



Sydney Girls High School

2004
HSC TRIAL EXAMINATION

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Student Number

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Board-approved calculators may be used
- A data sheet, formulae sheets and Periodic Table are provided at the back of this paper.
- Draw diagrams using pencil
- Write your student number on the multiple choice answer sheet, and pages 1 and 10.

Total marks – 100

Section I Pages 2–18

75 marks

This section has two parts, Part A and Part B

Part A – 15 marks

- Attempt questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt questions 16–29
- Allow about 1 hour and 45 minutes for this part

Section II Pages 19–20

25 marks

- Attempt question 30
- Allow about 45 minutes for this section

Section I

75 marks

Part A – 15 marks

Attempt questions 1 – 15

Allow about 30 minutes for this part

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

A B C D

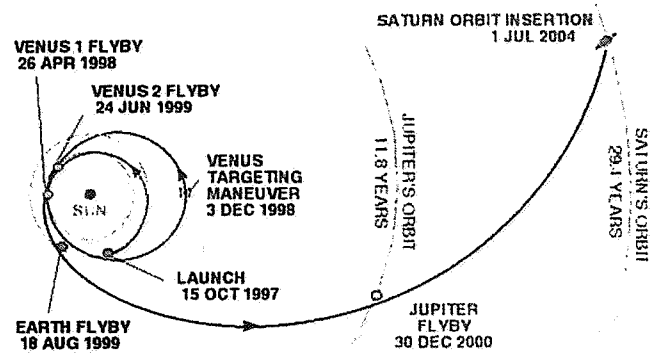
If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

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

A B C D
correct (arrow pointing to B)

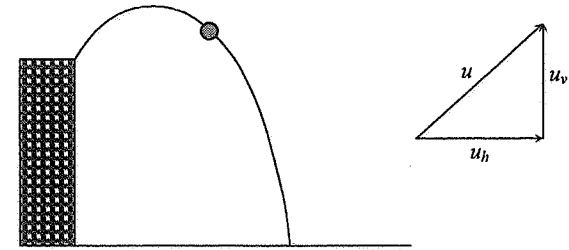
- 1 The diagram below shows the trajectory of the space probe Cassini, which recently went into orbit around Saturn.



Which of the following is the most likely reason for its path?

- (A) It was the shortest and therefore quickest route.
 (B) It allowed three slingshot manoeuvres to increase the probe's speed.
 (C) It allowed Cassini to take pictures of three other planets.
 (D) It was the path that required the least fuel at launch.
- 2 Matilda is travelling in a spacecraft travelling at $0.8c$. She watches live footage from Earth that includes a clock in the background. Using her own stop watch she measures the time it takes for the clock to tick over one second. What time would she measure?
- (A) 0.6 s
 (B) 1.0 s
 (C) 1.7 s
 (D) 2.2 s

- 3 The diagram (a) below shows the path of a projectile thrown off a building. Diagram (b) shows the components of its initial velocity.

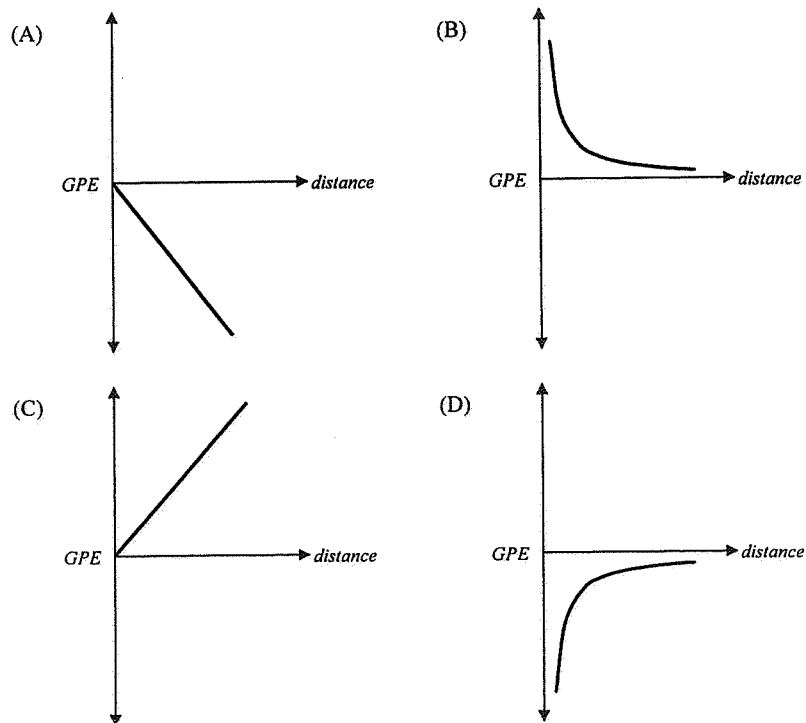


Which vector diagram shows the components of the projectile's final velocity?

- (A) (B)
- (C) (D)

- 4 Which of the following would constitute an inertial frame of reference?
- (A) Car travelling at a velocity of 40 km/h east
 (B) Boat in a storm
 (C) Train travelling around a corner at a speed of 30 km/h
 (D) Space probe during launch

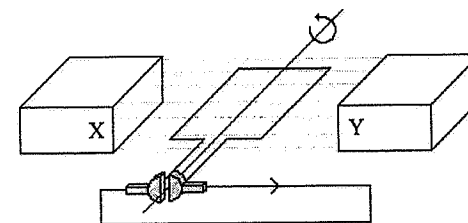
5 Which of the graphs below correctly shows the relationship between gravitational potential energy (GPE) and distance?



6 Which of the following scientists discovered that a current is produced in a circuit in the presence of a moving magnet?

- (A) Nikola Tesla
- (B) Michael Faraday
- (C) Heinrich Lenz
- (D) Hans Christian Oersted

7 The diagram below shows a DC generator. Determine which poles must be placed at X and Y in order for the generated current to flow as indicated.



	X	Y
(A)	N	N
(B)	N	S
(C)	S	N
(D)	S	S

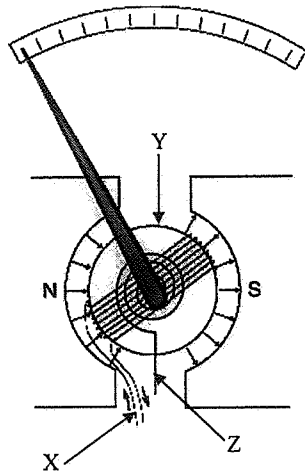
8 During the late 19th century George Westinghouse and Thomas Edison were competitors in the electricity supply business, but they had different ideas about how this could be achieved. Which option correctly identifies Edison and Westinghouse's opinions on how electricity should be delivered?

	Thomas Edison	George Westinghouse
(A)	AC	Batteries
(B)	DC	AC
(C)	Batteries	DC
(D)	AC	DC

9 Magnetic flux can be determined using which of the following expressions?

- (A) Flux = BA
- (B) Flux = $\frac{B}{A}$
- (C) Flux = $\frac{A}{B}$
- (D) Flux = B

- 10 The diagram below shows a moving coil galvanometer.



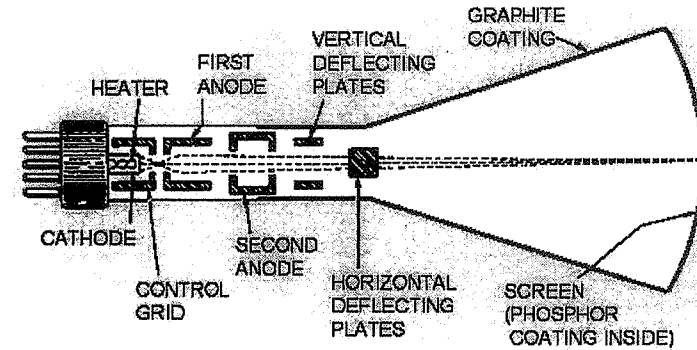
Identify the main function of each of the parts labelled X, Y and Z.

	X	Y	Z
(A)	Carry the current to be measured	Concentrate the magnetic field	Stop the pointer at the appropriate place on the scale.
(B)	Stop the coil turning too far.	Support the coil	Stop the pointer at the appropriate place on the scale.
(C)	Carry the current to be measured	Support the coil	Bring the pointer back to zero
(D)	Stop the coil turning too far.	Concentrate the magnetic field	Bring the pointer back to zero

- 11 Which of the following lists the four substances in order of increasing numbers of free electrons?

- (A) Pure silicon, *n*-type silicon, glass, copper
 (B) Copper, *n*-type silicon, pure silicon, glass
 (C) Glass, pure silicon, *n*-type silicon, copper
 (D) Glass, *n*-type silicon, pure silicon, copper

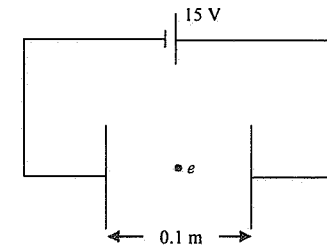
- 12 The diagram shows some of the main components of an oscilloscope.



What changes would need to be made to represent the picture tube of a typical black and white television?

- (A) Remove the heater.
 (B) Remove one set of deflecting plates.
 (C) Replace the deflecting plates with coils in the same location as the plates.
 (D) Replace the deflecting plates with coils located at right angles to the original plates.

- 13 The diagram below shows an electron in the space between two charged plates.



Determine the force on the electron due to the electric field.

- (A) $2.4 \times 10^{-17} \text{ N}$
 (B) $4.8 \times 10^{-17} \text{ N}$
 (C) $1.1 \times 10^{-21} \text{ N}$
 (D) 150 N

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Student Number

Section I (continued)

Part B – 60 marks

Attempt Questions 16 – 29

Allow about 1 hour and 45 minutes for this part.

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

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Question 16 (3 marks)

(a) Define the term “orbital decay”.

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(b) Clarify why orbital decay is only a problem for satellites in low Earth orbits.

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Question 17 (3 marks)

(a) Clarify the term “escape velocity”.

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(b) Account for escape velocity’s dependence on the mass of a planet.

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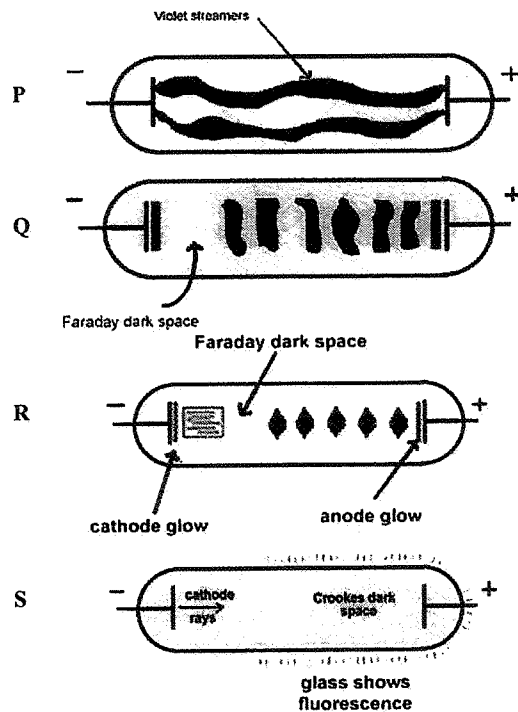
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14 A certain photoelectric cell is only activated by light of wavelengths <350 nm. Determine the energy in joules of the lowest energy photons that will activate the photoelectric cell.

- (A) 2.3×10^{-40} J
- (B) 5.7×10^{-28} J
- (C) 5.7×10^{-19} J
- (D) 3.6 J

15 The diagram below shows four identical cathode ray tubes (not to scale).



What property must be changed in order to get the progression PQRS as shown above?

- (A) Increase voltage
- (B) Increase pressure
- (C) Decrease voltage
- (D) Decrease pressure

Question 18 (5 marks)

Describe a first-hand investigation to determine a value for the acceleration due to gravity at the Earth's surface.

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In your description, include:

- A labelled sketch of the experimental set-up.
- How you controlled variables.

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Question 19 (5 marks)

Assess the importance of considering relativistic effects when planning a trip to Alpha Centauri, travelling at $0.9c$.

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Question 20 (4 marks)

A satellite of mass 100 kg is orbiting the Earth at an altitude of 1000 km . The radius of the Earth is 6380 km .

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(a) State the gravitational force on the satellite.

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(b) Calculate the orbital velocity of the satellite.

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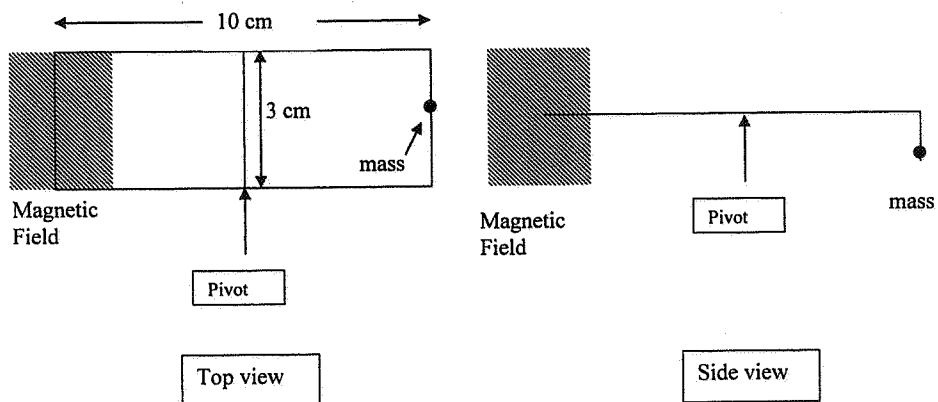
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Question 21 (9 marks)

Sandy wanted to test the relationship between the coil current and the torque the coil experiences in a magnetic field. She used a current balance with the dimensions as shown below.

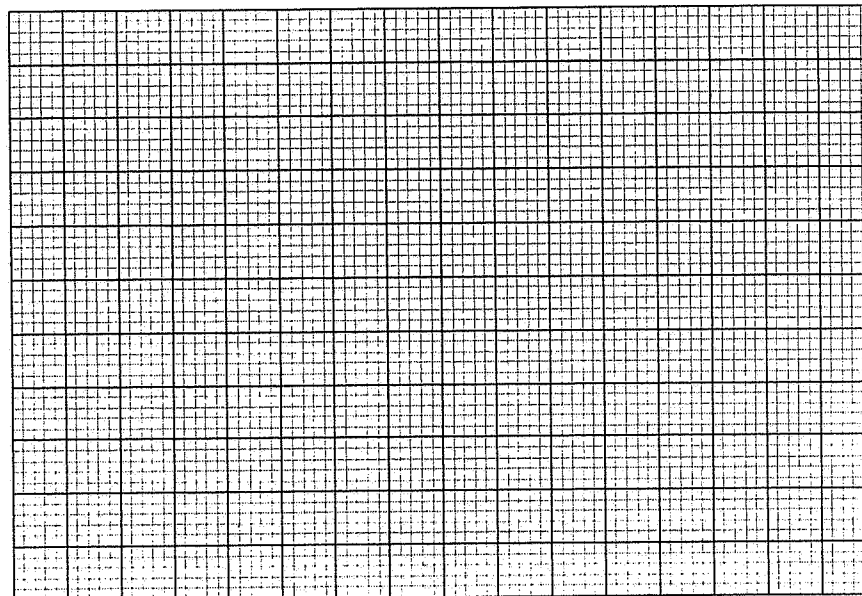
$B = 0.1 \text{ T}$



Sandy's results:

Coil Current (A)	Mass 1 ($\times 10^{-5} \text{ kg}$)	Mass 2 ($\times 10^{-5} \text{ kg}$)	Mass 3 ($\times 10^{-5} \text{ kg}$)	Average Mass ($\times 10^{-5} \text{ kg}$)	Torque (Nm)
0.4	20	24	26	23	
0.5	31	35	29	32	
0.6	32	35	40	36	
0.7	47	45	41	44	

(b) Plot a graph of torque vs current through the coil. Include a line of best fit.



(a) Calculate the torque in each case.

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(c) Qualitatively describe the relationship between torque and coil current. Compare this to the result expected by analysing the formula for the torque on a current carrying coil.

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(d) Comment on the precision of the measurement of the mass.

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Question 22 (3 marks)

A copper pipe is to be bent at a sharp angle. The worker realises that if the pipe were heated it would bend more easily. She decides to wrap it with insulated copper wire and connect it to an alternating supply. Explain how this will allow easier bending.

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Question 23 (3 marks)

Draw a labelled diagram of a transmission cable and its supporting tower, showing how it is insulated and protected from lightning strikes.

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Question 24 (2 marks)

The picture tube in a typical television requires approximately 24 000 volts. Explain exactly how this can be achieved in a normal household.

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Question 25 (3marks)

Electricity is an essential source of energy in the home today due to its ability to be transformed into many other forms of energy.

(a) Identify ONE form of energy that electrical energy can be converted into directly.

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(b) Outline how a named device achieves this transformation.

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Question 26 (4 marks)

Assess the validity of J. J. Thomson's conclusion that cathode rays were negatively charged particles, rather than electromagnetic waves. 4

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Question 27 (5 marks)

Heinrich Hertz was able to confirm Maxwell's prediction that there were electromagnetic waves existed and that their speed was $3 \times 10^8 \text{ ms}^{-1}$.

(a) Sketch a diagram of the apparatus Heinrich Hertz used to produce and detect radio waves. 2

(b) Describe an experiment Hertz carried out that enabled him to determine the speed of the waves he had produced. 3

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Question 28 (5 marks)

Explain the importance of the invention of the transistor to the development of the computer industry.

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Question 29 (6 marks)

The atoms in most solid materials are arranged in a regular crystal lattice. The nature of this lattice determines many of the solid's properties.

- (a) Describe how the Braggs were able to determine the structure of crystal lattices.

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- (b) Outline how the crystal lattice is involved in superconductivity.

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Physics

Section II

25 marks

Attempt Question 30

Allow about 45 minutes for this part.

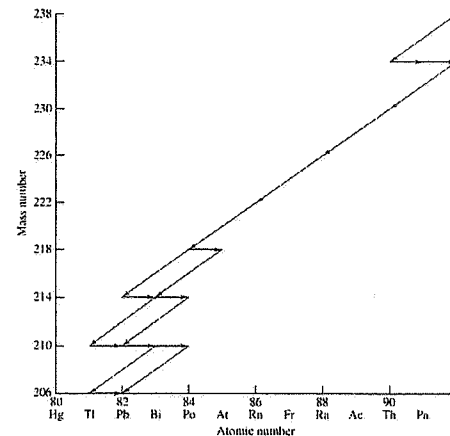
Answer the question in a writing booklet. Extra writing booklets are available.

Show all relevant working in questions involving calculations.

Mark:

Question 30 – From Quanta to Quarks (25 marks)

- (a) Identify two features of the hydrogen spectrum that cannot be explained by the Bohr model. 2
- (b) Pauli and Heisenberg were key figures in the development of quantum theory. 2
- (i) Outline Heisenberg's Uncertainty Principle. 2
- (ii) Outline Pauli's contribution to the understanding of the nature of the atom. 2
- (c) The daughter nucleus of most radioactive decays is itself unstable. The diagram shows the decays that result after the decay of Uranium-238. 1



- (i) Bi-214 can decay in two ways. Compare the two transmutations. 2
- (ii) Describe how the radiation from the two decays could be distinguished using a Wilson Cloud Chamber or similar device. 2
- (iii) Account for the kinetic energy of these released particles. 2
- (iv) Identify the final stable nuclide. 1

- (d) Describe Enrico Fermi's contributions to the understanding and development of nuclear physics. 4
- (e) Justify the acceptance of de Broglie's model of the atom, instead of Bohr's model. 7

Physics

DATA SHEET

Charge on the electron, q_e	$-1.602 \times 10^{-19} \text{ C}$
Mass of electron, m_e	$9.109 \times 10^{-31} \text{ kg}$
Mass of neutron, m_n	$1.675 \times 10^{-27} \text{ kg}$
Mass of proton, m_p	$1.673 \times 10^{-27} \text{ kg}$
Speed of sound in air	340 ms^{-1}
Earth's gravitational acceleration, g	9.8 ms^{-2}
Speed of light, c	$3.00 \times 10^8 \text{ m s}^{-1}$
Magnetic force constant, $\left(k \equiv \frac{\mu_0}{2\pi}\right)$	$2.0 \times 10^{-7} \text{ N A}^{-2}$
Universal gravitational constant, G	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Mass of Earth	$6.0 \times 10^{24} \text{ kg}$
Planck's constant, h	$6.626 \times 10^{-34} \text{ J s}$
Rydberg's constant, R_H	$1.097 \times 10^7 \text{ m}^{-1}$
Atomic mass unit, u	$1.661 \times 10^{-27} \text{ kg}$
1 eV	$931.5 \text{ MeV}/c^2$
Density of water, ρ	$1.00 \times 10^3 \text{ kg m}^{-3}$
Specific heat capacity of water	$4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$