NAME :

TEACHER:

2003

MID-HSC COURSE

EXAMINATION

PHYSICS

2 UNIT

General Instructions

- Assessment Task No. 1
- Weighting – 10%
- Reading time – 5 minutes
- Working time – 1 hour & 30 minutes
- Physics Formulae & Data Sheets are attached to the back of this paper.

This examination has TWO parts.

Part A **Multiple Choice**

Total marks **(10)**

- Attempt ALL Questions
- Mark your answers on the Multiple Choice Answer Sheet provided.

Part B **Extended Answer Questions**

Total marks **(42)**

- Attempt ALL Questions
- Write your answers in the spaces provided on the Examination Paper.

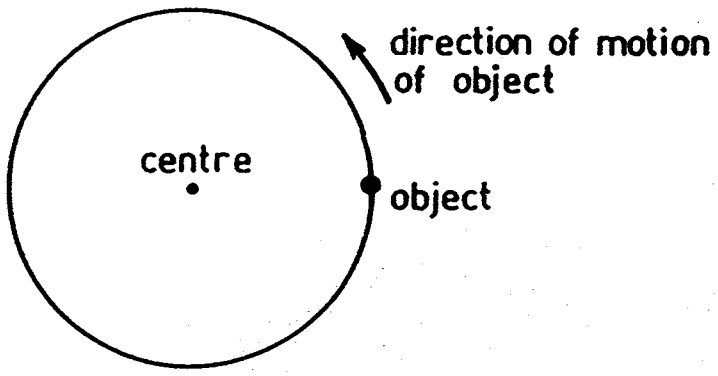
PART A

Total Marks (10)
Attempt all questions 1 to 10.
Allow 18 minutes for this part.

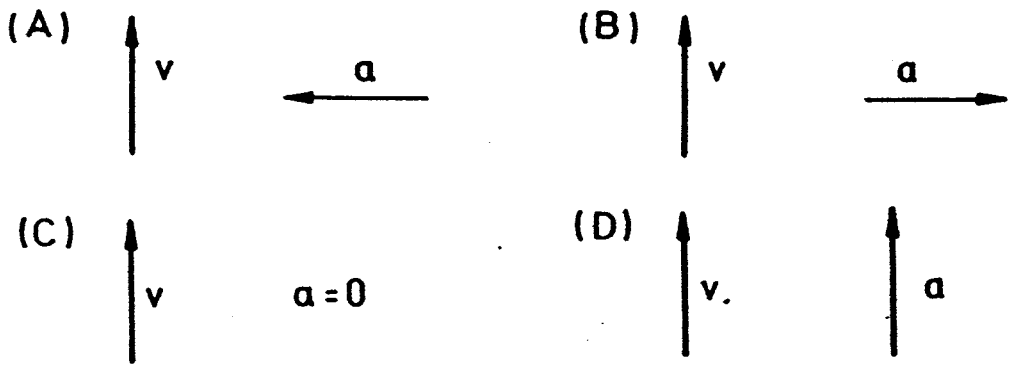
Questions 1 to 10 are worth One Mark Each.

For each question (1 – 10) choose the best of the four possible answers and indicate your choice by marking the appropriate space on the Answer Sheet provided. Mark only ONE choice for each question, using a pencil. Do NOT use a ball-point or an ink pen. If you change your mind, completely erase your first mark.

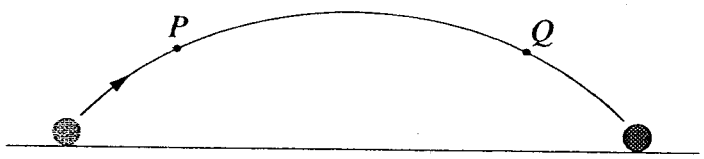
1. An object is travelling around a circular track at a constant speed of 15 $m\,s^{-1}$, as shown in the diagram below.



The vectors which best represent the velocity and acceleration of the object at the position shown are:



2. The diagram shows the trajectory of a golf ball.



Which set of arrows shows the direction of the acceleration of the ball at points P and Q respectively?

	At P	*At Q*
(A)	↑	↓
(B)	↓	↓
(C)	↗	↘
(D)	↙	↘

3. A rocket car moves on a straight horizontal track. Half of the initial mass of the rocket car is propellant. During the run, propellant is consumed at a constant rate and ejected at a constant nozzle velocity.

Which of the following best describes the force propelling the rocket car, and the magnitude of the acceleration of the rocket car while the propellant is being ejected?

	Force	*Acceleration*
(A)	constant	constant
(B)	increasing	constant
(C)	constant	increasing
(D)	increasing	increasing

4. AC electricity transmitted at 33 000 V is required for use at 240 V.
What would be the primary/secondary turns ratio for a transformer which would do this?

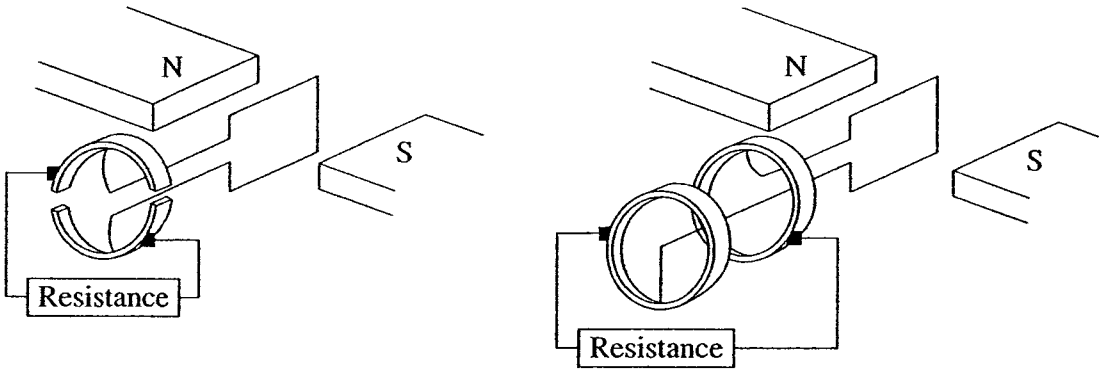
(A) $\frac{33\,000}{240}$.

(B) $\frac{240}{33\,000}$.

(C) $240 \times 33\,000$.

(D) $\frac{33\,000}{1}$.

5. Two types of generator are shown.



Generator 1 Generator 2

What type of current is produced by each generator when connected to an external resistance?

(A) Both produce d.c.

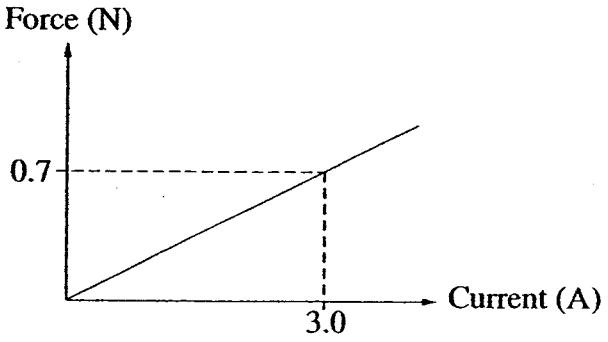
(B) Both produce a.c.

(C) Generator 1 produces d.c. and Generator 2 produces a.c.

(D) Generator 1 produces a.c. and Generator 2 produces d.c.

6. A student performed an experiment to measure the force on a long current-carrying conductor placed perpendicular to an external magnetic field.

The graph shows how the force on a 1.0 m length of the conductor varied as the current through the conductor was changed.



What was the magnitude of the external magnetic field in this experiment?

(A) 0.23 T

(B) 1.1 T

(C) 2.1 T

(D) 4.3 T

7. An astronaut travels to a star 250 light years away at a speed of 0.999999c. As seen by an observer who stays behind on Earth the astronaut would:

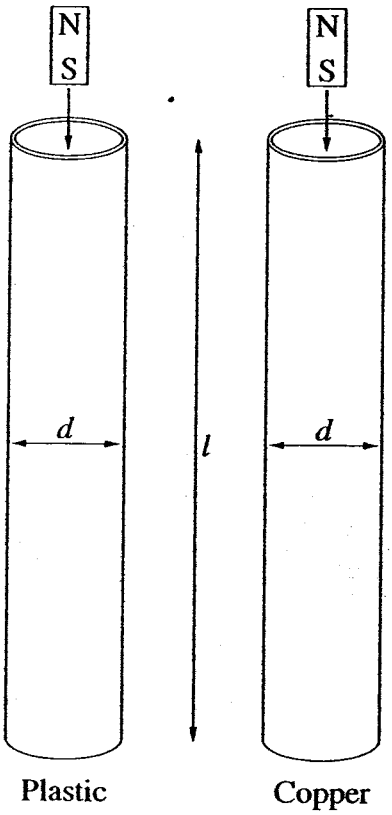
(A) not age compared to those left behind

(B) age 0.35 years

(C) age 250 years

(D) age 177 000 years in the trip to the star

8. In a student experiment, a bar magnet is dropped through a long plastic tube of length l and diameter d. The time taken for it to hit the floor is recorded.



The experiment is repeated using a copper tube of the same length and diameter.

Which of the following statements is correct?

(A) The magnet will take the same time to hit the floor in both cases.

(B) The magnet will come to rest in the middle of the copper tube.

(C) The magnet will take longer to fall through the copper tube.

(D) The magnet will take longer to fall through the plastic tube.

9. A girl weighs 500 N at the surface of the earth. With the aid of the information in the following table, estimate the girl's weight on the surface of planet K.

PLANET	MASS (10^{24} kg)	RADIUS (km)
Earth	6.0	6400
K	12.0	12800

(A) 5 N

(B) 250 N

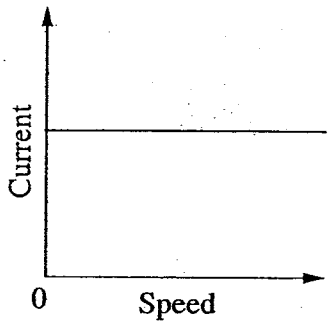
(C) 500 N

(D) 1000 N

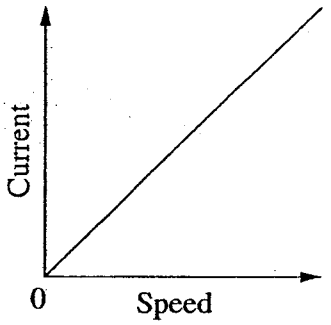
10 An electric motor is connected to a power supply of constant voltage. The motor is allowed to run at different speeds by adjusting a brake.

Which graph best shows how the current through the motor varies with speed?

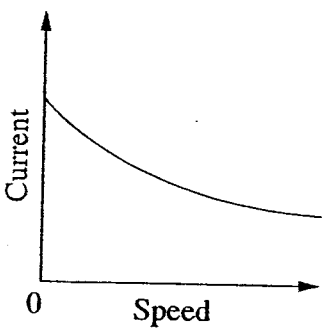
(A)



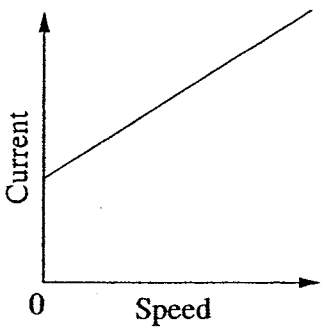
(B)



(C)



(D)



PART B

Total Marks (42)
Attempt all questions 11 to 19.
Allow 72 minutes for this part.

Questions 11 to 19 are FREE RESPONSE Questions.

For each question (11 – 19) write your answer in the appropriate space. You are advised to show your *full* working for all answers as marks may be awarded for relevant working.

QUESTION 11 (2 Marks) **Marks**

Spacecraft such as the Space Shuttle are designed to return astronauts safely to Earth's surface. Briefly discuss ONE important issue associated with safe re-entry into Earth's atmosphere and landing on the surface of the Earth. **2**

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QUESTION 12 (2 Marks)

The OPTUS satellites occupy geostationary orbits around the Earth.

(a) Define the term "geostationary orbit". **1**

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(b) Calculate the radius of orbit in kilometres of an OPTUS satellite given that the mass of the Earth is 6×10^{24} kg. **1**

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End of Question 12

QUESTION 13 (4 Marks) **Marks**

A projectile is launched with a velocity of 100 ms^{-1} at an angle of 30° to the horizontal. If the acceleration due to gravity is 9.8 ms^{-2}, determine the value of the following quantities 7 seconds after launch.

(a) The horizontal speed of the projectile. **1**

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(b) The vertical speed of the projectile. **1**

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(c) The total velocity of the projectile. **2**

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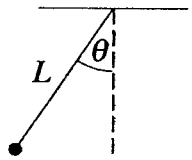
End of Question 13

Question 14 (8 marks)

Two students, Kim and Ali, performed an experiment to determine the acceleration due to gravity (g) using a simple pendulum consisting of a small mass hanging from a light string.



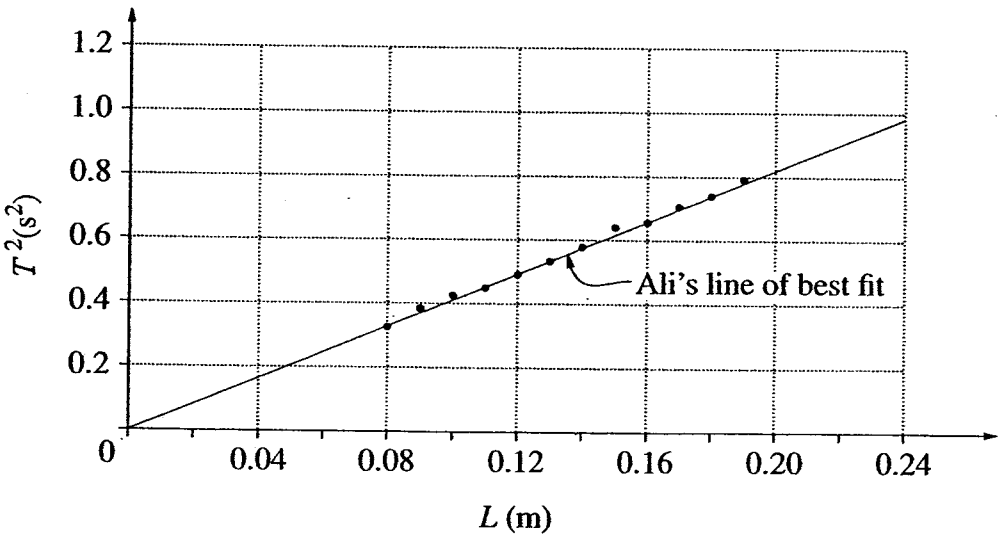
Their procedure was as follows:

1. Adjust the length of the string (L) to measure 0.08 m.
2. Hold the mass to the side to give a small angular displacement, θ.
3. Release the mass and measure the time for one period (T).
4. Record the result in a table.
5. Repeat using a string length (L) of 0.09 m and continue until the string length is 0.19 m (going up in 0.01 m increments, using the same initial angular displacement each time).
6. Calculate g using the relationship $T = 2\pi\sqrt{\frac{L}{g}}$.

The results are shown in the table:

L (m)	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19
T (s)	0.57	0.62	0.65	0.67	0.70	0.73	0.76	0.80	0.81	0.84	0.86	0.89

Kim used the data in the table to obtain a mean value for g. Kim's result was $g = 9.3\ \text{m s}^{-2}$. Ali used the results to produce the following graph. Ali's line of best fit was used to calculate g.



Question 14 continues on page 10

Marks

Question 14 (continued)

(a) Outline TWO changes that could be made to the experimental procedure that would improve its accuracy. 2

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(b) Compare Kim's and Ali's methods of calculating g and identify the better approach. 3

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(c) Calculate the value of g from the line of best fit on Ali's graph. 3

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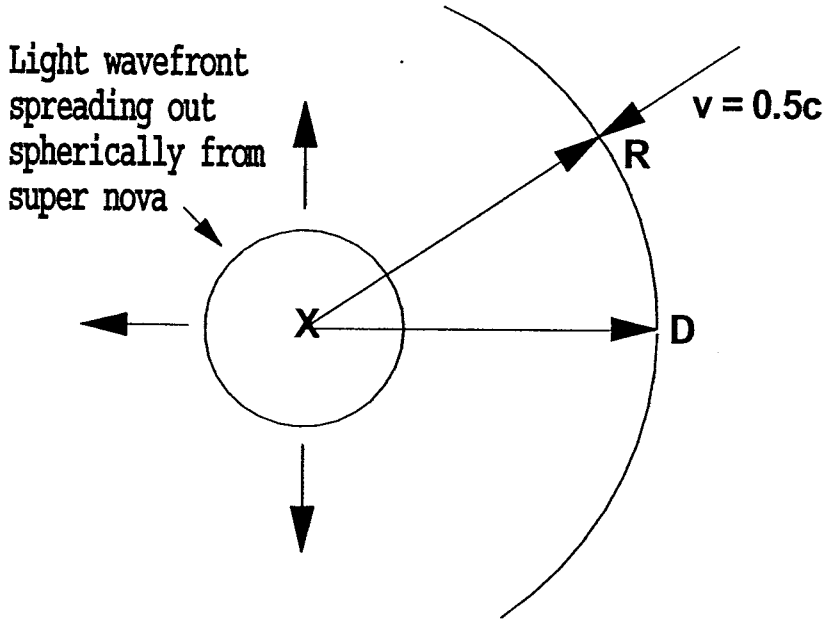
End of Question 14

QUESTION 15 (5 Marks) Marks

Two eminent and daring physicists, Daniel and Ricky, observe a supernova (stellar explosion) at X in the diagram below. As the initial light wavefront from the explosion reaches Daniel, he is stationary and located at D in the diagram below. As this same wavefront reaches Ricky at R, he is moving at 0.5c radially inwards towards the centre of the explosion as shown.



According to the Theory of Special Relativity, both Daniel and Ricky will measure the speed of light as the same constant value, $c = 3 \times 10^8$ ms^{-1}.

(a) Identify the implications of the constancy of the speed of light for our understanding of the nature of space and time. 1

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(b) Daniel knows that he is 1.08×10^{12} m from X, the centre of the explosion. Determine the time taken in hours for the light to travel from X to D as calculated by Daniel. 1

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Question 15 continues on page 12

QUESTION 15 (Continued) **Marks**

(c) As seen by a stationary observer, the distance from X to R is also 1.08 x 10^{12} m. Calculate the distance from X to R as seen by Ricky. **1**

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(d) Determine the total time in hours for light from X to travel to R as calculated by Ricky. **1**

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(e) The Super Giant star that exploded had a mass of 5 x 10^{31} kg and 35% of this mass was converted into energy during the explosion. Determine the amount of energy liberated in this process. **1**

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End of Question 15

QUESTION 16 (7 Marks) **Marks**

(a) State Lenz's Law. **1**

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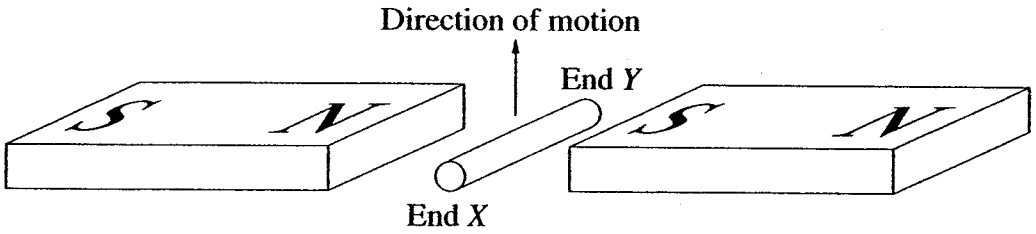
(b) When the metal rod is moved upwards through the magnetic field as shown in the diagram below, an emf is induced between the two ends.



(i) Which end of the rod becomes positive? **1**

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(ii) Explain how the emf is produced in the rod. **3**

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(c) Explain how eddy currents are used in electromagnetic braking. **2**

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End of Question 16

QUESTION 17 (4 Marks) **Marks**

A rectangular coil with sides 0.2 m and 0.4 m consists of 1000 turns of wire. The coil lies in a magnetic field of 2.0×10^{-3} T so that the plane of the coil is parallel to the plane of the magnetic field.

(a) Define in words the term "torque". **1**

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(b) If the torque on the coil described above is 0.5 Nm, find the size of the current flowing in the coil. **1**

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(c) Write down an equation for magnetic flux density B, in terms of magnetic flux ϕ and surface area A perpendicular to the flux. **1**

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(d) Using the equation from part (c) above, calculate the magnetic flux threading through the coil when it has turned to a position where it is perpendicular to the field direction. **1**

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End of Question 17

QUESTION 18 (4 Marks)

(a) State the principle of operation of an AC induction motor. **1**

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(b) Outline an investigation that you have carried out to demonstrate the principle of operation of an AC induction motor. **3**

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End of Question 18

QUESTION 19 (6 Marks)

AC generators are currently the main source of electrical power supply worldwide. Assess the effects of the development of AC generators on society and the environment. **6**

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End of Exam