Student Name: _____

Class: _____

2022

YEAR 11 (PRELIMINARY) EXAMINATION

Kinematics, Dynamics, Waves and Thermodynamics, Electricity and Magnetism

Physics

General Instructions

- Reading time – 5 minutes.
- Working time – 2 hours.
- Write using black pen.
- Draw diagrams using pencil.
- For questions in Section II, show all relevant working in questions involving calculations.
- NESA approved calculators may be used.

Total marks: 75

Section I – 20 marks (pages 3 – 12)

- Attempt questions 1 – 20.
- Allow about 35 minutes for this section.

Section II – 55 marks (pages 13 – 25)

- Attempt questions 21 – 33
- Allow about 1 hour and 25 minutes for this section.

Section I – 20 marks

Attempt Questions 1-20

Allow about 35 minutes for this section

Use the multiple-choice answer sheet.

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

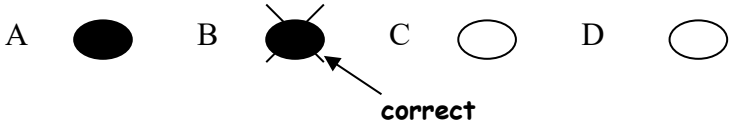
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9



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

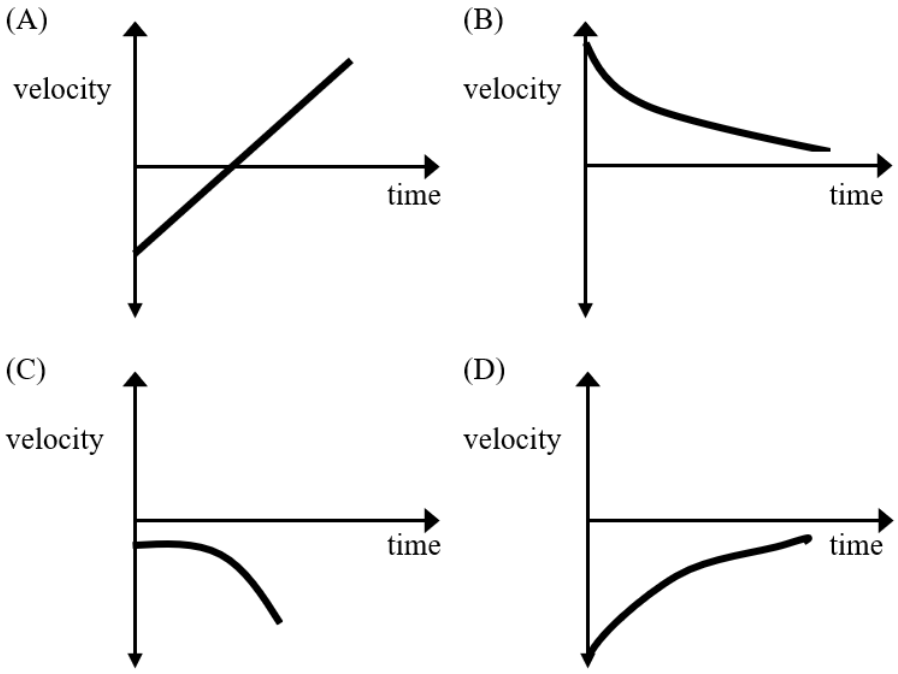


If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



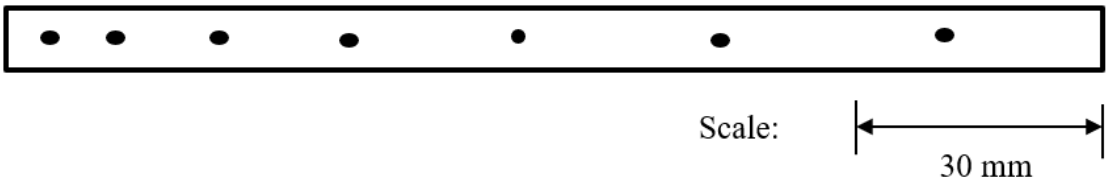
1. A vehicle is described as having a negative velocity and a positive acceleration.

Which one of the graphs below correctly displays this?



2. As a trolley moved across a desk, dots were produced every 0.10 s on a length of ticker tape to mark the trolley's position.

The segment of the tape is shown below:



During this time, the trolley's acceleration was closest to:

(A) 0.040 m s^{-2}

(B) 4.0 mm s^{-2}

(C) 0.40 m s^{-2}

(D) 1.2 m s^{-2}

3. A landing strip is being built in Antarctica. It must be sufficiently long so that a plane can reach its take-off speed of 70 m s^{-1} after accelerating at 3.0 m s^{-2} from rest.

What is the minimum length of this landing strip?

(A) 550 m

(B) 723 m

(C) 817 m

(D) 945 m

4. A large truck is travelling north at a constant speed of 20ms^{-1} and a car is travelling east at a constant speed of 30 ms^{-1} as shown by the arrows on the freeway photo below.



The velocity of the truck with respect to the car is approximately

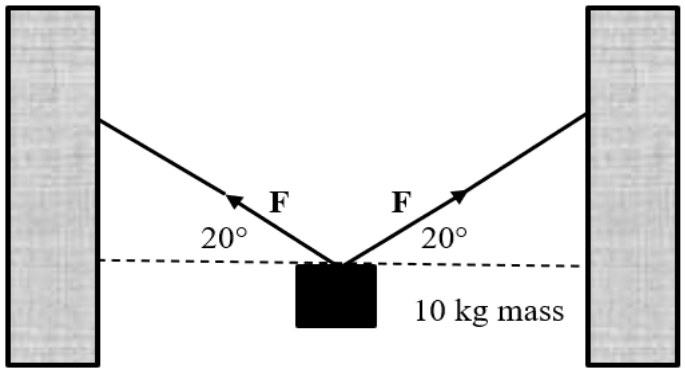
(A) NW at 36 ms^{-1}

(B) SE at 36 ms^{-1}

(C) SW at 50 ms^{-1}

(D) NE at 10 ms^{-1}

5. A 10 kg mass is suspended by two strings, as shown below.



The force applied to the mass by each of the strings, **F** is closest to:

(A) 98 N

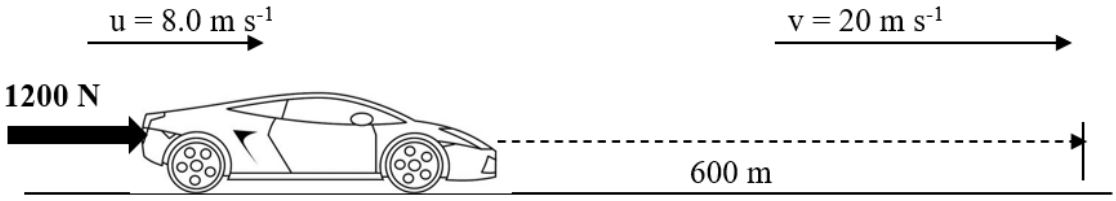
(B) 143 N

(C) 52 N

(D) 72 N

6. A 1500 kg car has a 1200 N force acting on it in the same direction as its motion. The car moves a distance of 600 m over horizontal ground while the force is acting.

The car's initial speed is 8.0 m s^{-1} and its final speed is 20 m s^{-1}.



From these data, it can be concluded that:

(A) the car's kinetic energy doubled.

(B) the work done on the car by the 1200 N force was (1200 × 12) J.

(C) the car's acceleration was 12 m s^{-1}.

(D) the work done on the car by the 1200 N force was (1200 × 600) J.

7. The crane on a small fishing boat can lift a net full of fish weighing 1.5 tonne through a vertical height of 3 metres to place the fish into the boat.



If the process takes 2 minutes, approximately what minimum power (in Watts) must the engine of the crane be able to provide?

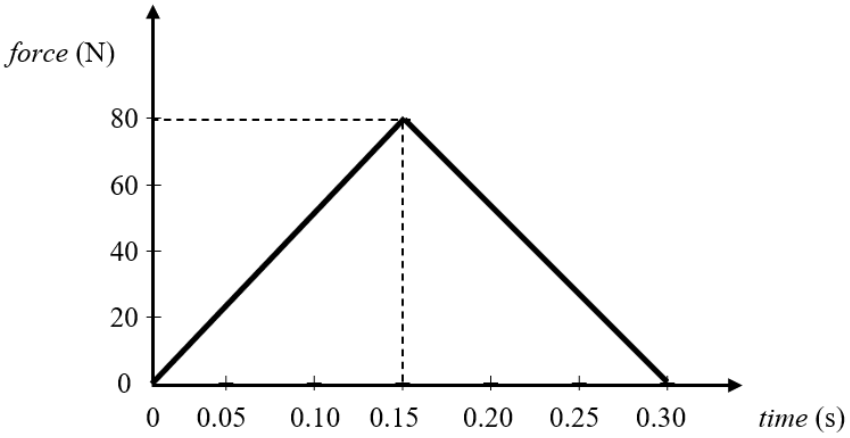
(A) 0.37 W

(B) 22 W

(C) 220 W

(D) 370 W

8. The force applied to a 0.200 kg ball is plotted against time, as shown below.



The magnitude of the change in the velocity of the ball caused by the application of this force is:

(A) 12 m s^{-1}

(B) 120 m s^{-1}

(C) 60 m s^{-1}

(D) 24 m s^{-1}

9. A 1300 kg car is moving to the right at 25 m s^{-1} when it collides head-on with a 15000 kg truck moving to the left at 14 m s^{-1}. The vehicles move off together after they collide.

Which of the alternatives is correct?

(A) Kinetic energy is gained.

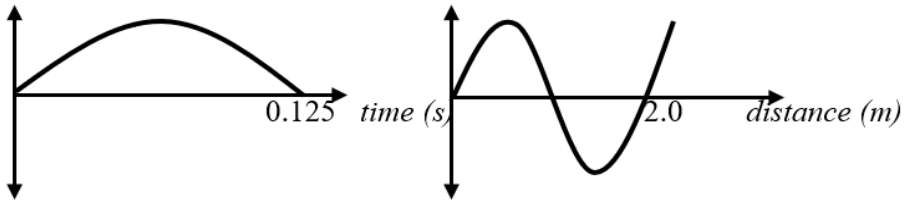
(B) Kinetic energy is lost.

(C) The collision is elastic.

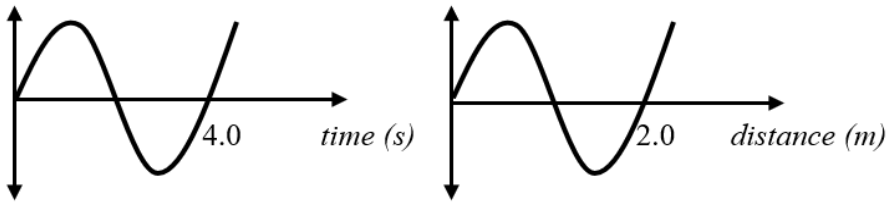
(D) Momentum is not conserved.

10. Which pair of graphs depicts a wave with a velocity of 10 m s^{-1}?

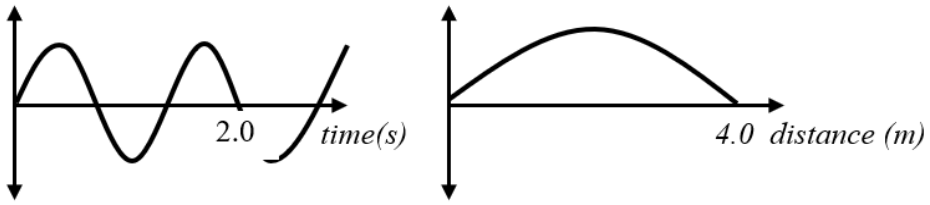
(A)



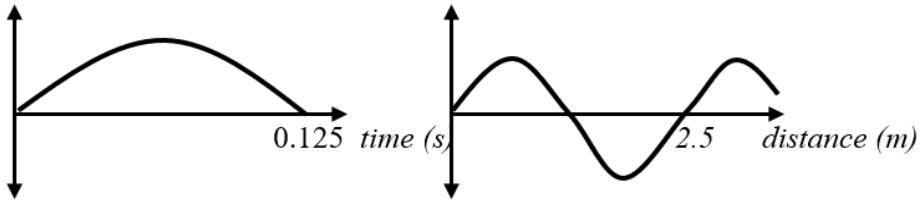
(B)



(C)



(D)



11. Which combination of driving frequency and natural frequency of an oscillating system will result in resonance?

	Driving frequency (Hz)	Natural frequency (Hz)
(A)	40	40
(B)	40	20
(C)	20	5
(D)	40	60

12. A child pushes their toy car (mass of 200g) across a room with a horizontal floor. If the car is released with a speed of $2ms^{-1}$ and travels 2.5 metres before coming to rest, the value of the average frictional forces on the car while it is rolling to a stop is



(A) 1.25 N

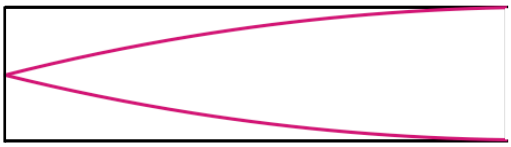
(B) 0.8 N

(C) 0.16 N

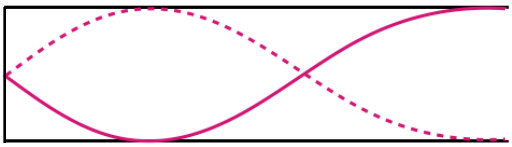
(D) 0 N

13. For the four closed air columns shown below, which shows a wave with a third harmonic?

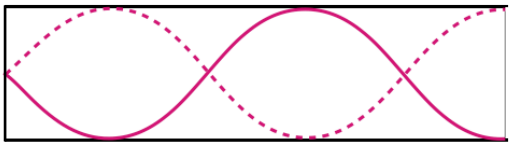
(A)



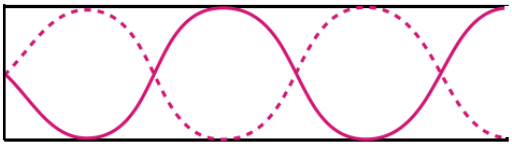
(B)



(C)



(D)



14. When viewed from the same distance, lamp **A** appears to be 9 times more intense than lamp **B**.

Which combination of distances must these two lamps be viewed from so that they appear equally bright?

	Distance to lamp A (m)	**Distance to lamp B (m)**
(A)	36	4
(B)	27	9
(C)	4	12
(D)	3	27

15. 200.0 g of an unknown pure liquid has 1.200 kJ of heat energy added to it.

The initial temperature of the liquid was 20.00 °C. Its final temperature is 22.44 °C.

The specific heat capacity values for several liquids are listed in the table below.

liquid	**specific heat capacity ($J\ K^{-1}\ g^{-1}$)**
water	4.18
ethanol	2.46
methanol	2.53
hexane	2.26

What is the unknown liquid?

(A) water

(B) ethanol

(C) methanol

(D) hexane

16. A Perspex rod is rubbed with a piece of silk cloth and becomes positively charged. When the charged Perspex rod is placed near a narrow stream of water coming from a laboratory tap, the stream of water moves towards the Perspex rod.

Which of the following represents the best explanation?

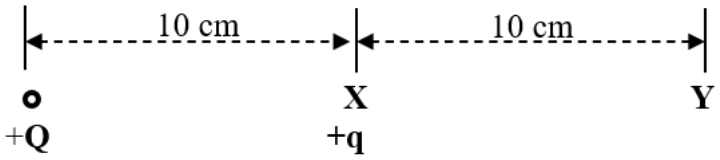
(A) Electrons are removed from the Perspex by the silk. Protons in the water molecules are attracted to the charged Perspex.

(B) Protons are removed from the silk by the Perspex. Negatively charged water molecules are attracted to the positively charged Perspex.

(C) Rubbing produces positive charges on the Perspex and silk cloth. Electrons in the water molecules are attracted toward the positive charge.

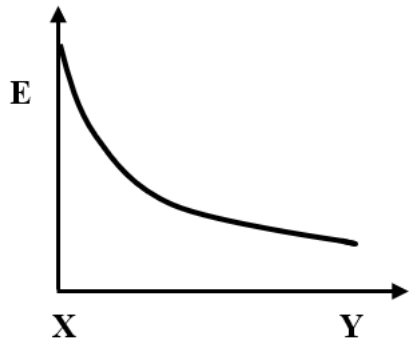
(D) Electrons are removed from the Perspex by the silk. Neutral water molecules are attracted towards the charged rod.

17. A point charge, +**q**, is moved from position **X** to **Y** in a region where an electric field exists due to another charge, +**Q**, as shown in the diagram:

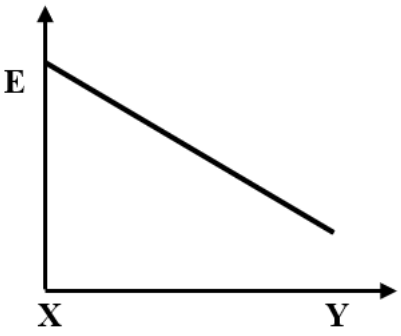


Which of the graphs below best shows how the electric field strength, **E**, changes as the charge +**q** moves from **X** to **Y**?

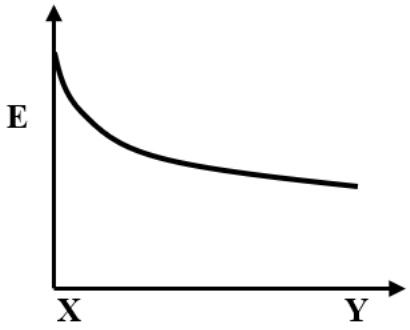
(A)



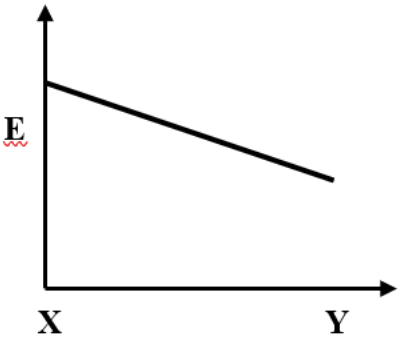
(B)



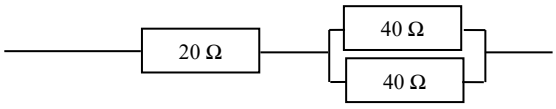
(C)

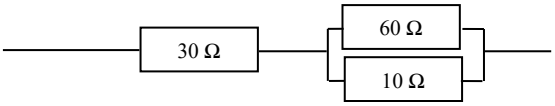


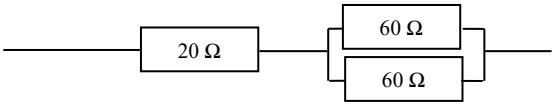
(D)

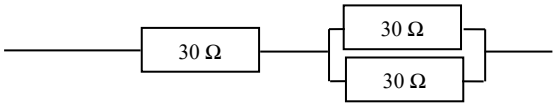


18. Which of the following combinations of resistors will have the least resistance?

(A) 

(B) 

(C) 

(D) 

19. A 25 V potential difference is applied across a 30 cm length of wire with a resistance of 5.0 Ω.

How many electrons would pass a point in the wire in 15 seconds?

(A) 4.7×10^{20}

(B) 7.8×10^{20}

(C) 1.6×10^{20}

(D) 3.1×10^{19}

20. What is the magnetic field intensity inside a solenoid which is 280 mm long, has 500 turns of wire and a current of 2.5 A flowing through the turns?

(A) 5.6×10^{-6} T

(B) 0.45 T

(C) 1.4×10^{-3} T

(D) 5.6×10^{-3} T

2022

YEAR 11
(PRELIMINARY)
EXAMINATION

Physics

Section II
Answer Booklet

55 marks

Attempt Questions 21 – 32

Allow about 1 hour and 25 minutes for this part

Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- 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 questions you are answering.

Marks

Question 21 (5 marks)

(a) Outline a safe procedure for an investigation with an aim to calculate the acceleration due to gravity using a falling mass. Include any required measurements and formulae needed. **3**

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(b) Identify *one* potential source of error in the investigation and describe how this error would affect the value of "g" obtained in the investigation. **2**

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Marks

Question 22 (4 marks)

The following is a student's description of the motion of a person who rode a push bike on a large flat concrete area.
The trip can be divided into three parts.
Part 1: The person got on the bike and rode 50 meters north taking 10 seconds.
Part 2: When the person reached the 50 m mark, they made a sharp turn and headed East and rode for 20 seconds at a constant speed of 4 ms^{-1}.
Part 3: The person then – without stopping – rode the bike directly back to the starting position and stopped.

(a) Calculate the average speed of the person on the push bike during Part 1 of the trip. **1**

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(b) Use a vector diagram and calculations to determine the direction and distance that the person needed to travel during Part 3 of the trip. **3**

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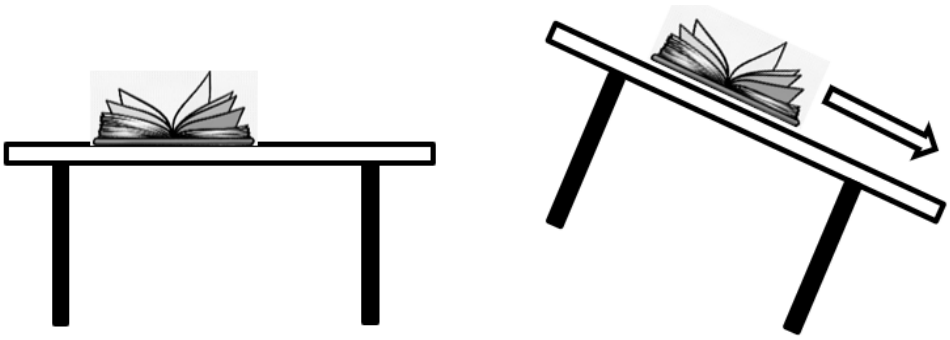
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Marks

Question 23 (3 marks)

In an investigation into the motion of objects sliding down inclined planes, a book was placed on a desk. The desk was then gradually tilted until at a certain angle, the book just began to slide.



It was observed that the book accelerated as it slid down the tilted desk, even though the desk was not tilted any further.

(a) What can be concluded about the direction of the net force acting on the book as it slides down the tilted desk? **1**

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(b) From the time it started to move, the book took 1.25 s to slide 80 cm. **2**

What was its acceleration during this time?

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Marks

Question 24 (5 marks)

(a) Calculate the work done on a 75.0 tonne aeroplane that starts from rest on the ground and some time later is flying with a speed of 240 m s^{-1} at a height of 3.00 km. Ignore any friction. **3**

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(b) When flying at a constant speed and height, the thrust from the aeroplane's engines is 25 kN. What is the resistance force acting on the aeroplane at this time, and explain how this can be known? **2**

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Marks

Question 25 (4 marks)

Two identical 1400 kg cars travelling at 90 km h^{-1} in opposite directions collide head-on and then re-bound with exactly half of their original speeds.

(a) Is this collision elastic or inelastic? Give your reasons. **1**

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(b) Given that the cars were in contact with each other for a total of 0.40 s, calculate the average force that acts on each car whilst they are in contact. **3**

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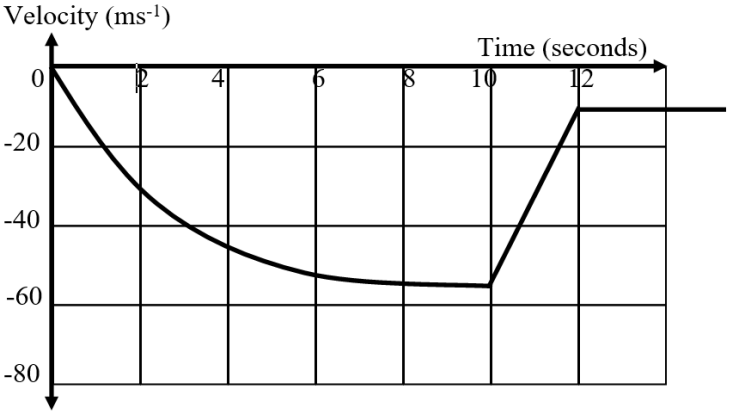
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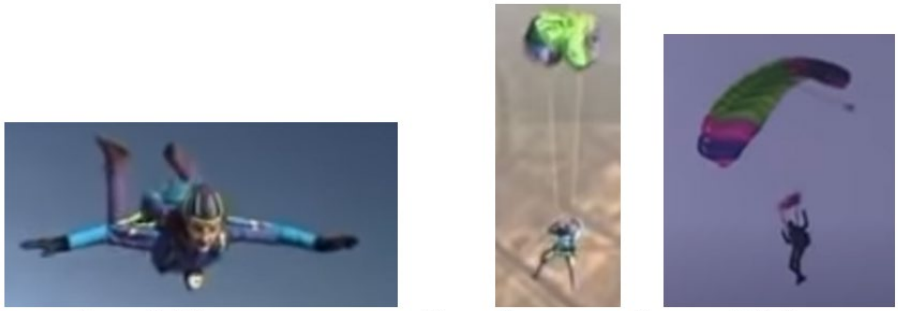
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Marks

Question 26 (4 marks)

The graph below is a velocity vs time graph for a skydiver. The images below the graph show three parts of the journey that match the three sections of the graph.





Free falling Parachute opening Gliding

(a) Use the graph to estimate how far the skydiver fell before opening the parachute. **2**

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(b) Determine the average acceleration of the skydiver while the parachute was opening. **1**

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(c) If the total mass of the skydiver and parachute is 100kg, determine the maximum upwards force provided by air resistance during the freefall section of the skydive. **1**

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Marks

Question 27 (5 marks)

Some students wanted to determine the temperature of the flame of a Bunsen burner. They heated a 25.0g piece of copper by holding it in the flame using metal tongs (see Figure 1).

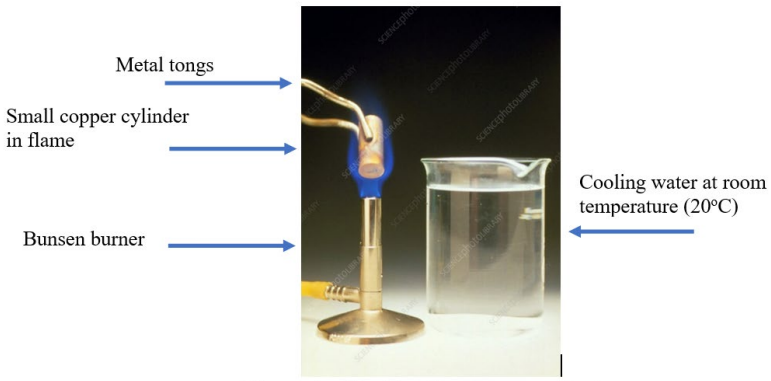


Figure 1 - Heating the copper cylinder

The heated copper was then quickly placed into a measured amount of water in a calorimeter (see Figure 2).

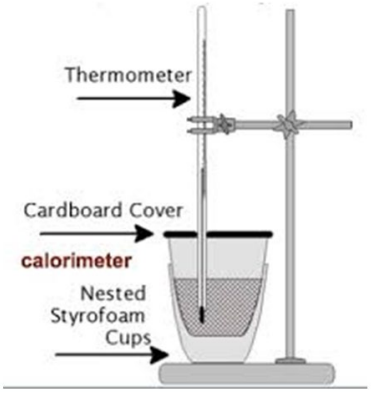


Figure 2 – the calorimeter containing 200.0 mL of water

When the heated copper cylinder was placed into the calorimeter, the temperature of the water increased by 10.5°C.

(a) Calculate the amount of energy absorbed by the water in the calorimeter. **1**

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Marks

(b) The small copper cylinder had a mass of 25.0 g and a specific heat capacity of 390 J kg^{-1} K^{-1}. Determine an approximate temperature for the flame by calculating the change in temperature of the heated copper. **2**

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(c) Explain how one feature of the experiment shows that the students were striving for *valid* results? **1**

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(d) Describe one way in which the *reliability* of the results could be improved. **1**

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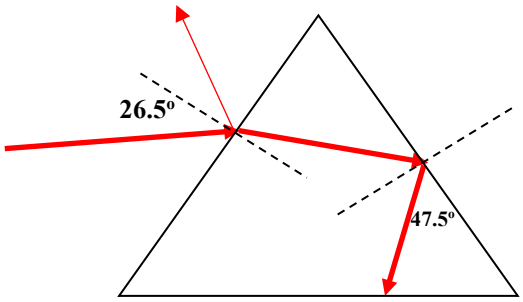
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Marks

Question 28 (4 marks)

Students directed a narrow beam of red light with a frequency of 4.3×10^{14} Hz, towards an equilateral (3×60^{o}) triangular glass prism on a laboratory bench as shown in the sketch below:

(View from above – not to scale)



Part of the beam was reflected from the surface but most of the light passed into the glass prism. The prism was slowly rotated until the light that entered the prism was completely reflected from the inside surface on the opposite side as shown above, and the two angles shown were recorded.

(a) Determine the wavelength of the red light before it enters the glass prism. **1**

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(b) Determine the critical angle for the red light and use it to calculate the refractive index for the glass prism. **2**

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(c) *On the diagram above* - draw the path of the light as it leaves the prism. **1**

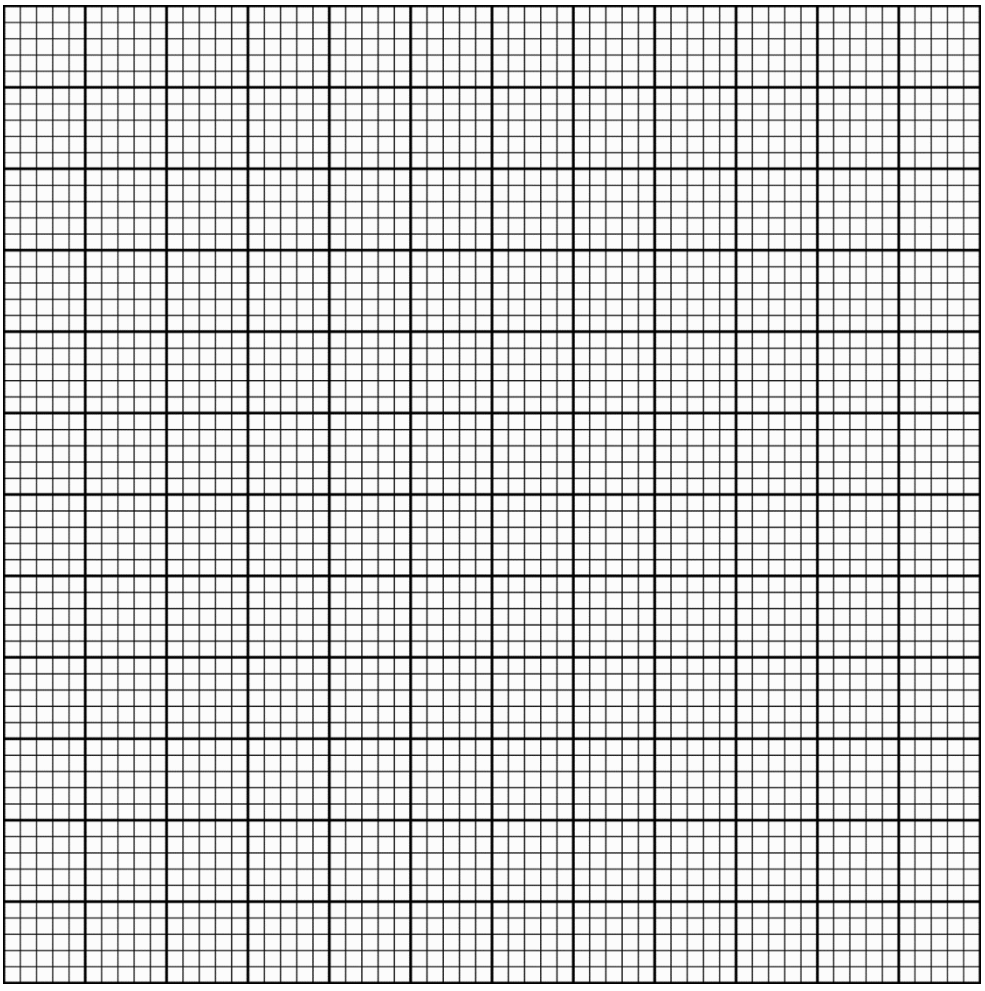
Question 29 (6 marks) **Marks**

A student set up a Perspex block and angled a ray of light into the block to find the refractive index (RI) of the block. The angle of incidence and angle of refraction was measured for 5 different angles. The RI of air is 1.00.

	Angle of incidence (°)	Angle of refraction (°)	Sin θ_1	Sin θ_2
1	54	33		
2	73	40		
3	61	35		
4	35	17		
5	10	7		

(a) Fill in the missing calculations in the table. **1**

(b) Graph the appropriate columns and use the line of best fit to find the RI of the Perspex. **3**



-Question 29 is continued on the next page-

Marks

(c) Use your line of best fit to calculate the RI of Perspex. Show all working. **2**

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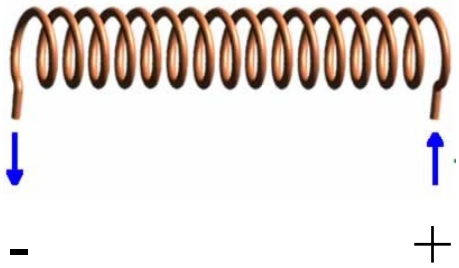
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Question 30 (6 marks)

The diagram below represents a solenoid (actual size).

(a) Add lines to the diagram to represent the shape and direction of the magnetic field inside and around the solenoid when a direct current is running through the wires in the direction shown. **3**



(b) On the diagram above (in part (a)) label the North end of the solenoid when the current is running in the direction shown. **1**

(c) Calculate the magnetic field strength inside the solenoid (shown above) when a direct current of 3.5 amperes is flowing through the coils. **2**

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Marks

Question 31 (4 marks)

(a) Calculate the work done in moving a +3.60 mC charge through a potential difference of 160 V. **2**

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(b) The same +3.60 mC charge now experiences a force of 5.40 x 10^{-6} N due to the proximity of another charge 50.0 mm away.

What is the magnitude of this other charge? **2**

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Marks

Question 32 (5 marks)

A rooftop solar panel installation produces a constant 5.0 kW of electrical power for 4.0 hours every day.



(a) (i) How many kilowatt-hours of energy are produced by the solar panels in one week? **1**

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(ii) How many joules of energy is this? **1**

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(b) When the solar panels are generating 5.0 kW of power, the voltage is 400 V. **1**

What current is flowing at this time?

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(c) The solar panels are 20% efficient at converting sunlight into electrical energy. **2**

Given that the incident solar intensity is 1.00 kW m^{-2}, what is the area of the solar panel installation?

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