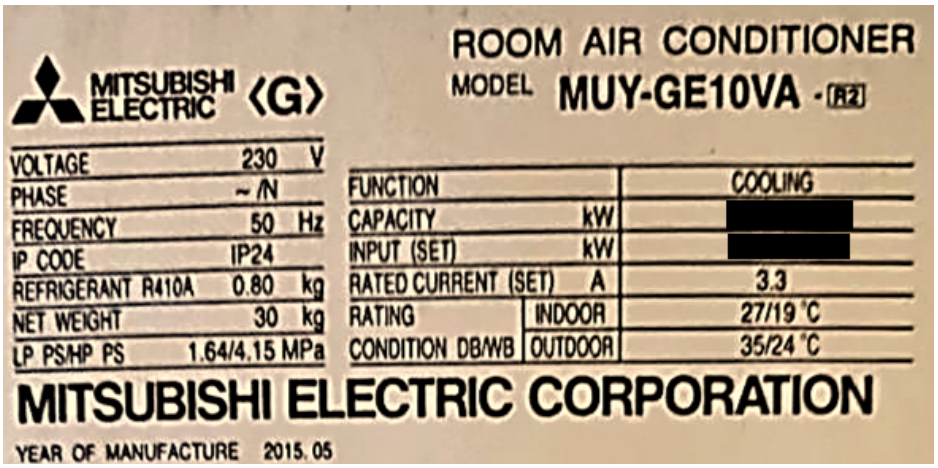
.....

..... [1]

## Section B [20 marks]

Answer any **two** questions in this section.
Write your answers in the spaces provided.

**10** The diagram below shows a label on an air conditioner, which is connected to domestic 230 V AC grid.




**(a)** Calculate the rated power of the air conditioner based on the label.

power = ..... [1]

**(b)** On average, the air conditioner is turned on for 4 hours per day. Calculate the cost of using this air conditioner for 365 days. The electrical tariff is $0.195/kWh.

cost = ..... [2]

**(c)** The air conditioner is fitted with a fuse.

**(i)** State the rating of the fuse suitable for this air conditioner.

..... [1]

**(ii)** State and explain where the fuse should be connected.

.....

.....

..... [2]

**(d)** State another safety feature which is used together with the air conditioner. Explain how it reduces the risk of electrical hazards.

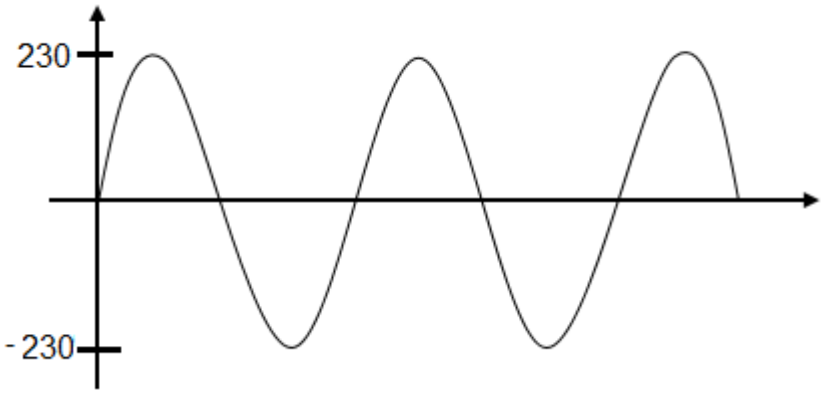
……..

……..

……..

…….. [2]

**(e)** The input voltage against time can be observed as shown on the graph below. On the graph, you are required to label both axis with units and all relevant values. [2]




**11** During an earthquake, two different types of waves are generated. The characteristics of the two waves are shown in the table below.

| Wave | Speed/(km/s) | Type | Impact | Frequency / Hz |
|---|---|---|---|---|
| **P**-wave | 7.5 | longitudinal | nondestructive | 0.1 - 2.0 |
| **S**-wave | 4.0 | transverse | highly destructive | 10.0 – 50.0 |

Due to the difference in speeds of **P** and **S** waves, it is possible to use seismographs to provide early warning for earthquakes.

**(a)** Describe how **P**-waves are propagated from the epicenter to the seismograph.

……..

……..

……..

…….. [2]

**(b)** For a particular earthquake, **P**-wave is detected 60 s before the **S**-wave on the seismograph. Calculate the difference in distance between **P**-wave and **S**-wave.

distance = ……. [2]

**(c)** State and explain why human beings are unable to detect the **P**-wave.

……..

…….. [1]

**(d)** Calculate the maximum wavelength of **S**-wave.

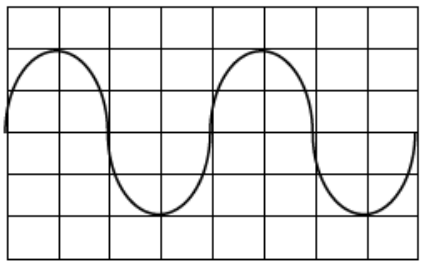
wavelength = ……. [1]

**(e)** A seismograph registered a force of 15 N when a **P**-wave is detected. Calculate the pressure of the **P**-wave given the area of the sensor is 1.5 $cm^2$.

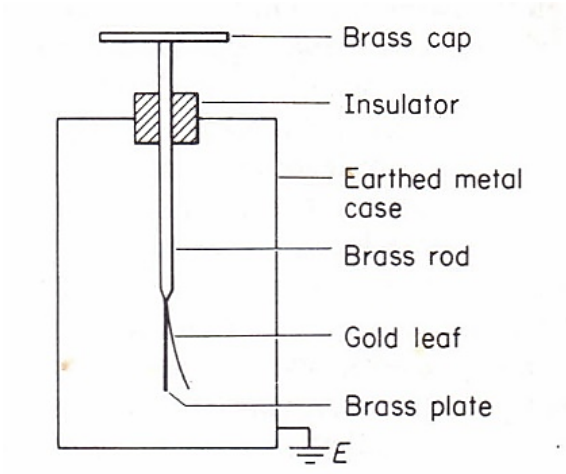
[2]

pressure = …….

**(f)** The figure below shows the waveform of a sound wave. On the figure below, draw a new waveform to represent the new sound that is half the loudness and twice the pitch. [2]



**12** The diagram below shows a gold leaf electroscope.




A Perspex rod become positively charged after rubbing a piece of cloth, it is brought near to the brass cap of the electroscope.

**(a)** **(i)** Explain how the Perspex rod becomes positively charged.

……

…… [1]

**(ii)** Describe and explain what happen to the gold leaf when the positively charged Perspex rod is brought near to the brass cap.

……

……

……

…… [3]

**(b)** 0.025 C of positive charge is accumulated in the brass cap of another electroscope. When wire **A** is used to earth the brass cap, it is discharged in
0.01 ms, releasing 10 J of energy in the process.

**(i)** Calculate the current flowing through wire **A** when the brass cap is earthed.

current = …….. [2]

**(ii)** Calculate the voltage of the brass cap and earth before it is earthed.

voltage = ……. [2]

**(c)** The brass cap is now earthed using wire **B** which is made of the same material as wire **A**. Wire **B** is twice the length and half the cross-sectional area as compared to wire **A**.

**(i)** State how the resistance of wire **B** will differ from wire **A**.

……

…… [1]

**(ii)** Hence, describe how the current flowing through wire **B** will differ from wire **A**.

……

……

…… [1]

**END OF PAPER**