PENRITH HIGH SCHOOL

2023 Preliminary Yearly

SCIENCE PRELIMINARY PHYSICS

Task Weighting: 30 %

General Instructions:

- Reading Time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A data, formulae sheet, and Periodic Table are provided at the back of this paper
- Write your student number at the bottom of every answer page
- There is supplementary writing paper at the back of this booklet. Students using this supplementary space should indicate this at the relevant question

Total Marks: 75

Section I Pages 2 - 9

16 marks

- Multiple Choice
- Attempt Questions 1–15
- Allow about 25 minutes for this part

Section II Pages 2 – 18

59 marks

- Short Response
- Attempt Questions 16–26
- Allow about 1 hours and 35 minutes for this part

Total pages this exam: 32
M/C answer sheet: 1

Student Number:----------

Section I

20 marks

Attempt Questions 1 – 16

Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1- 16

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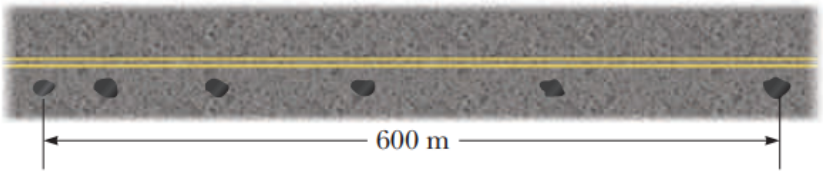
1. The radio station Tripple J emits a signal of 105.7 MHz. Which of the following best describe the wavelength of the signal.

   A. 4.2 m
   B. 3.2 m
   C. 2.8 m
   D. 2.8×10^6 m

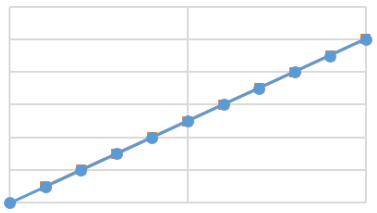
2. One drop of oil falls straight down onto the road from the engine of a moving car every 5s. What is the average speed of the car over this section of its motion?



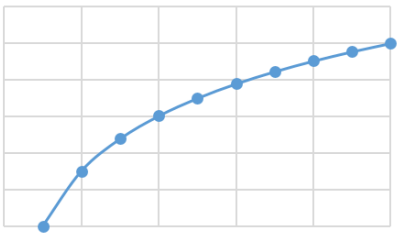
   A. 20 ms^{-1}
   B. 24 ms^{-1}
   C. 30 ms^{-1}
   D. 100 ms^{-1}

3. Which of the following position vs time graphs would best represent the motion of the car dripping oil during its motion?

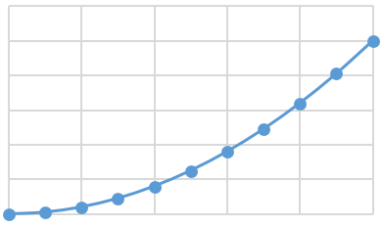
A



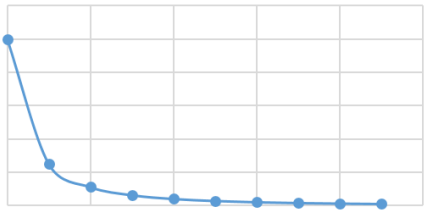
C



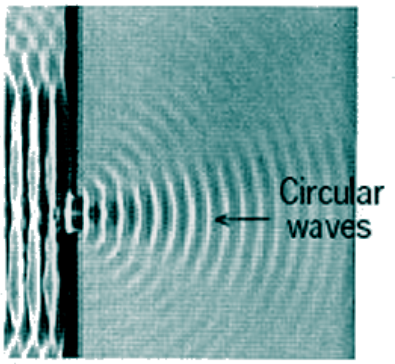
B



D



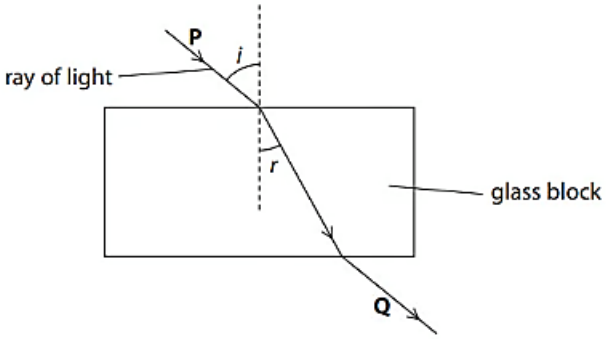
4. Water waves are produced in a ripple tank by a flat piece of plastic that moves quickly up and down. The waves travel forward toward a small hole in a mask. From the mask, the waves move outward in concentric, semicircular rings. This is shown in the diagram below:



What is the name of this phenomena?

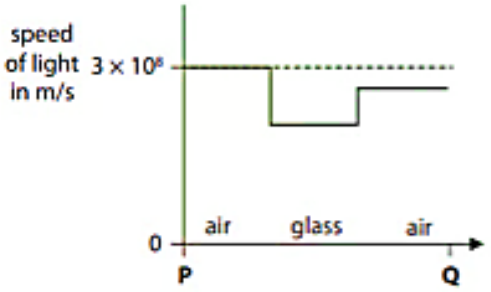
A. Reflection
B. Refraction
C. Diffraction
D. Interference

5. Light travels from **P** to **Q.**

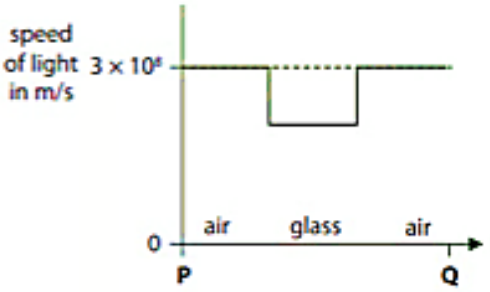


Choose the graph that best represents the speed of light as it travels from **P** to **Q**.

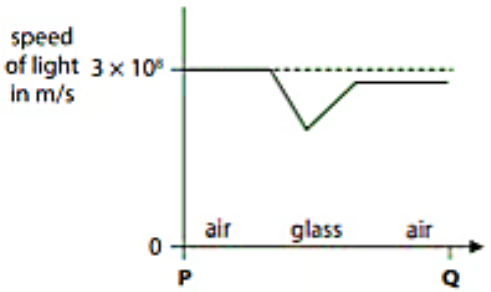
☐ A


speed
of light
in m/s
3 × 10⁸
0
air
glass
air
P
Q

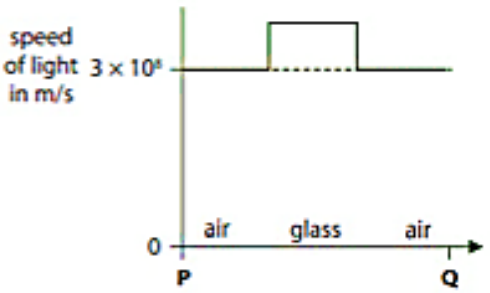
☐ B


speed
of light
in m/s
3 × 10⁸
0
air
glass
air
P
Q

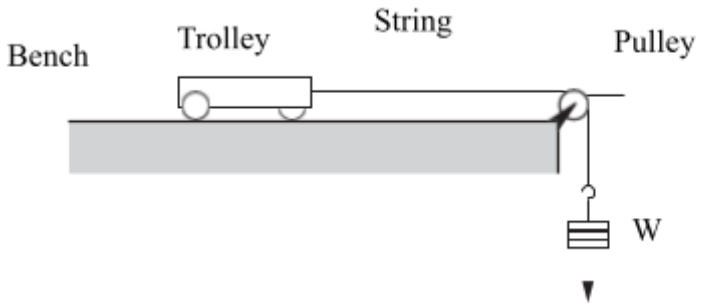
☐ C


speed
of light
in m/s
3 × 10⁸
0
air
glass
air
P
Q

☐ D


speed
of light
in m/s
3 × 10⁸
0
air
glass
air
P
Q

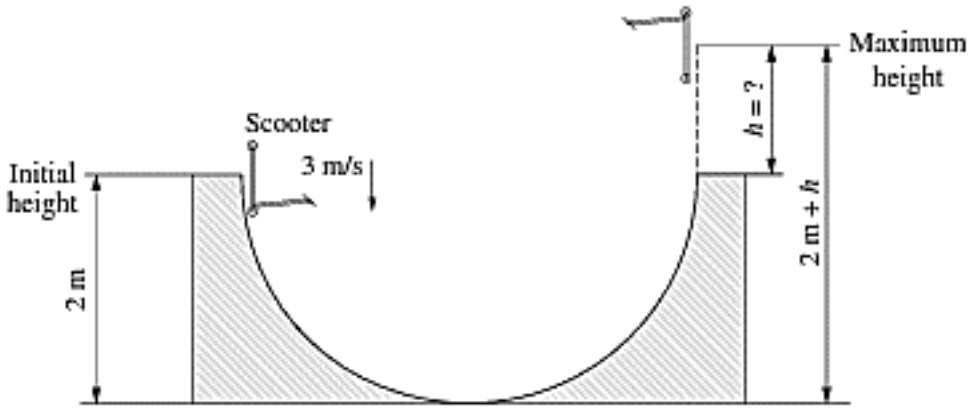
6. A trolley of mass *M* is pulled along a horizontal table by a force *W* provided by a mass hanging from the end of a string as shown.



The correct formula for the acceleration of the trolley is;

A. a = M/W
B. a = g
C. a = W/2M
D. a = W/(M + Wg)

7. A scooter and rider enter a half pipe as shown in the diagram The entry speed is 3 ms^{-1}. The scooter and the rider have a combined mass of 65 Kg.



What is the maximum height, h, the scooter and rider will reach above the other side of the pipe wall if there is no loss of energy?

A. 0.45 m
B. 2.0 m
C. 2.45 m
D. 5.45 m

8. A cathode ray oscilloscope (CRO) and microphone set up can be used to represent sound waves as longitudinal waves. The amplitude on a CRO is measured in volts because the microphone converts the sound to an electrical signal.

   A student collects two images of sounds from a CRO.

Image I

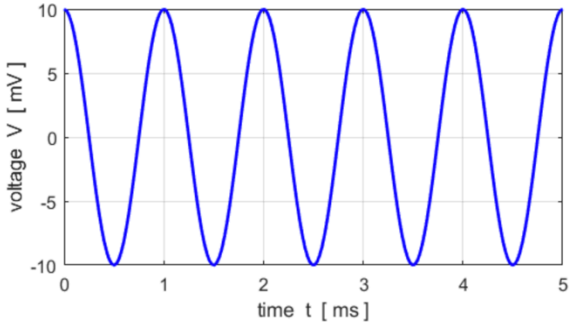
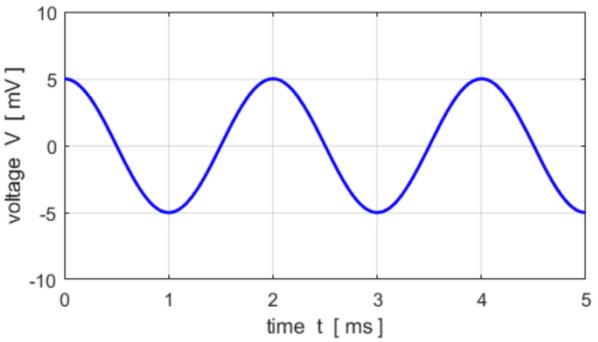


Image II



   Compare the two sounds.

   A. The sound produced by Image I is not as loud than the sound produced by Image II
   B. The sound produced by Image I has half the wavelength of the sound produced by Image II
   C. The sound produced by Image I is louder and has twice the wavelength of the sound produced by Image II
   D. The sound produced by Image I is louder and has twice the wavelength of the sound produced by Image II

9. A computer produces a signal made of two frequencies. The sound is output to a speaker. The frequencies are 440 Hz and 441 Hz.

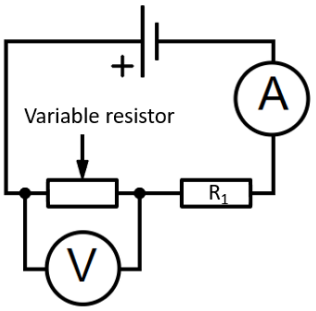
   What will be heard in the room?

   A. A lower pitch sound of 1 Hz
   B. A higher pitched sound of 881 Hz
   C. A complex sound with timbre
   D. A sound that gets louder every second

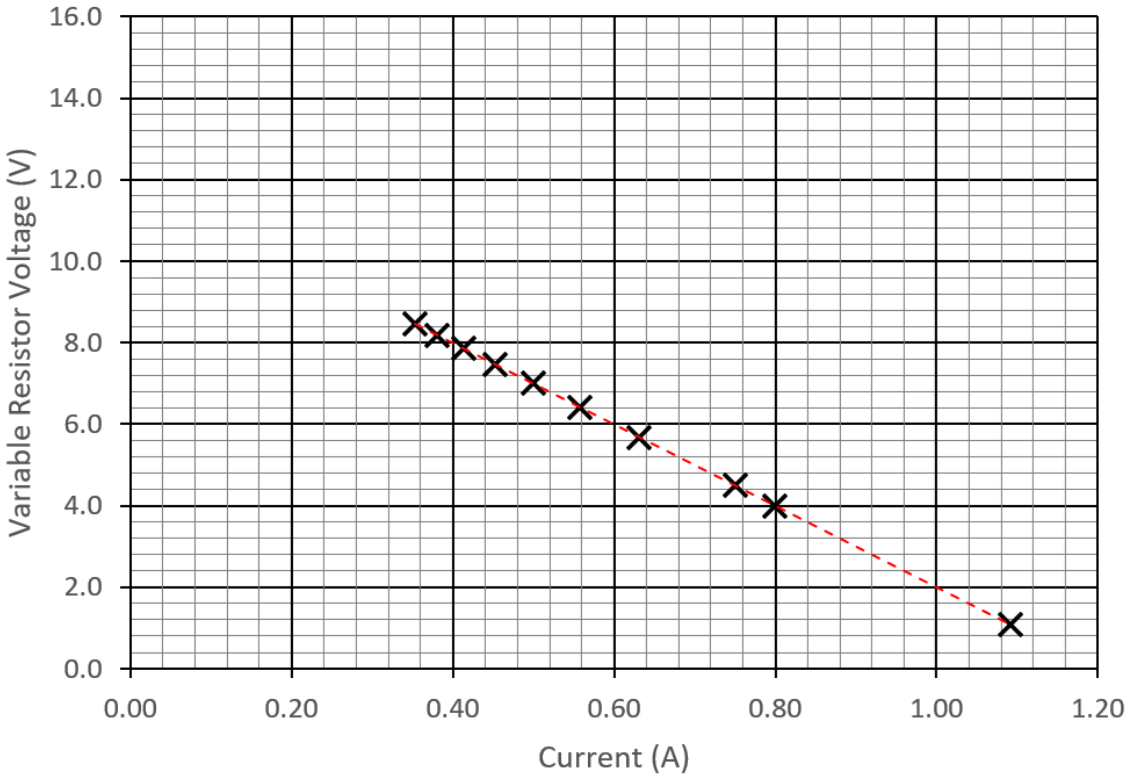
10. A ball is thrown straight up into the air with at initial velocity of 10 ms^{-1}. How much time does it spend in the air before falling back to its initial launch point?

    A. 0.51 s
    B. 1.02 s
    C. 2.04 s
    D. 2.55 s

The stimulus below applies to the following two questions. A student connected an unknown DC source to a fixed resistor that was connected in series with a variable resistor. The variable resistor had a voltmeter attached to it to measure the effects of resistance on the circuit, and ammeter was used to measure the changing current through the circuit.



The following data was collected.



11. What is the resistance value of R_1?

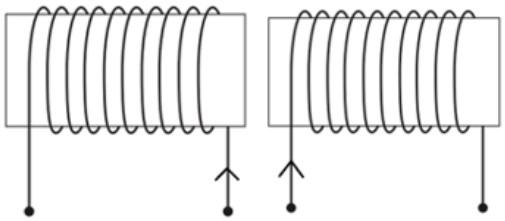
A. 16Ω
B. 10Ω
C. 4Ω
D. 0.1Ω

12. Extrapolate the value of the voltage source?

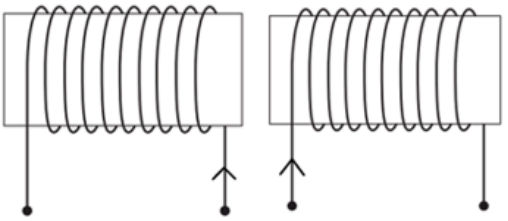
A. 16 V
B. 12 V
C. 8.4 V
D. 1.2 V

13. Which of the following solenoid pairs will result in a attraction between the solenoids?

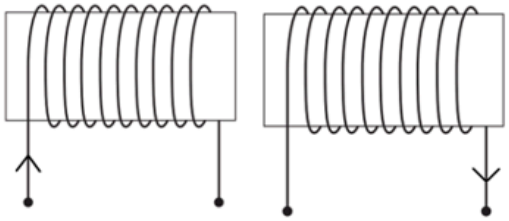
A.



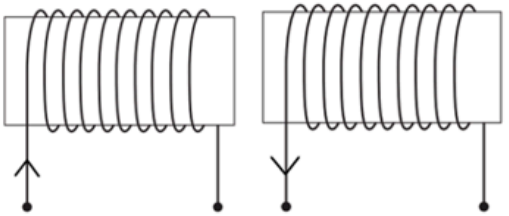
B.



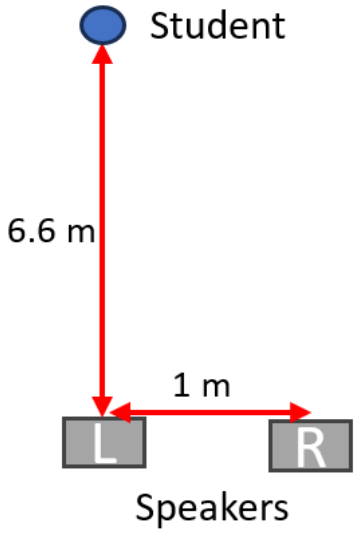
C.



D.



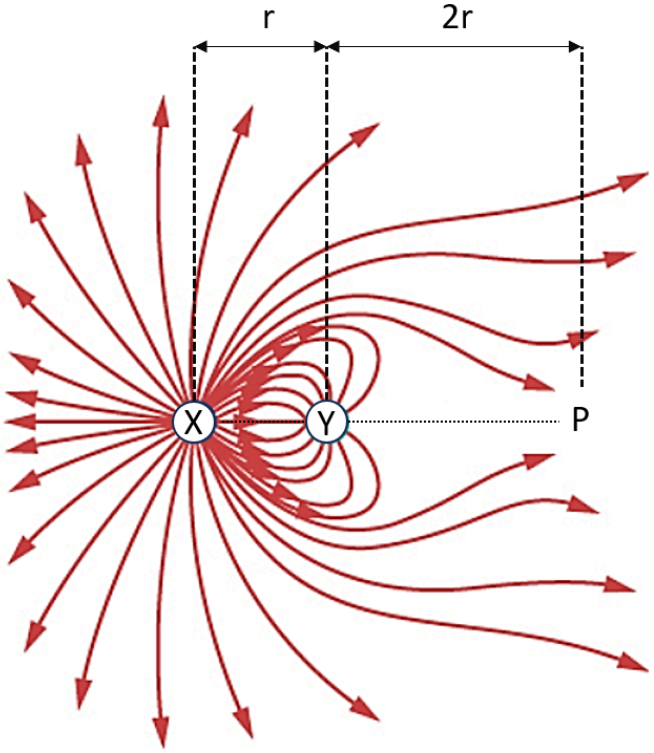
14. Sound waves are produced by two speakers. The waves are in phase with each other and have a frequency of 2300 Hz. The speakers are positioned 1 m apart. A diagram of the set up is shown below:



Take the speed of sound of air in this room is 345 ms^{-1}. A student is standing 6.6 m in front of the speaker on the left hand side of the picture, what will they hear?

A. The student will hear a lower pitch sound because the interference of the waves produced by the two speakers will decrease the frequency of the sound.
B. The student will hear a fluctuating beat frequency because the two speakers will cause beats.
C. The student will hear a louder sound because the interference of the two sound waves will produce a local maximum.
D. The student will hear a quieter sound because the interference of the two sound waves will produce a local minimum.

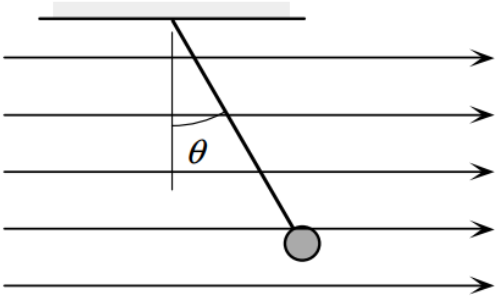
15. The following stimulus pertains to the next two questions. Two charges "X" and "Y" are separated by a distance "r". A location in space marked as point "P" is a distance "2r" away from charge "Y".



If charge "X" had a value of 5.97 x 10^{-6} C and charge "Y" had a value of 3.14 x 10^{-6} C. What charge value must be placed at point "P" in order for charge "Y" to remain static?

A. 5.98 x 10^{-5} C
B. 3.75 x 10^{-5} C
C. 2.39 x 10^{-5} C
D. 1.87 x 10^{-5} C

16. A 1 g aluminum ball with a charge of 22.5μC is hung in an electric field of 235.6 Vm^{-1}.



At what angle "θ" does the aluminum ball subtend from the equilibrium point?

A. 25°
B. 35°
C. 45°
D. 55°

2022 TRIAL HSC EXAMINATION **Multiple Choice – Answer Sheet**

Student Number.....

1.	**A** ○	**B** ○	**C** ○	**D** ○
2.	**A** ○	**B** ○	**C** ○	**D** ○
3.	**A** ○	**B** ○	**C** ○	**D** ○
4.	**A** ○	**B** ○	**C** ○	**D** ○
5.	**A** ○	**B** ○	**C** ○	**D** ○
6.	**A** ○	**B** ○	**C** ○	**D** ○
7.	**A** ○	**B** ○	**C** ○	**D** ○
8.	**A** ○	**B** ○	**C** ○	**D** ○
9.	**A** ○	**B** ○	**C** ○	**D** ○
10.	**A** ○	**B** ○	**C** ○	**D** ○
11.	**A** ○	**B** ○	**C** ○	**D** ○
12.	**A** ○	**B** ○	**C** ○	**D** ○
13.	**A** ○	**B** ○	**C** ○	**D** ○
14.	**A** ○	**B** ○	**C** ○	**D** ○
15.	**A** ○	**B** ○	**C** ○	**D** ○

See overleaf for instructions

Instructions for answering multiple-choice questions in Section I

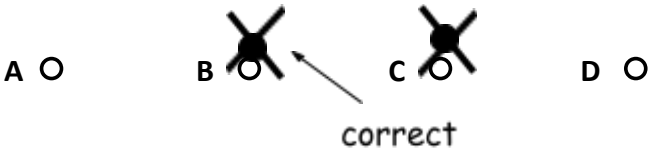
- Complete your answer in either blue or black pen
- Multiple choice

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 1: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word ***correct*** and drawing an arrow as follows.



Student Number

Physics
Section II Answer Booklet

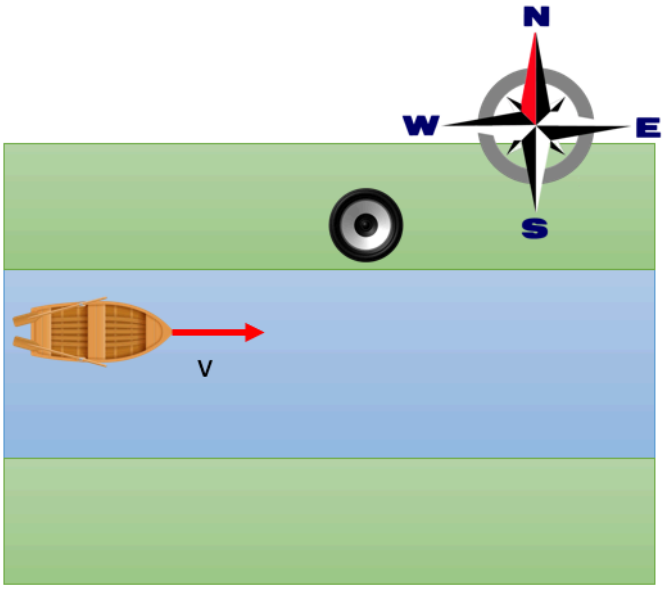
35 marks
Attempt Questions 16 – 25
Allow about 1 hours for this section.

Instructions

- Write your Student Number at the top of this page
- Answer the questions in the spaces provided.
- Show all relevant working in questions involving calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Question 16 (3 marks)

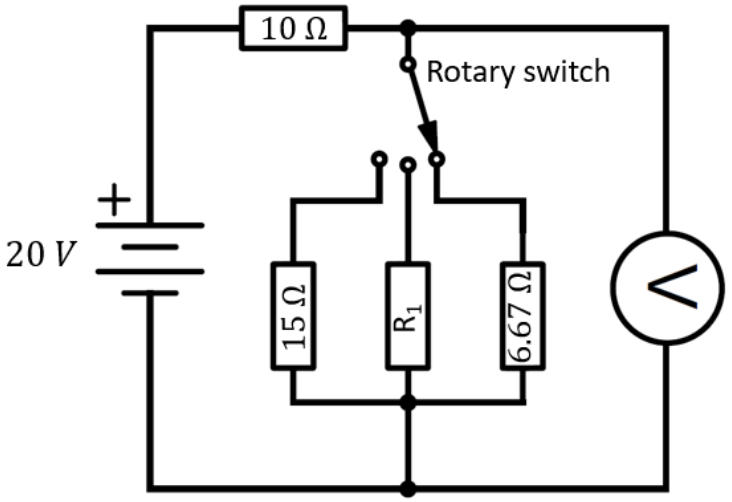
A boat sails down a river with a velocity "v" in the East direction. The boat approaches a stationary speaker resting on the riverbank that is emitting a sound with a frequency of 680 Hz. The river has a current of 10 ms^{-1} in the downstream in the East direction. As the boat approaches the speaker the frequency heard by an on-board observer is 750 Hz.



What is the boats velocity relative to the river?

Question 17 (4 marks)

The following circuit is called a circuit divider. A 10 Ω resistor is connected in series with a rotary switch that can be adjusted to connect three different resistors in order to change the voltage measured in the voltmeter.



When the switch is connected with the 15 Ω resistor the voltmeter will read a voltage of 12 V. If the switch is connected with the 6.67 Ω resistor the voltmeter will read a voltage of 8 V.

(A) What should be the value of resistor R_1 will make the voltmeter to read a value of 10 V? (2 marks)

(B) The electrical engineer does not have a 6.67 Ω resistor, they only have trays full of 10 Ω, 15 Ω, and 20 Ω resistors. What configuration of two resistors could the use to replace the missing resistor? (2 marks)

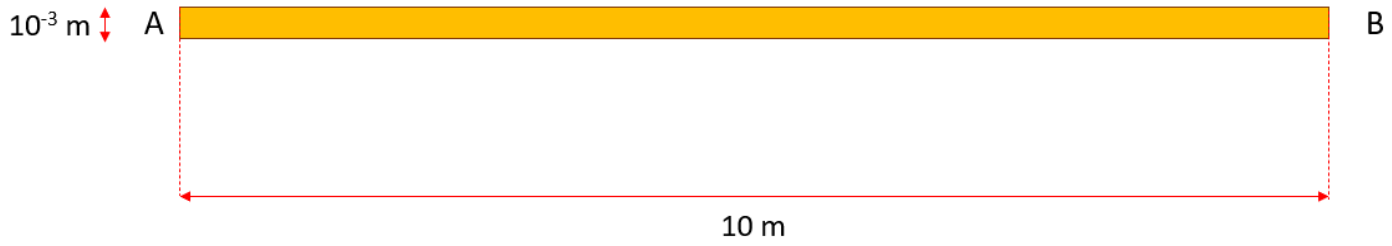
Question 18 (2 marks)

Maximum safe acceleration for the human body is widely considered to be 10g's. When designing a "safe" car what would be the minimum safe collision time for a 90kg passenger, assuming the car is travelling at 120kmh^{-1}?

Question 19 (2 marks)

A 10 m copper wire has a cross-sectional diameter of 0.001 m. It has 8 A of current flowing through it from "A" to "B".

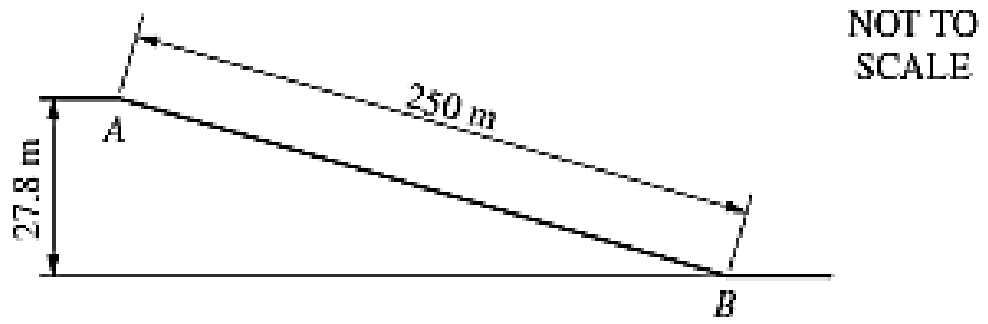
(A) Draw and annotate the diagram of the wire below to show the direction of the magnetic field around the wire. (1 mark)



(B) What is the strength of the magnetic field 1 cm away from the wire? (1 marks)

Question 20 (6 marks)

A parcel is placed at the top of an inclined plane. This is position A in the diagram. The mass of the parcel is 4.2 Kg.

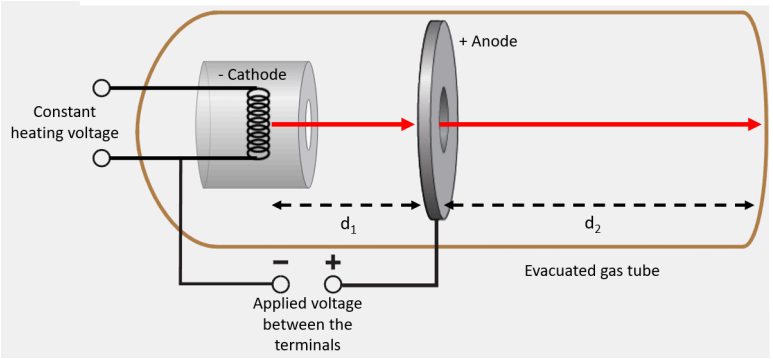


(A) Calculate the speed of the parcel at position B if the frictional force between the mass and the surface is 2 N at this angle. (3marks)

(B) At what height should the ramp be moved to in order for the frictional force to just balance the force due to gravity down the incline? (3marks)

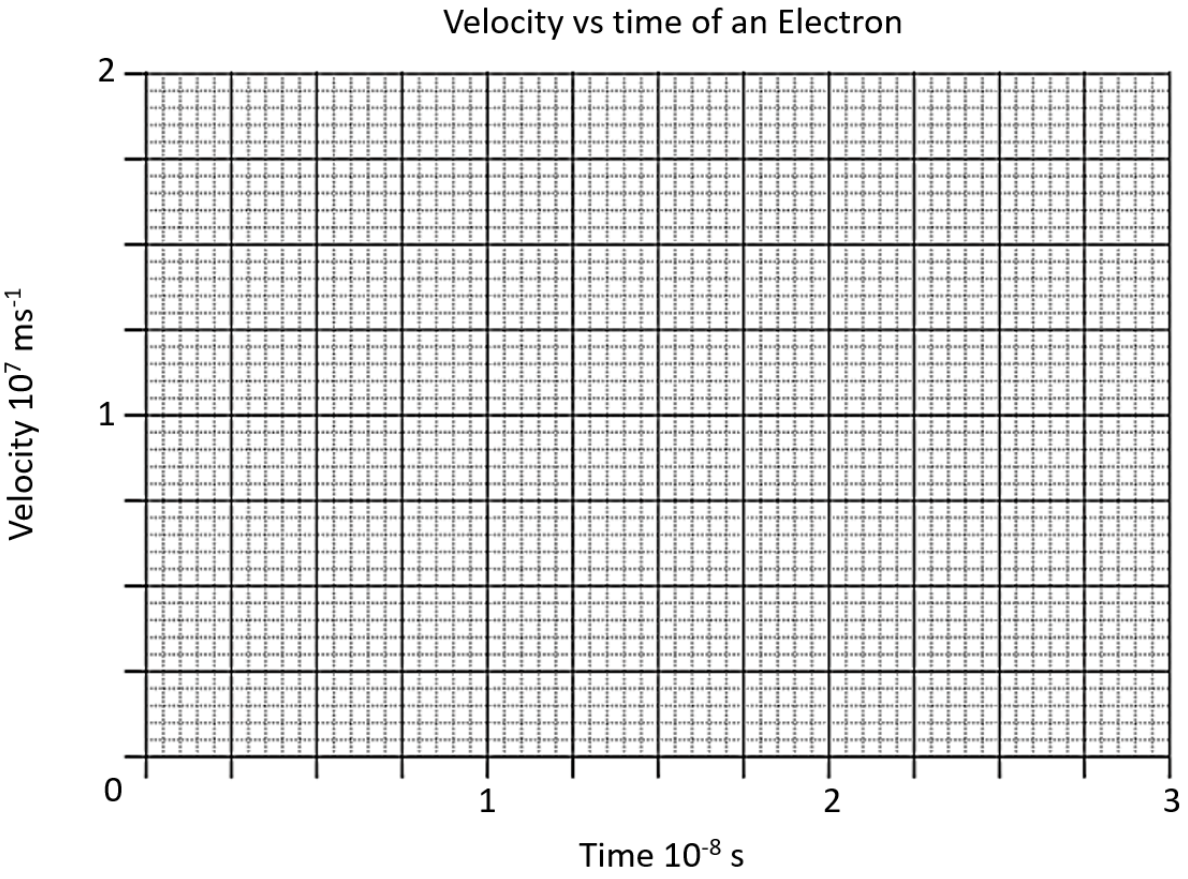
Question 21 (6 marks)

An electron gun is used to speed up free electrons released from a cathode terminal. The direction of the electron is marked with the arrows in the diagram. The electron travels through a distance d_1 then proceeds through an opening in the anode terminal a distance d_2, before colliding to the wall at the end of the evacuated gas tube.



(A) Use the data provided to create a velocity vs time graph for the electron. (2 marks)

Time 10^{-8}s	Velocity 10^{7}ms^{-1}
0.00	0.00
0.36	0.63
0.71	1.25
1.07	1.88
1.42	1.88
2.13	1.88
2.67	1.88


Velocity vs time of an Electron
Velocity 10^7 ms^{-1}
2
1
0
1
2
3
Time 10^{-8} s

(B) Use the graph to show that the size of d_1 is 0.1m (2 marks)

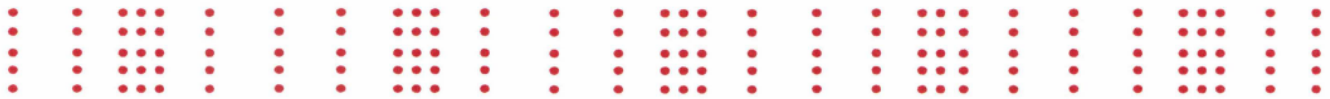
(C) What is the applied voltage between the terminals used to accelerate the electrons? (2 marks)

Question 22 (3 marks)

Two waves are shown below. Each wave is shown actual size and the diagrams also shows the time that the wave has been travelling. Analyse each diagram to determine the wavelength, frequency and velocity.

(A) Analyse the following diagram to determine the wavelength, frequency and velocity (3 marks)

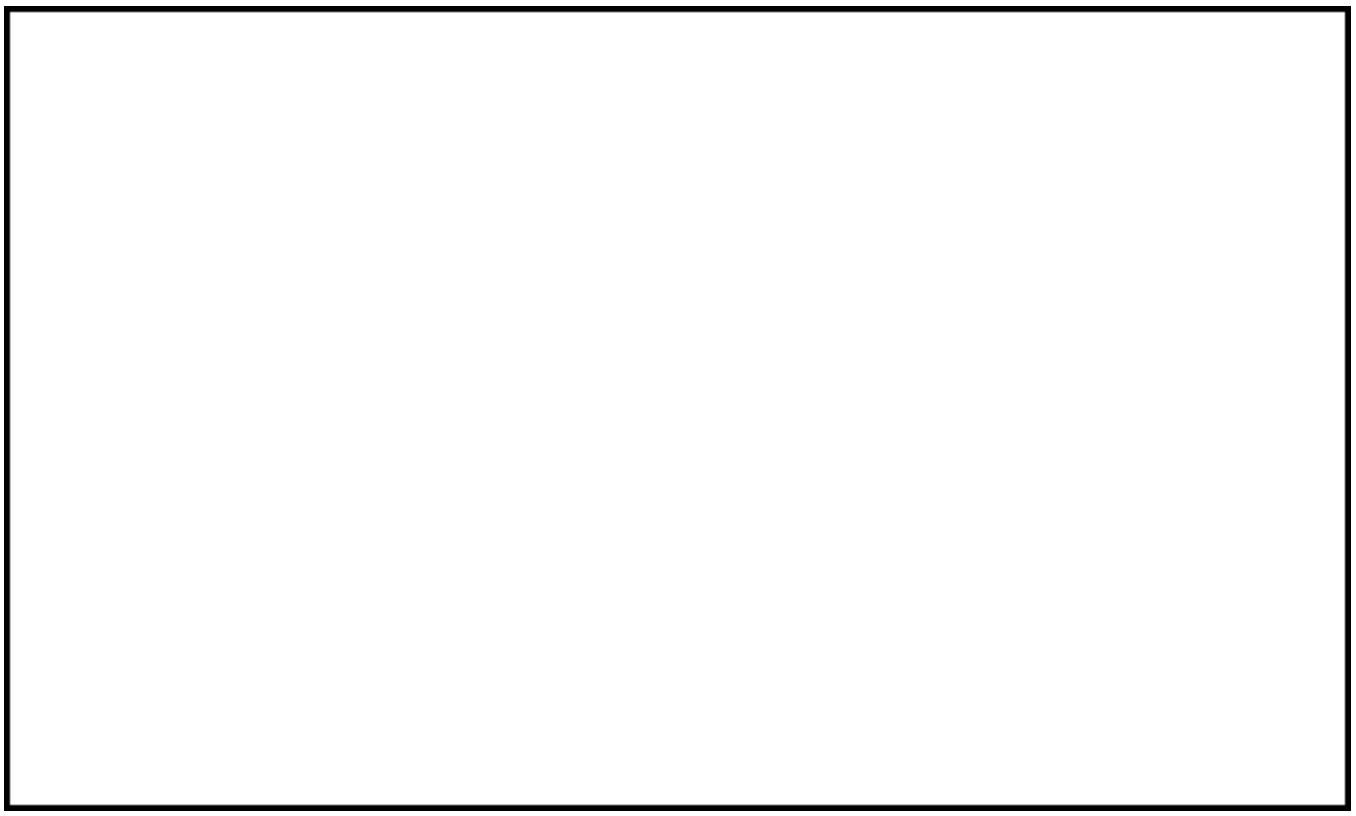
Wave A: time = 0.04S



Question 23 (3 marks)

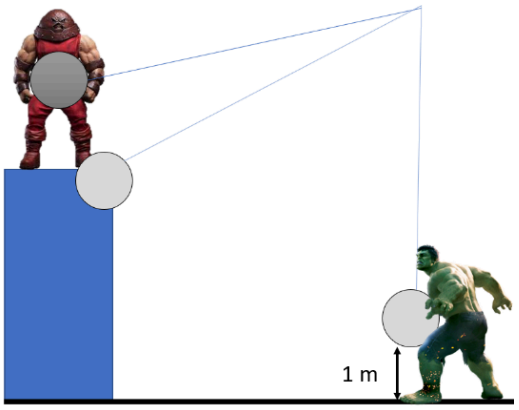
Construct a labelled diagram to demonstrate the formation of an image by a bi-concave lens with the following details:

A 3 cm tall object is placed 5 cm to the left of the biconcave lens. The focal length of the lens is 2 cm.



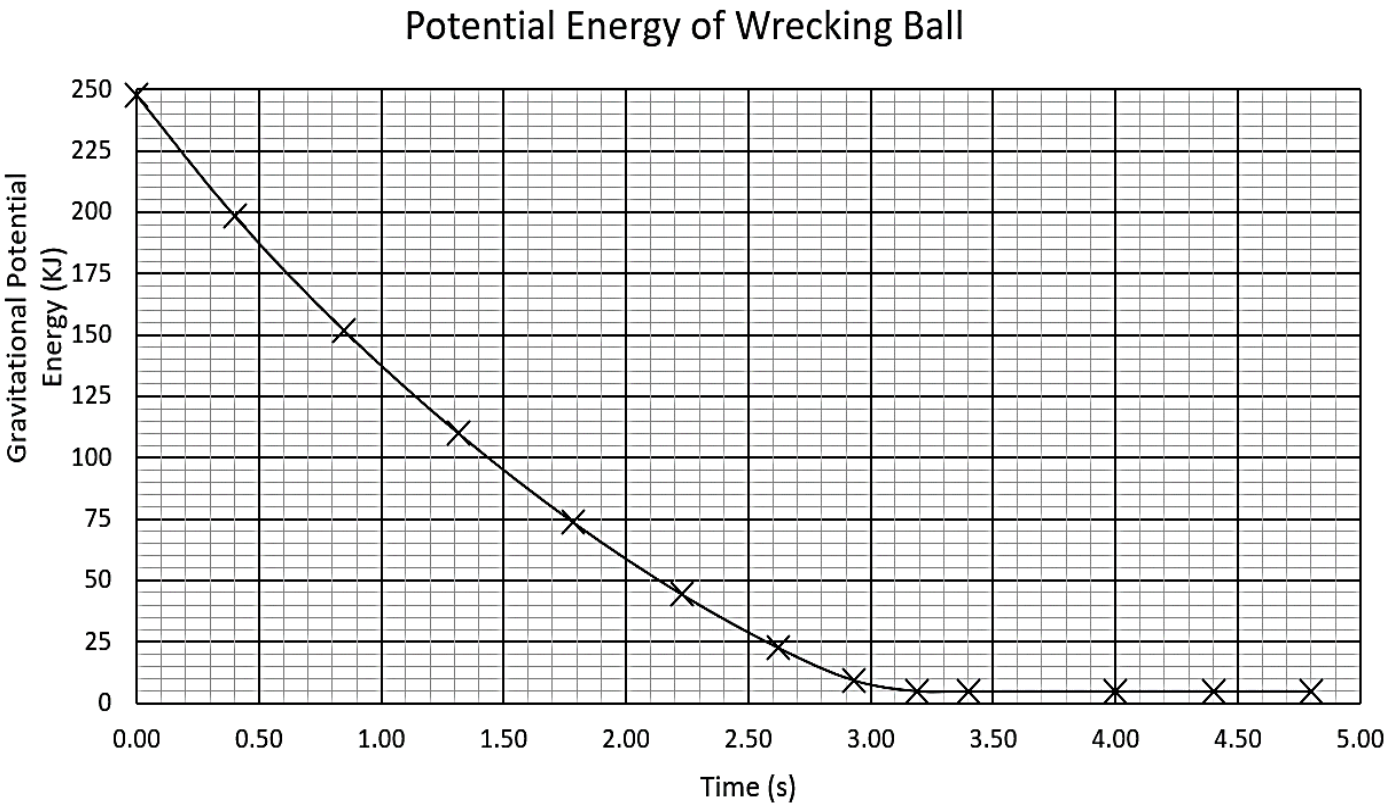
Question 24 (4 marks)

The Hulk is a superhero with a mass of approximately 635 kg. His enemy the Juggernaut is on top of a building holding 500 kg wrecking ball. The Juggernaut releases the wrecking ball directed towards the Hulk. The wrecking ball makes impact with the Hulk at the lowest part of its swing.



a

The following graph shows the change in gravitational potential energy (in kilojoules) of the wrecking ball as it swings to its impact with the Hulk. It takes the Hulk 1.6 seconds to bring the wrecking ball to a complete stop.



(A) Calculate the final velocity of the wrecking ball at its lowest point? (2 marks)

(B) What force does the Hulk apply on the wrecking ball to bring it to a complete stop? (2 marks)

Question 25 (2 marks)

The Sun's energy output is produced by nuclear fusion reactions that essentially occur at its centre, 6.9 x 10^5 km from its surface. The energy radiated per second at the surface is 6.41 x 10^7 W m^{-2}. The energy from the Sun reaching Earth per square metre at the top of Earth's atmosphere, averaging 1.5 x 10^8 km from the Sun, is known as the solar constant (I).

Calculate the Earths solar constant

End of Paper

Section II extra writing paper.
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