

Prairiewood High School

2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used

Total marks:
100

Section I – 20 marks (pages x–xx)

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

Section II – 80 marks (pages xx–xx)

- Attempt Questions 21–xx
- Allow about 2 hours and 25 minutes for this section

Section I

20 marks

Attempt Questions 1–20

Allow about 35 minutes for this section

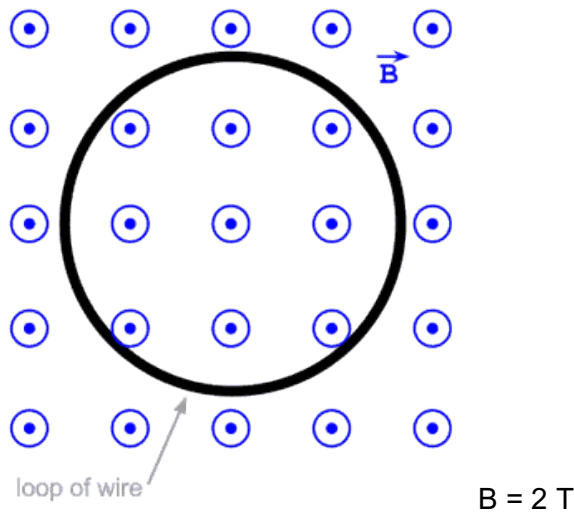
Use the multiple-choice answer sheet for Questions 1–20.

- 1 A conductor of length 12.0 cm carries a current of 40 mA in a magnetic field of strength 0.50 T and makes an angle of 45° with the field. The force experienced on the conductor is:
- A) 1.7 N
B) 2.4 N
C) 1.7×10^{-3} N
D) 2.4×10^{-3} N
- 2 A projectile is fired from ground level at an angle of elevation of 50 degrees. It lands 200 metres away after 2.4 seconds.

What was the initial velocity of the projectile?

- A) 83 ms^{-1}
B) 99 ms^{-1}
C) 109 ms^{-1}
D) 130 ms^{-1}

- 3 Calculate the magnetic flux of the situation in the diagram below if the radius of the circle is 8 cm:



- A) 0.02 Wb
 B) 0.04 Wb
 C) 0.5 Wb
 D) 200 Wb
- 4 Hubble's astronomical observations provided evidence which supported the Big Bang Theory. What did Hubble observe?
- A) Galactic Red Shift
 B) Galactic Blue Shift
 C) Abundance of light elements
 D) Microwave Background Radiation
- 5 Tomas is looking through the window of his hotel at the ocean. The hotel window is polarised and he is wearing a pair of sunglasses that are also polarised but at an axis 45° from that of the window. Given the light entering the window has an intensity of I_0 , what is the intensity of the light as seen by Tomas?
- A) $0.25 I_0$
 B) $0.45 I_0$
 C) $0.50 I_0$
 D) $0.75 I_0$

6 A car is travelling at constant speed on a circular track.

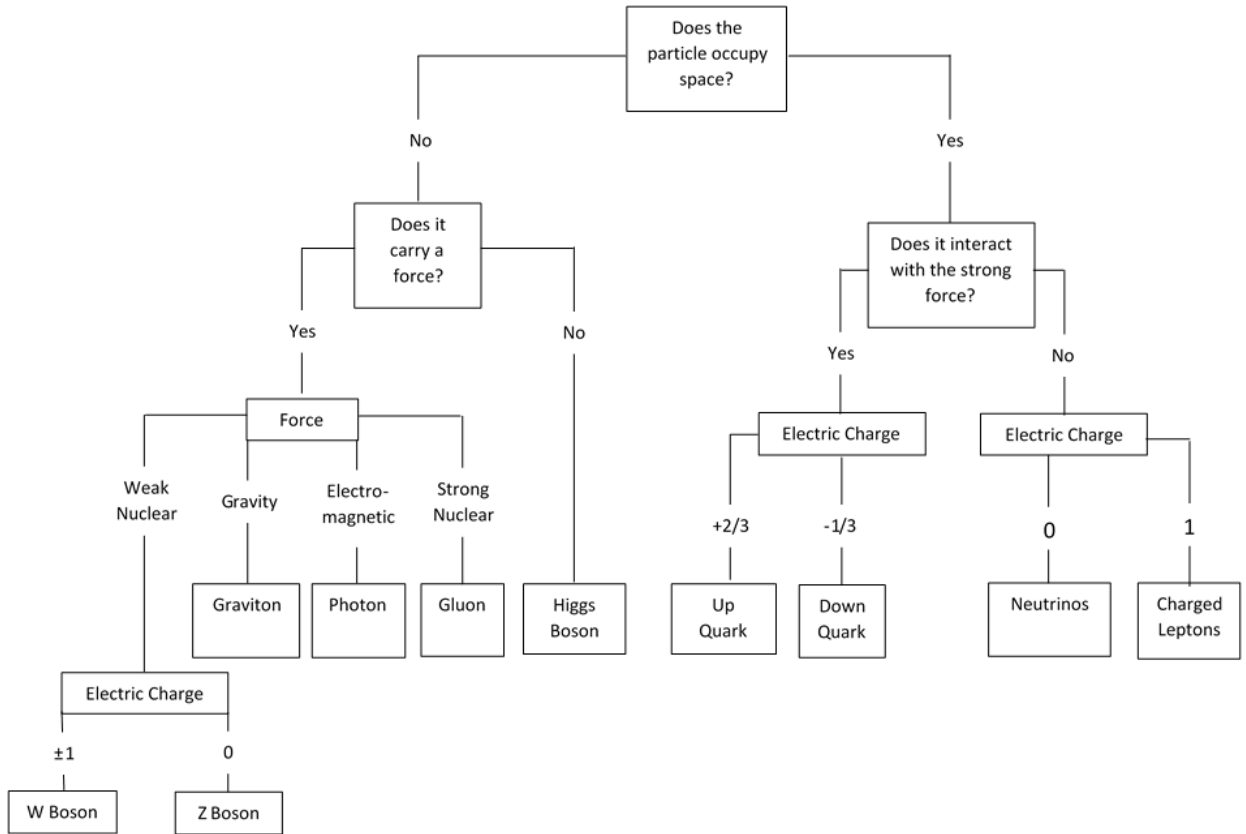
Which of the following correctly describes the acceleration of the car?

	Magnitude	Direction
A)	is constant	is constant
B)	is constant	changes
C)	changes	is constant
D)	changes	changes

7 Scientists send an expedition to a comet that is travelling at 90% of the speed of light. According to the scientists on Earth, the expedition members are experiencing:

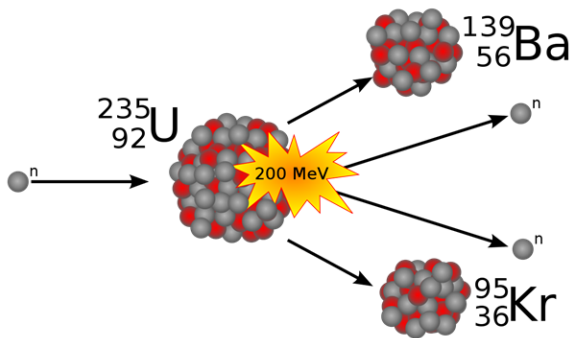
	Time	Mass	Size
A)	Moving slower	Decreasing	Decreasing
B)	Moving faster	Increasing	Increasing
C)	Moving slower	Increasing	Increasing
D)	Moving faster	Decreasing	Decreasing

8 Use the flowchart below to identify a particle which doesn't take up space, carries the weak nuclear force and has no electric charge.



- A) Photon
- B) Z Boson
- C) Graviton
- D) W Boson

9 Identify the type of nuclear reaction shown in the diagram below.

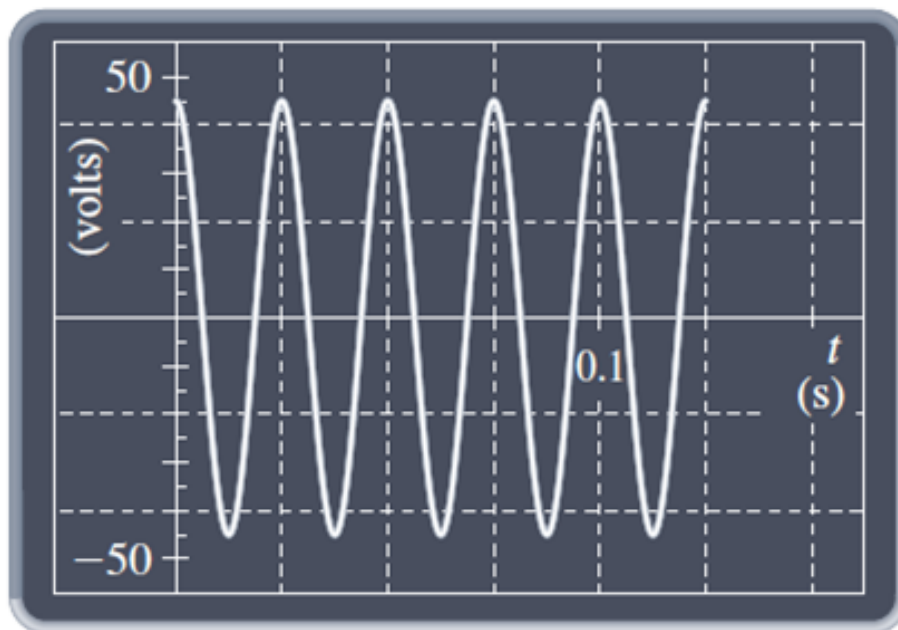


- A) Beta Decay
- B) Alpha Decay
- C) Fusion Reaction
- D) Fission Reaction

10 How much work is done on an electron being accelerated between two charged plates with a voltage drop of 20 V?

- A) 8.0×10^{-19} J
- B) 3.2×10^{-18} J
- C) 6.4×10^{-18} J
- D) 8.0×10^{-17} J

11 The image below shows an oscilloscope reading of an electric generator. The frequency is:



- A) 4 Hz
- B) 8 Hz
- C) 20 Hz
- D) 40 Hz

- 12 JJ Thomson's charge-to-mass ratio experiment required both Magnetic and Electric Deflecting Coils to solve the equation,

$$\frac{q}{m} = \frac{v}{Br}$$

Use the table below to match the type of field with the equation it satisfies in order to find the charge-to-mass ratio.

	Electric Field	Magnetic Field
A)	$F_E = qE$	$F_B = qvB$
B)	$E = \frac{V}{d}$	$F_c = \frac{mv^2}{r}$
C)	$E = \frac{V}{d}$	$F_B = qvB$
D)	$F_E = qE$	$F_c = \frac{mv^2}{r}$

- 13 Two satellites (Gemini and Aries) are in circular orbits around the Earth.

Aries is R metres from the centre of the Earth and has an orbital velocity of V.

Gemini is 2R metres from the centre of the Earth. What is Gemini's orbital velocity?

- A) V/2
- B) 2 x V
- C) V/1.4
- D) 1.4 x V

- 14 A scientist while calibrating a spectrometer attached to a telescope records the

observed Hydrogen α line in the Balmer series with a wavelength of 656.28 nm. Later a star is observed and its spectrum analysed and the Hydrogen α line in this spectra is recorded as 680 nm. Which of the following is true?

- A) The star is blue-shifted and moving towards us
- B) The star is red-shifted and is moving towards us
- C) The star is red-shifted and is moving away from us
- D) The star is blue-shifted and is moving away from us

15 Ultraviolet light with a wavelength of 2×10^{16} Hz falls on a material which then emits photons with an energy of 3.98eV. What was the material? Assume Planck's constant is 4.14×10^{-15} eV.

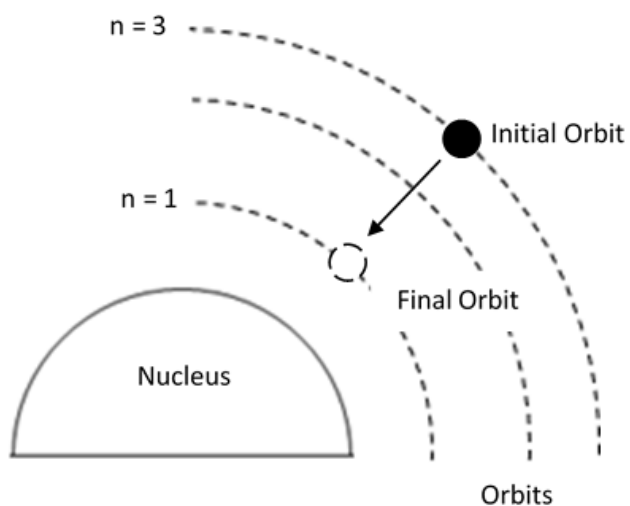
- A) Zn with a work function 4.3
- B) Cu with a work function 4.7
- C) Ni with a work function 5.01
- D) Se with a work function 3.11

16 Two satellites are in circular orbits around the Earth, at the same altitude. Pisces weighs M kg. Libra weighs 2M Kg. They are joined to each other by a cable.

If the cable is disconnected, how will that affect the satellites?

	Altitude	Kinetic Energy
A)	No change	No change
B)	No change	Increases for Libra, decreases for Pisces
C)	Decreases for Libra, increases for Pisces	No change
D)	Increases for Libra, decreases for Pisces	Increases for Libra, decreases for Pisces

17 An electron, in a Hydrogen atom, undergoes the following change in orbit.



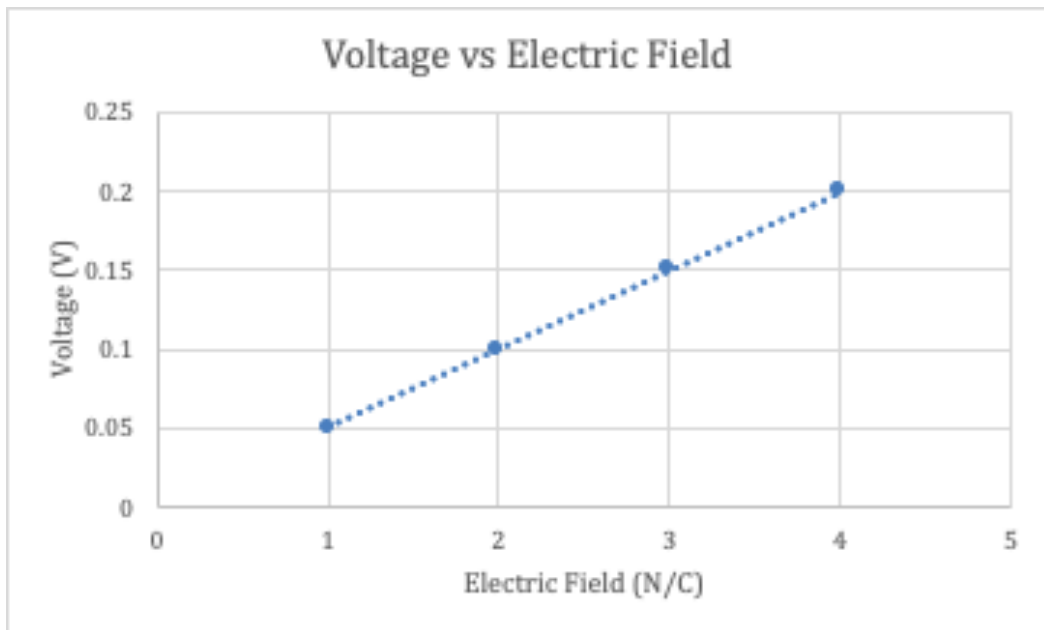
Calculate the wavelength of the photon released by this change.

- A) -975 Gm^{-1}
- B) -103 nm
- C) 103 nm
- D) 975 Gm^{-1}

18 Calculate the speed of a photon with a frequency of $5 \times 10^{14} \text{ Hz}$ and a wavelength of 600 nm .

- A) $2.8 \times 10^8 \text{ m s}^{-1}$
- B) $2.9 \times 10^8 \text{ m s}^{-1}$
- C) $3.0 \times 10^8 \text{ m s}^{-1}$
- D) $2.72 \times 10^9 \text{ m s}^{-1}$

19 Use the graph provided to determine the distance between two charged plates in a uniform electric field.

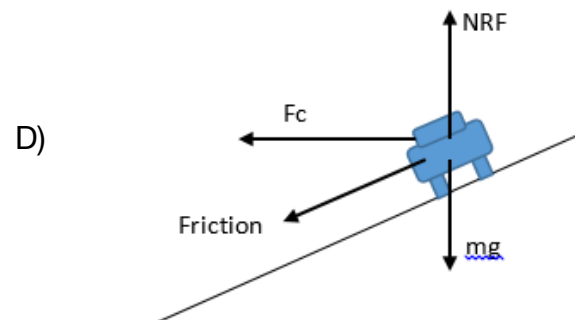
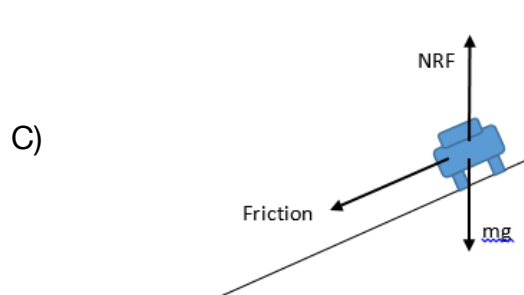
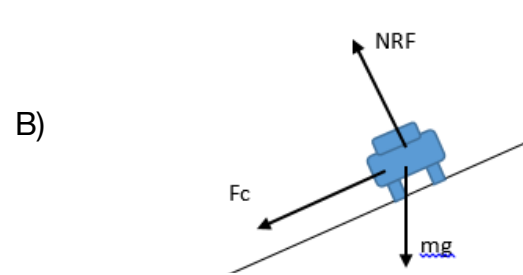
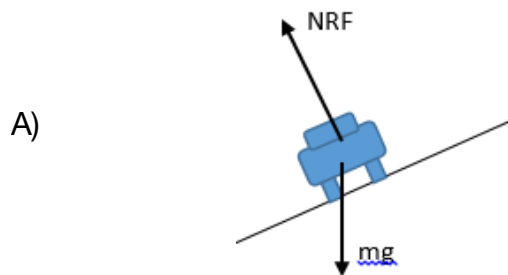


- A) 0.25 m
- B) 0.50 m
- C) 2.50 cm
- D) 5.00 cm

20 A car is travelling along a banked circular track.

The height of the car above the ground stays constant.

Which of the following correctly shows forces acting on the car?



2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION	<table border="1"> <tr> <td></td><td></td><td></td><td></td><td></td> </tr> </table>									
Physics Section II Answer Booklet	Centre Number									
	<table border="1"> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>									
Student Number										
80 marks Attempt Questions 21–xx Allow about 2 hours and 25 minutes for this section										

Instructions	<ul style="list-style-type: none"> • Write your Centre Number and Student Number at the top of this page • 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.
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Please turn over

Question 21 (4 marks)

A ray of white light hits a glass with an incidence of 60 degrees to the normal. Upon refraction the light splits into colours which include a red and blue ray. If the blue ray is travelling with a speed of $1.9 \times 10^8 \text{ ms}^{-1}$ and the red is travelling at $1.95 \times 10^8 \text{ ms}^{-1}$ calculate the angular separation between the red and blue ray.

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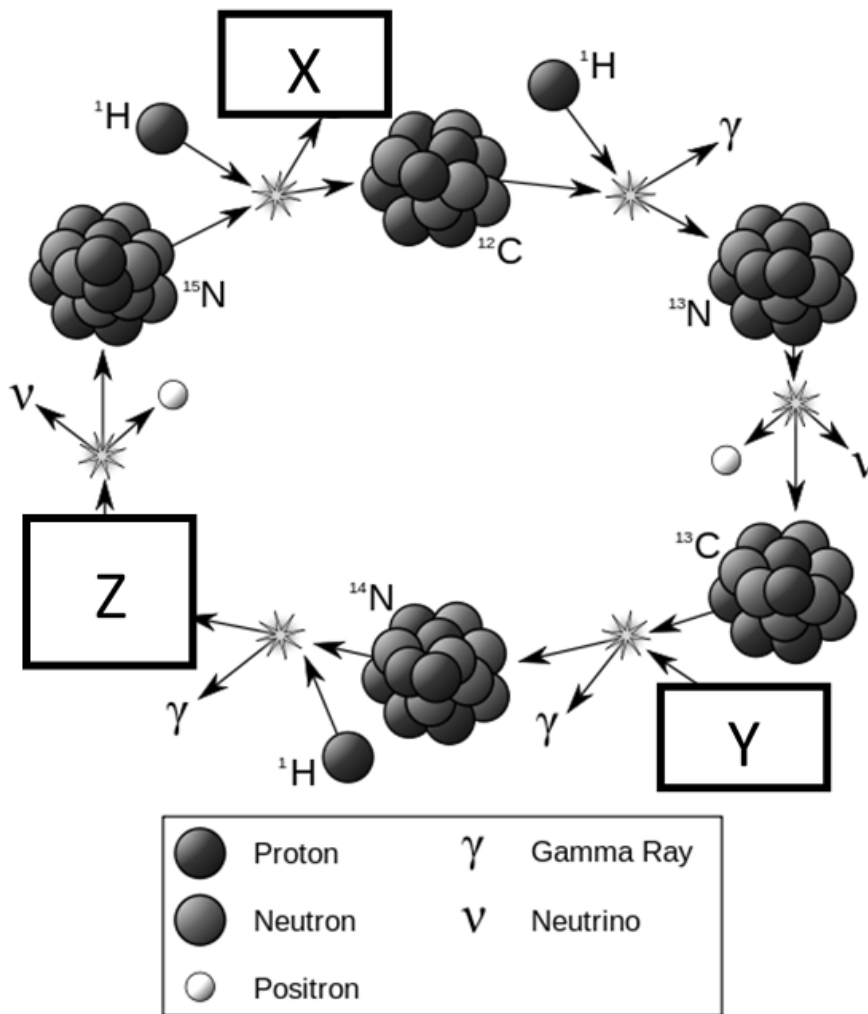
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Question 22 (6 marks)

Below is a diagram of the CNO (Carbon-Nitrogen-Oxygen) cycle.



(a) Write the full name OR annotated symbol of the missing isotopes from each box:

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- (b) Given the values below, calculate the energy of the gamma ray “ γ ” emitted by the fusion of a Carbon-12 with a Hydrogen-1 to produce a Nitrogen-13 atom. 3

Particle	Mass (amu)
Carbon-12	12.010
Hydrogen-1	1.008
Nitrogen-13	13.006

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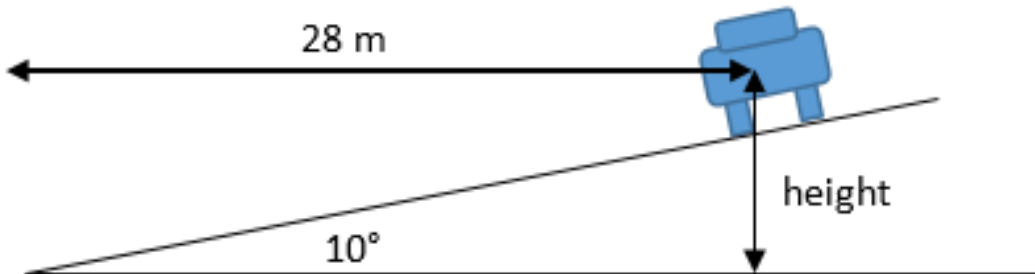
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Question 23 (4 marks)

Consider a banked circular track angled at 10° .

A car weighing 1,800 Kg is moving around the track at 20 m/s at a radius of 28 metres.

There are two frictional forces to consider:



- The friction between the tyres and the track that acts as the driving force (in the direction of motion).
- The friction between the tyres and the track that prevents the car moving up or down the track (perpendicular to the direction of motion). The coefficient of friction for this is 1.4.

Is it possible for the car to maintain its current height on the track at that speed?
Justify your answer using appropriate calculations.

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Question 24 (2 marks)

An astronomer recorded Hydrogen spectral data from a star. She noticed the spectral lines she recorded for this star were shifted downwards by 30 angstroms and were broader than expected. Explain what caused these 2 observations.

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Question 26 (3 marks)

Explain why a geostationary satellite must be above the earth's equator, travelling from west to east, at an altitude of approximately 36,000 km.

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Question 27 (2 marks)

Identify 2 key concepts from Maxwell's electromagnetic theory of light.

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Question 28 (3 marks)

- (a) In a replication of Young's double slit experiment interference fringes are formed on a screen. Explain the effect on the spacing between interference fringes if the separation between the slits was increased. 2

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- (b) State one important change that would occur to the pattern on the screen if one of the slits was covered. 1

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Question 29 (7 marks)

Light from a laser is shone onto a diffraction grating with 30 micrometer spacings. An interference pattern appears on a wall 10m away from the diffraction grating, with 17.45cm spacings between the antinodes. Calculate the power of the laser and identify its colour based on the table below:

Colour	Wavelength (nm)
Red	635 - 700
Yellow	560 - 590
Green	520 - 559
Blue	450 - 490

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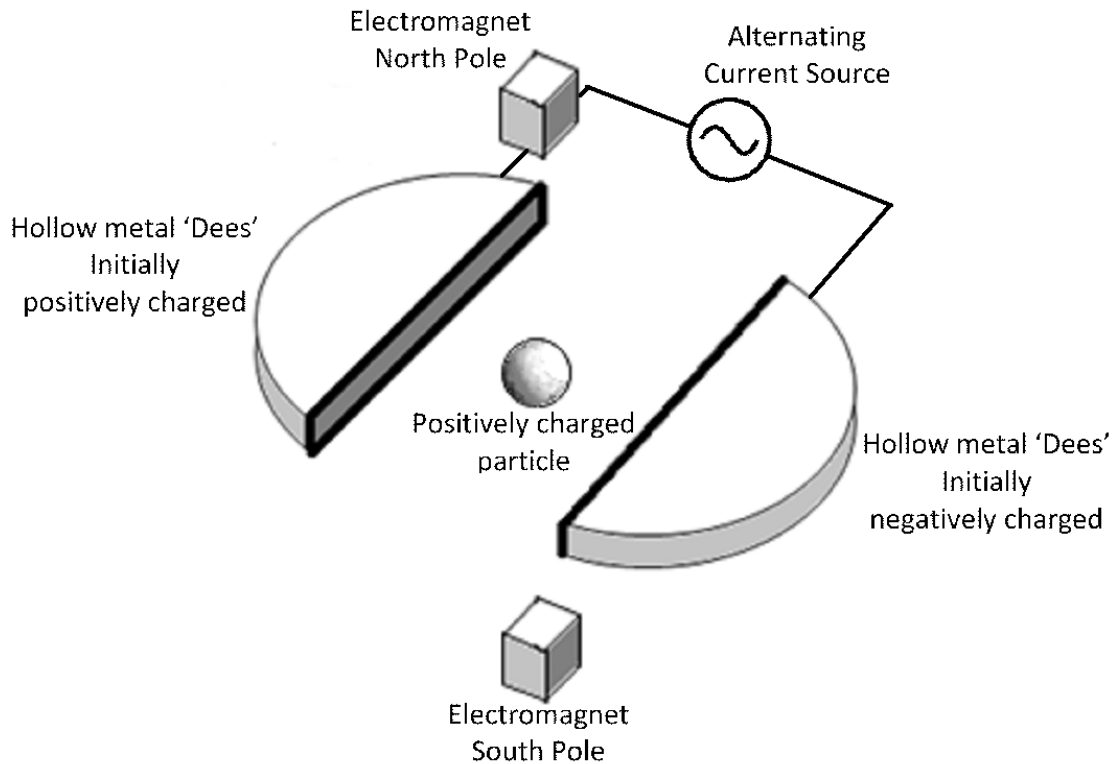
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Question 30 (8 marks)

Below is a diagram of a cyclotron particle accelerator. A positively charged particle is placed in the centre of the cyclotron with some small initial velocity. The particle is moving so that it is in the same horizontal plain as the electric field from the dees and is perpendicular to the magnetic field from the electromagnets.



- (a) Identify the forces each labelled component would exert on the particle at the moment illustrated in the diagram.

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- (b) Outline the net motion the particle would undergo if the strength of the magnetic field was gradually increased and the current were allowed to alternate. 3

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Question 31 (4 marks)

Design an experiment to find the angle of elevation that gives a projectile maximum horizontal range. In your response, refer to dependent, independent and controlled variables and how you can ensure reliability and validity. 4

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Question 32 (2 marks)

Briefly describe an experimental observation which can be used as evidence to support Huygens' principle of wave propagation in diffraction.

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Question 33 (3 marks)

Upon completing his experiment to measure the charge to measure the charge-to-mass ratio of cathode ray particles, J. J. Thomson concluded that they were a part of all atoms.

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Outline the experimental steps and observations Thomson made to arrive at this conclusion and assess the validity of his conclusion based on this evidence.

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Question 34 (3 marks)

The formula for escape velocity is

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$$v_{esc} = \sqrt{\frac{2GM}{r}}$$

Explain how this formula is derived.

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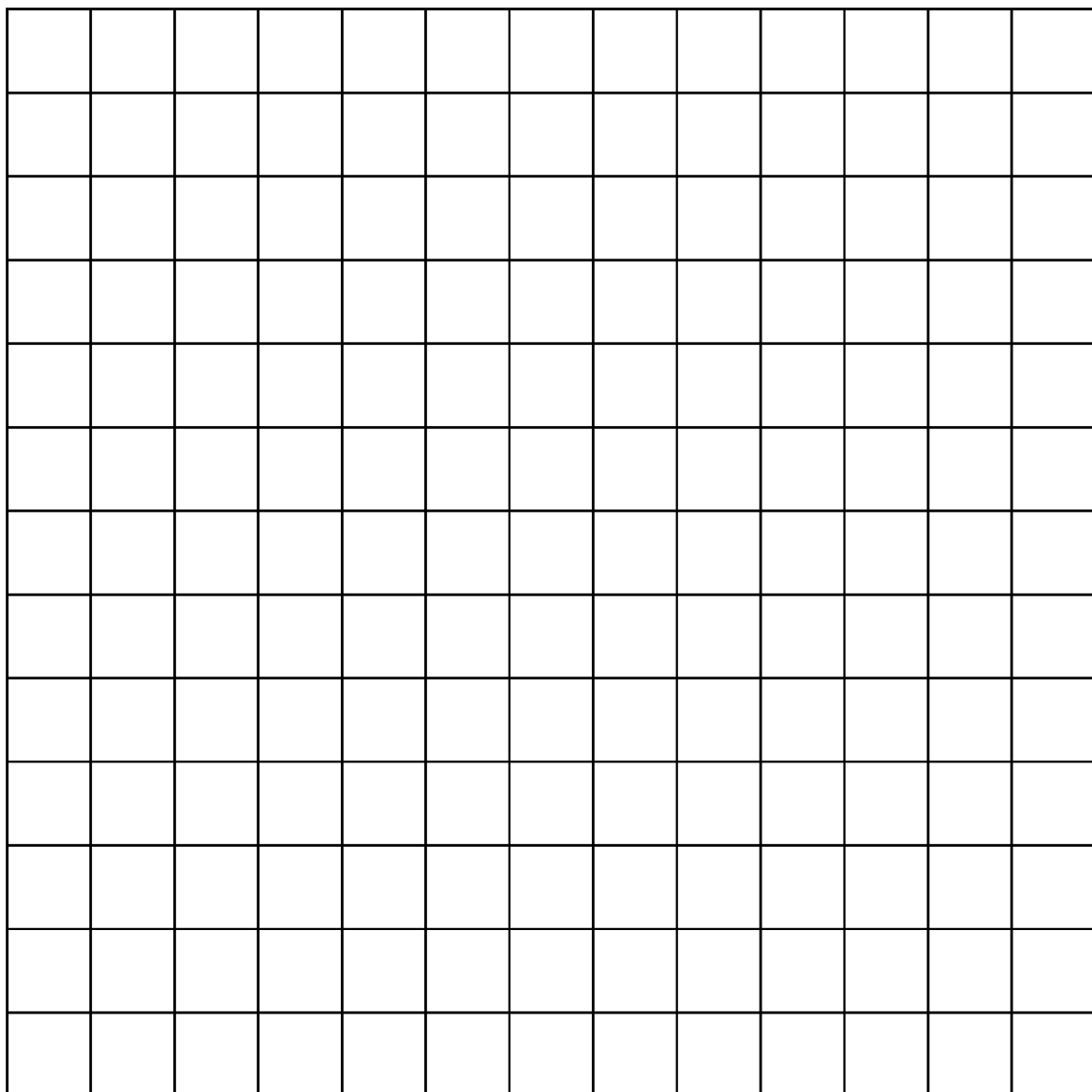
Question 35 (6 marks)

The motion of a projectile was tracked. The results were recorded in the following table.

Time (s)	Horizontal displacement (m)	Height above ground (m)
0	0	35
1	15	51
2	30	58
3	45	55
4	60	42
5	75	19

(a) Use the data to produce a graph of height vs horizontal displacement.

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(b) Use your graph to estimate the horizontal displacement when the projectile's velocity was a minimum. 1

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(b) Explain why the shape of the graph is a parabola. 2

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Question 36 (6 marks)

- (a) A student wishes to charge their iPhone and plugs the charging cord into the wall power point which delivers an input voltage of 240 V. The transformer within the charger converts this to an output voltage of 6 V. The iPhone charges with an output current of 1 A. Determine the input current. 2

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- (b) Use a diagram in the space provided below to model the transformer from part (a) above. 2

- (c) Explain how transformers are designed to maximise efficiency and minimise energy losses. 2

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Question 37 (3 marks)

Analyse Schrodinger's contributions to the development of the current model of the atom. 3

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Question 38 (7 marks)

Draw the eddy currents formed in each situation on the diagrams below.

(a) i) A metal sheet moving through a magnetic field. 2

ii) Magnetic field applied to a spinning disk. 2

(b) Outline the physics principles involved in one application of eddy currents.

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