



CATHOLIC SECONDARY SCHOOLS
ASSOCIATION OF NEW SOUTH WALES

Centre Number									
Student Number									

2007
TRIAL HIGHER SCHOOL CERTIFICATE
EXAMINATION

Physics

Afternoon Session
Thursday 16 August 2007

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Use Multiple Choice Answer Sheet provided
- A Data Sheet, Periodic Table and Formulae Sheets are provided separately
- Write your Centre Number and Student Number at the top of this page and page 9

Total marks – 100

Section I
Pages 3–20

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 16–27
- Allow about 1 hour and 45 minutes for this part

Section II
Pages 21–28

25 marks

- Attempt ONE question from Questions 28–32
- 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 provided

- 1 An astronaut has a mass of 67 kg. What is her weight on Earth and the Moon, given the moon has gravity one-sixth that of Earth?

- (A) 6.8 N and 1.1 N
(B) 6.8 N and 41.0 N
(C) 656.6 N and 109.4 N
(D) 656.6 N and 3939.6 N

- 2 Calculated centripetal force of the Earth on the moon, given that the Moon travels at a speed of 1.02 km/s with a distance of 384 000 km between the centre of masses (the Moon's mass is 7.35×10^{22} kg).

- (A) 2.00×10^{10} N
(B) 2.00×10^{17} N
(C) 2.00×10^{20} N
(D) 2.00×10^{23} N

- 3 The Michelson-Morley experiment was design to detect the presence of the aether. To do this a shift in interference pattern needed to be detected. When would there be a shift in the interference pattern?

- (A) When the experiment apparatus is rotated with no change in the speed of the light beams.
(B) When the experiment apparatus rotates through 90° and there is a change in speed of the light moving relative to the aether
(C) When the light beams travel different speeds relative to each other while the apparatus is stationary
(D) When a 360° spin of the apparatus results in a fringe shift compared to the original reading.

Disclaimer

Every effort has been made to prepare these 'Trial' Higher School Certificate Examinations in accordance with the Board of Studies documents, *Principles for Setting HSC Examinations in a Standards-Referenced Framework* (BOS Bulletin, Vol 8, No 9, Nov/Dec 1999), and *Principles for Developing Marking Guidelines Examinations in a Standards-Referenced Framework* (BOS Bulletin, Vol 9, No 3, May 2000). No guarantee or warranty is made or implied that the 'Trial' Examination papers mirror in every respect the actual HSC Examination question paper in any or all courses to be examined. These papers do not constitute 'advice' nor can they be construed as authoritative interpretations of Board of Studies intentions. The CSSA accepts no liability for any reliance use or purpose related to these 'Trial' question papers. Advice on HSC examination issues is only to be obtained from the NSW Board of Studies.

3401-1



The projectile is initially fired at a speed of 35 m/s at 30° to horizontal.

At the top of the trajectory, what would be the velocity and acceleration of the ball?

- (A) 30 m/s and -9.8 m/s^2
- (B) 30 m/s and 9.8 m/s^2
- (C) 35 m/s and -9.8 m/s^2
- (D) 35 m/s and 9.8 m/s^2

5 At approximately what radius would a geostationary satellite need to be placed in orbit around the Earth?

- (A) $7.57 \times 10^{22} \text{ metres}$
- (B) $7.57 \times 10^{22} \text{ kilometres}$
- (C) $5.84 \times 10^7 \text{ metres}$
- (D) $5.84 \times 10^7 \text{ kilometres}$

6 A bar magnet is moved quickly into a coil of wire connected to an ammeter. A current of $8 \mu\text{A}$ is produced. If this experiment is repeated using two bar magnets identical to the first one (that are taped together, side by side) and a different wire coil containing twice as many turns as the first one, what would be the expected current?

- (A) $4 \mu\text{A}$
- (B) $8 \mu\text{A}$
- (C) $16 \mu\text{A}$
- (D) $32 \mu\text{A}$

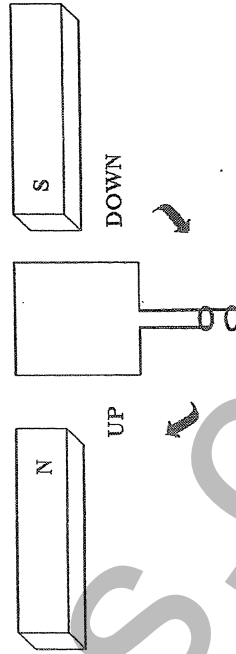
7 A motor consists of a 200 loop square coil of sides 2 cm . The maximum torque produced by the coil while carrying a current of 0.5 A is 0.012 Nm . What is the magnetic field strength experienced by the coil?

- (A) $3.0 \times 10^{-5} \text{ T}$
- (B) $6.0 \times 10^{-3} \text{ T}$
- (C) 0.3 T
- (D) 60 T

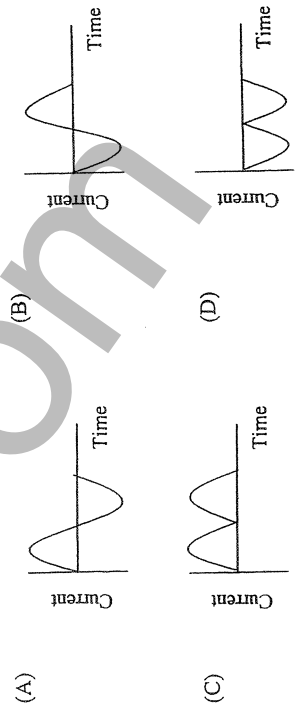
8 What does the back EMF in motors accounts for?

- (A) increasing torque as the motor starts up
- (B) increasing current in the coil as the motor starts up
- (C) the need to have an effective means of slowing the motor
- (D) the need to include a variable resistor in motors

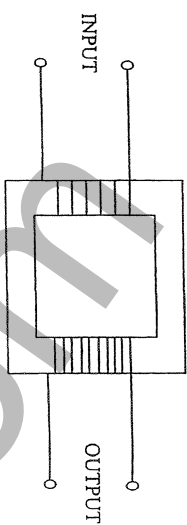
9 The model generator below is rotating from its present position starting from rest, as indicated.



The variation in current over time is most accurately represented as:



- 10 Which appliance would the type of transformer illustrated below be most suited to?



- (A) a radio
(B) a digital camera recharger
(C) a CRT television
(D) a laptop computer

- 11 Who were the scientists who determined the crystal structure of metals?

- (A) Bardeen and Cooper
(B) Bragg and Bragg
(C) Cookes and Thomson
(D) Hertz and Maxwell

- 12 What determines the magnitude of the maximum force a moving charged particle experiences in a magnetic field?

- (A) the magnitude of the charged particle, the sign of the charged particle and the magnitude of the magnetic field
(B) the magnitude of the charged particle, the speed of the charged particle and the magnitude of the magnetic field
(C) the speed of the charged particle, the magnitude of the magnetic field and the angle it makes with the magnetic field
(D) the speed of the charged particle, the sign of the charged particle and the angle it makes with the magnetic field direction

- 13 The resistance of a metal is affected by the presence of impurities. It is also affected by having a metal lattice vibrate.

Which if A, B, C or D correctly identifies how the resistance is affected in these two cases?

	Impurities present	Metal lattice vibrates
(A)	resistance increases	resistance increases
(B)	resistance increases	resistance decreases
(C)	resistance decreases	resistance increases
(D)	resistance decreases	resistance decreases

- 14 The force experienced by an electron in a uniform electric field is 1.54×10^{-15} N. The magnitude of the electric field is:

- (A) $2.47 \times 10^{-34} \text{ Vm}^{-1}$
(B) $1.04 \times 10^{-4} \text{ Vm}^{-1}$
(C) $9.61 \times 10^3 \text{ Vm}^{-1}$
(D) $1.69 \times 10^{15} \text{ Vm}^{-1}$

- 15 A red laser emits a wavelength of 600 nm. The energy of a photon of light from this laser would be:

- (A) $3.31 \times 10^{-48} \text{ J}$
(B) $3.98 \times 10^{-40} \text{ J}$
(C) $3.98 \times 10^{-31} \text{ J}$
(D) $3.31 \times 10^{-19} \text{ J}$



--	--	--	--	--	--	--	--

Centre Number

--	--	--	--	--	--	--	--

Student Number

Physics

Section I (continued)

Part B – 60 marks

Attempt Questions 16-27

Allow about 1 hour and 45 minutes for this part

Show all relevant working in questions involving calculations.

Marks

Question 16 (6 marks)

- (a) Identify the force that causes the centripetal force that keeps a satellite in orbit around a planet.

- (b) Find the mathematical expression for the mass of a planet as derived from the centripetal and gravitational forces.

- (c) Use the expression derived in part (b), or otherwise, to calculate the mass of Jupiter, given that a satellite of Jupiter, Io, has an orbital velocity of 17.3 km/s and an orbital radius of 421 700km.

- (d) Calculate the acceleration due to gravity at the visible surface of Jupiter (Jupiter has a radius of 71000km).

Question 17 (6 marks)

Students were set the task of determining the initial velocity of a bottle rocket. They were allowed to take any measurements they liked using a protractor, stopwatch and a ruler. The students also recorded the flight of the rocket on video and analysed the footage later. The data obtained is shown below.

Diagram of launch of rocket from inclined plane.

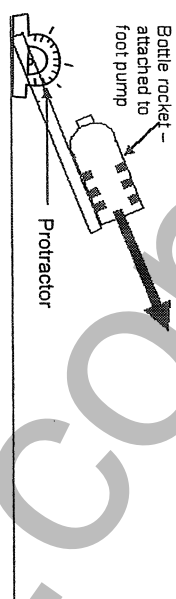


Table 1: Averages of readings taken on the day.

Data collected	
Range of projectile	72m
Initial angle of inclined plane from horizontal	48°
Flight time	4.06seconds

Table 2: Data collected from video footage.

Data	Reading taken
Horizontal distance from launch point	50m
Angle made by rocket (at this point) to horizontal	22°

Assuming that the bottle rocket is an ideal projectile, analyse the information in table 1 above to calculate the initial velocity of the rocket.

Then justify that the readings taken in table 2, from the video footage, are consistent with the collected data in table 1, and hence of the same rocket launch.

Marks

Question 18 (4 marks)

A 1 tonne satellite has been launched from Earth and sometime later the potential energy of the satellite was determined to be 3.97 J . Determine the distance of the satellite from Earth at this point and hence the escape velocity of the satellite.

4

Question 19 (4 marks)

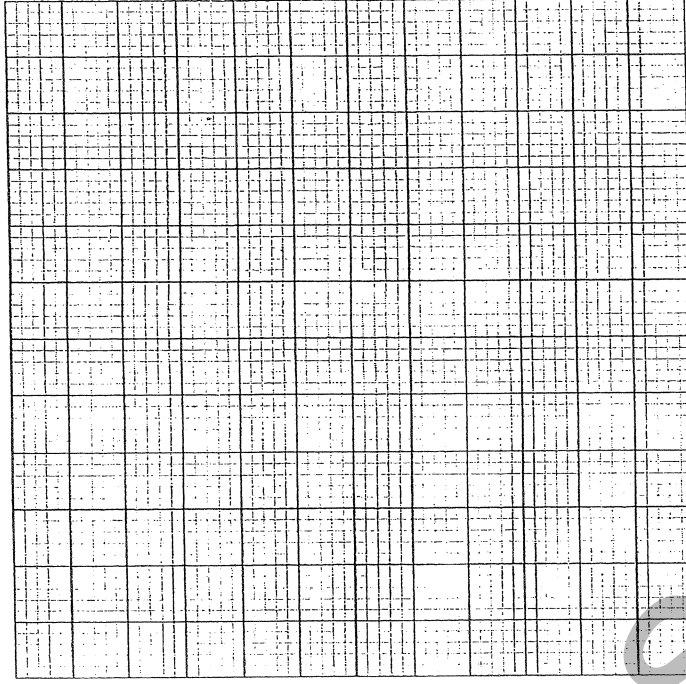
A CD player, a computer and a television set all incorporate loudspeakers. With the aid of a labeled diagram, describe how a loudspeaker works.

4

Question 20 (continued)

4

- (b) Plot the data onto the grid below and add the line of best fit (trend line).



1

- (c) Use the graph to predict the repulsive force between the two wires if placed 3 mm apart.

Question 20 (7 marks)

A student placed two 50 cm long parallel current carrying wires at various distances from one another. The student measured the repulsive force that was produced and recorded the readings in the table below.

Distance between wires (mm)	Force acting on each wire (10^{-3} N)
2	4.8
4	2.4
6	1.6
8	1.2
10	1.0
12	0.8
14	0.7
16	0.6

2

- (a) The current through each of the wires is identical. Using data from the table above, calculate a possible current value.

.....

.....

.....

.....

Question 20 continues on page 13

Marks

Question 21 (5 marks)

Assess the impact on the development of new technologies of scientists being able to manipulate electrons.

un

Marks

Question 22 (5 marks)

Discuss the proposals by Westinghouse and Edison to supply electricity to cities.

Un

Marks

Question 23 (6 marks)

The invention of the transistor was made possible by an understanding of the structure of semiconductors.

2

- (a) Use diagram(s) to show the position of electrons and holes, in the band structure, when a pure semiconductor carries a current under the influence of an electric field.

2

- (b) Using your diagram, or otherwise, describe the production of this current.

2

- (c) Explain the difference between an n-type semiconductor and a p-type semiconductor.

Marks

Question 24 (3 marks)

3

Describe how difficulties of heating caused by eddy currents in transformers may be overcome.

Question 25 (6 marks)

Marks

- (a) In the space provided, sketch a diagram of a cathode ray tube, identifying the electrodes in the electron gun, deflection plates and the fluorescent screen. 2

- (b) If the electron in the cathode ray tube was travelling at $0.2c$, qualitatively predict how mass and time for the electron would vary in the laboratory frame of reference and the electrons' frame of reference? 2

- (c) In the laboratory, the length of the cathode ray tube is 25cm. Calculate the length of the cathode ray tube in the electrons' frame of reference if it was able to travel the 25cm at a constant $0.2c$. 2

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 26 (4 marks)

Marks

- Discuss Einstein and Planck's differing views about whether science research is removed from social and political forces. 4

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 31 – Quanta to Quarks (25 marks)

- (a) (i) Calculate the wavelength of the light photon generated by an electron moving from energy level 4 to energy level 2 in the normal hydrogen atom.
- (ii) Determine the deBroglie wave length of an electron moving with a velocity of $6.5 \times 10^5 \text{ ms}^{-1}$.
One of the electrons of a particular atom has a periodic path length (circumference) of $4.48 \times 10^{-9} \text{ m}$. Explain why this electron mentioned above could be associated with this particular atom.

(b) During your study of Quanta to Quarks you gathered information from secondary sources to assess the significance of the Manhattan Project on society.

- (i) Describe how you would determine the validity of the data sources you used.
- (ii) Explain why the Manhattan Project was significant to society.
- (c) Evaluate how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking using the work of Heisenberg and Pauli to develop of the modern theory of the structure of the atom and assessing the significance of their contribution.

(d) (i) Identify the properties of a named radio-isotope that make it useful in medicine or industry.

(ii) Compare the requirements for a controlled nuclear chain reaction with the requirements for one which is uncontrolled.

(iii) Contrast the properties and uses of at least TWO different particle accelerators in assisting scientists to investigate the structure of matter.

Question 27 (4 marks)

In the 19th century, soon after cathode rays were discovered, a debate arose as to whether they were made up of electromagnetic radiation or streams of particles.

- (a) Identify TWO contradicting pieces of evidence regarding the nature of cathode rays.

- (b) Identify ONE significant hazard encountered in using cathode ray tubes in the school laboratory and ONE precaution to minimise this hazard.

End of Section I



CATHOLIC SECONDARY SCHOOLS ASSOCIATION

2007 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

PHYSICS – MARKING GUIDELINES

Section I
Part A
15 marks
Questions 1-15 (1 mark each)

Question	Answer	Outcomes Assessed	Targeted Performance Bands
1	A	H6	2-3
2	C	H6	3-4
3	B	H1, H6	4-5
4	A	H6, H13	3-4
5	A	H6, H14	4-5
6	D	H7, H9	2-3
7	C	H9	4-5
8	D	H7, H9	3-4
9	B	H7, H9	5-6
10	C	H7, H9	4-5
11	B	H1, H8	2-3
12	B	H9	3-4
13	A	H7	2-3
14	C	H7	3-4
15	D	H7, H13	2-3

DISCLAIMER
The information contained in this document is intended for the professional assistance of marking staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

Part B

60 marks

Questions 16-27

Question 16 (6 marks)

(a) (1 mark)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 2-3

Criteria	Mark
• identifies correct force	1

Sample answer
gravity

(b) (1 mark)

Outcomes assessed: H6, H9

Targeted Performance Bands: 3-4

Criteria	Mark
• Equates centripetal force and universal gravitational force to obtain an expression for mass	1

Sample answer

$$\frac{Gm_1m_2}{r^2} = \frac{mv^2}{r}$$

$$G \frac{m_2}{r^2} = \frac{v^2}{r}$$

$$m_2 = \frac{v^2 r}{G}$$

(c) (2 marks)

Outcomes assessed: H6, H9

Targeted Performance Bands: 3-5

Criteria	Mark
• correct substitution and correct answer with units	2
• correct substitution into part (b) OR into one relevant equation	1

Sample answer

$$m_2 = \frac{v^2 r}{G}$$

$$= \frac{(17.3 \times 10^3)^2 (421700 \times 10^3)}{(6.67 \times 10^{-11})}$$

$$= 1.89 \times 10^{27} \text{ kg}$$

(d) (2 marks)

Outcomes assessed: H6, H9

Targeted Performance Bands: 3-6

Criteria	Mark
• correct substitution, using mass from part (c), and correct answer with units	2
• correct substitution	1

Sample answer

$$g = \frac{Gm}{r^2}$$

$$= \frac{6.67 \times 10^{-11} (1.89 \times 10^{27})}{(71000 \times 10^3)^2}$$

$$= 25 \text{ m/s}^2$$

Question 17 (6 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 2-6

Criteria	Mark
• correctly calculates initial velocity, showing working and units	5-6
• uses collected data to determine that video footage data is consistent with table 1 data, makes link between table 1 and table 2 data	
• correctly calculates initial velocity AND	3-4
• attempts to use collected data to show consistency with video footage data	
• identifies initial velocity correctly OR	1-2
• uses some collected data appropriately	

Sample answer

$$\Delta x = u_x t = u \cos \theta \times t$$

$$72 = u_x \times 4.06$$

$$u_x = 17.7 \text{ m/s}$$

$$u_x = u \cos 48^\circ$$

$$u = 26.5 \text{ m/s}$$

hence initial velocity is 26.5 m/s

$$u_y = 26.5 \sin 48^\circ$$

$$u_y = 19.7 \text{ m/s}$$

$$\text{when } \Delta x = 50 \text{ m}$$

$$t = \Delta x / u_x = 50 / 17.7 = 2.82 \text{ s}$$

$$v_y = u_y + a_y t$$

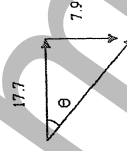
$$= 19.7 + (-9.8) \times 2.82 = -7.9 \text{ m/s}$$

$$\text{And } u_x = 17.7 \text{ m/s so since they are vectors,}$$

$$\tan \theta = 7.93 / 17.7$$

$$\theta = 24^\circ$$

This angle is consistent with the video footage data of 22°.



Question 18 (4 marks)

Outcomes assessed: H7, H9

Targeted Performance Bands: 3-6

Criteria	Marks
correctly calculates the velocity with which the satellite was launched, showing all working and units	3-4
- correctly uses E_p equation to calculate radius at given E_p OR - equates E_p and E_k to obtain velocity	2
- correctly substitutes into equation for E_p OR - correctly substitutes into equation for E_k	1

Sample answer

$$E = \frac{-Gm_1m_2}{r}$$

$$-3.97 = \frac{-6.67 \times 10^{-11} (1000)(6.0 \times 10^{24})}{r}$$

$$r = 1.00 \times 10^7 \text{ m}$$

escape velocity:

$$\frac{-Gm_1m_2}{r} = \frac{1}{2}mv^2$$

$$r$$

$$v = \sqrt{2m/r}$$

$$v = \sqrt{2(5.9 \times 10^{24}) / 1.00 \times 10^7}$$

$$v = 10828 \text{ m/s or } 11 \text{ km/s}$$

4

DISCLAIMER
The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

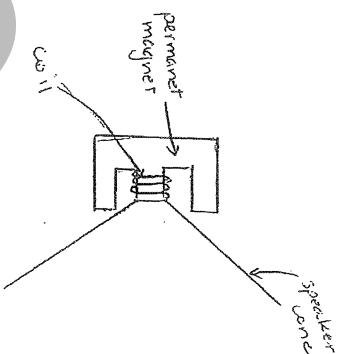
Question 19 (4 marks)

Outcomes Assessed: H9

Targeted Performance Bands: 2-4

Criteria	Marks
- Draws a labelled diagram of a loudspeaker. - Outlines the role of an alternating current in inducing an oscillating magnetic field in the loudspeaker coil. - Outlines the vibration produced in the speaker cone due to the interaction of oscillating and permanent magnetic fields, motor effect.	3-4
- Draws a labelled diagram of a loudspeaker OR - Identifies the alternating current supplied to the loudspeaker coil. - Identifies the interaction between the coil's magnetic field and a permanent magnetic field OR mentions motor effect	2
- Identifies the alternating current supplied to the loudspeaker coil OR - identifies the interaction between the coil's magnetic field and a permanent magnetic field OR mentions motor effect OR - Draws a labelled diagram of a loudspeaker.	1

Sample answer



In a loudspeaker a varying current is provided by an amplifier to a coil placed between the poles of circular magnetic field provided by a permanent magnet. The coil vibrates in response to the interaction between the circular magnetic field and the oscillating magnetic field induced in the coil supplied with AC (this is the motor effect). This causes the speaker cone to which it is attached to vibrate producing sound waves. The frequency & volume of the sound waves determined by the amplifier's input to the coil.

5

DISCLAIMER
The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

Question 20 (7 marks)

(a) (2 marks)

Outcomes Assessed: H9

Targeted Performance Bands: 3-4

Criteria	Marks
Identifies the correct formula AND Substitutes ANY correct values into the formula from the data table given	2
Identifies the correct formula	1

Sample answer

$$F/L = (kI_1I_2)/d \text{ where } I_1 = I_2$$

$$\text{Using } F = 4.8 \times 10^{-3} \text{ N and } d = 2 \text{ mm (students may choose any point in table)}$$

$$F/L = (kI^2)/d$$

$$I^2 = Fd/kL = \frac{4.8 \times 10^{-3} (2 \times 10^{-3})}{(2 \times 10^{-7}) \times 0.5}$$

$$I^2 = 96$$

$$I = 9.8 \text{ A}$$

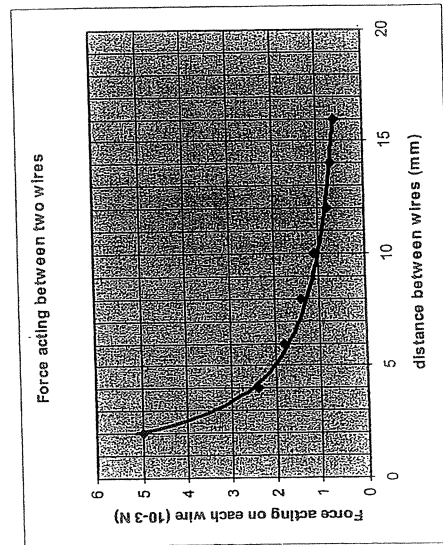
(b) (4 marks)

Outcomes assessed: H13

Targeted Performance Bands: 2-4

Criteria	Marks
Linear scales on x and y axes that extend over the majority of the grid space Axes are clearly labelled with the appropriate units [x (independent variable) = distance, y (dependent variable) = force] Data points accurately plotted Smooth trend line drawn Any combination of the above points, as deemed appropriate	4
	1-3

Sample answer



(c) (1 mark)

Outcomes assessed: H13

Targeted Performance Bands: 3-5

Criteria	Mark
Correctly predicts the force between the two wires, consistent with graph	1

Sample answer

Force between the wires is approximately $3.1 \times 10^{-3} \text{ N}$.

Question 21 (5 marks)

Outcomes Assessed: H4

Targeted Performance Bands: 2-6

Criteria	Marks
Identifies that electrons can be manipulated by electric or magnetic fields due to their negative charge Identifies a use of the manipulation of charges Identifies more than TWO technologies that make use of the manipulation of electrons Identifies the use these technologies are put to Makes a judgement of the value of the development of new technologies Identifies that electrons can be manipulated by electric or magnetic fields due to their negative charge Identifies a use of the manipulation of charges Identifies TWO technologies that make use of the manipulation of electrons Identifies the use these technologies are put to Makes no judgement statement (or is not based on any criteria) Identifies that electrons can be manipulated by electric or magnetic fields due to their negative charge OR Identifies a use of the manipulation of charges OR Identifies ONE technologies that make use of the manipulation of electrons OR Identifies the use these technologies are put to	4-5
	2-3
	1

Sample answer

Electrons can be manipulated using electric or magnetic fields because of their negative charge. Charges are manipulated in devices such as cathode ray tubes. Cathode ray tubes are used in a number of technologies. CRT can be used to measure voltage changes – ie in electricity generation, sound production, even heart rates and breathing rates. In CRT the electron is accelerated in a large electric field and then deflected by a combination of electric and magnetic fields. The electrons then hit a fluorescent screen, where it is possible to create an image. The image formed could be created by computer software, collecting data from a variety of sources – eg CAT or MRI scanners, which are used to create images of the inside of bodies, allowing diagnosis of life threatening diseases. Being able to manipulate electrons has enabled scientists to develop these technologies, as well as many others.

Note: there are MANY possible technologies – using electricity, semiconductors, and superconductors – that are valid examples for this question.

Question 22 (5 marks)

Outcomes Assessed: H1, H9

Targeted Performance Bands: 2-6

Criteria	Marks
- Identifies the proposals by Westinghouse and Edison to supply electricity to cities - Identifies TWO issues associated with each proposal by Westinghouse and Edison to supply electricity to cities - Outlines an argument for each proposal - Outlines an argument against each proposal	4-5
- Identifies the proposals by Westinghouse and Edison to supply electricity to cities - Identifies an issue associated with each proposal by Westinghouse and Edison to supply electricity to cities - Outlines an argument for or against each proposal	3
- Identifies the proposals by Westinghouse and Edison to supply electricity to cities OR - Identifies an argument for and/or against each proposal - Identifies the proposals by Westinghouse OR Edison to supply electricity to cities	2
Identifies the proposals by Westinghouse and Edison to supply electricity to cities	1

Sample answer

Edison proposed supplying DC electricity to cities. DC voltages could not be easily stepped up using transformers and so could only supply locations in close proximity without suffering substantial line loss.

Westinghouse argued for AC electricity to be supplied to cities. AC voltages are readily stepped up and down using transformers to minimise line loss and so can supply distant locations. AC is transmitted at high voltages and low currents to minimise energy losses due to resistance heating.

Edison attempted to discredit Westinghouse's proposal based on safety; he argued that the high AC transmission voltages suggested by Westinghouse endangers the public's safety and demonstrated its capacity to kill by electrocution.

DISCLAIMER
The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies.
No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

Question 23 (6 marks)

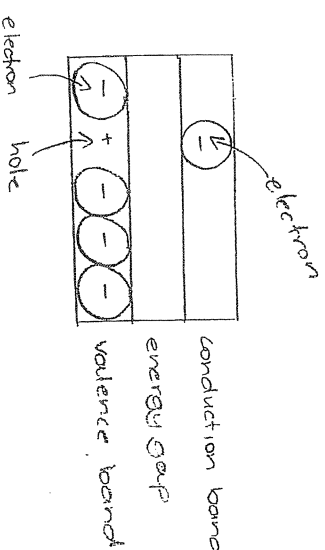
(a) (2 marks)

Outcomes Assessed: H2, H9

Targeted Performance Bands: 2-4

Criteria	Marks
- Diagram shows the location of valence band, conduction band and energy gap appropriate for a semiconductor - Identifies most electrons inhabiting valence band and a few on the conduction band - Identifies holes in valence band	2
Identifies ONE of the above	1

Sample answer



(text is not necessary for full marks) The valence band contains most of the electrons. The electrons in the conduction band move towards the positive plate of the applied potential, because they are negatively charged. The positive holes move in the valence band towards the negative plate. The movement of the charges is the current the semiconductor carries.

DISCLAIMER
The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies.
No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

(b) (2 marks)

Outcomes assessed: H2, H9

Targeted Performance Bands: 2-6

Criteria	Marks
- Provides characteristic of the production of holes in semiconductors - Identifies that energy is required for the electron to move into the conduction band	2
Identifies that a hole is left behind when an electron moves from the valence band into the valence band	1

Sample answer

An electric potential is placed across the semiconductor. This potential allows some electrons to gain enough energy to move from the valence band into the conduction band, where they can move freely as a current towards the positive potential. In the valence band where the electron has left, it creates a hole. The holes can move in the valence band creating another current towards the negative potential.

(c) (2 marks)

Outcomes assessed: H2, H9

Targeted Performance Bands: 3-6

Criteria	Marks
- Identifies a difference between n-type and p-type semiconductors - Gives reasons for the difference given	2
Identifies a difference between n-type and p-type semiconductors	1

Sample answer

An n-type semiconductor has extra electrons in the valence band than semiconductors which are not doped. The extra electrons come from the group V element which is used to dope the semiconductor, this has more valence electrons than the group IV element the semiconductor is made from.

A p-type semiconductor has more holes in the valence band than semiconductors which are not doped. The extra holes come from the lack of valence electrons in the group III element used to dope the semiconductor, which has less valence electrons than the group IV element the semiconductor is made from.

Question 24 (3 marks)

Outcomes Assessed: H7

Targeted Performance Bands: 2-6

Criteria	Marks
- Explains how eddy currents form - Identifies TWO methods of reducing eddy currents in transformers - Gives reasons how BOTH of these methods reduce eddy currents	3
- Explains how eddy currents form AND - Identifies TWO methods of reducing eddy currents in transformers OR - Identifies ONE method of reducing eddy currents in transformers AND - Gives reasons how this method reduces eddy currents	2
- Identifies ONE method of reducing eddy currents in transformers OR - Explains formation of eddy currents	1

Sample Answer

Eddy currents are induced currents flowing in the core caused by a change of flux through the core. Heating is caused by the conversion of electrical energy to heat energy. Reducing the size of the eddy current reduces the energy (heat) lost. Lamination of the iron core in transformers reduces the size of the eddy currents induced. Lamination involves slicing the core into thin sheets and coating them with a thin layer of enamel material. This means any eddy currents induced are much smaller, due to the smaller amount of metal able to conduct a current. Using ferrite material for the transformer core will reduce eddy currents. The ferrite material still allows the magnetic field to be enhanced but it is not as good a conductor as iron, hence reducing the size of the eddy currents.

Question 25 (4 marks)

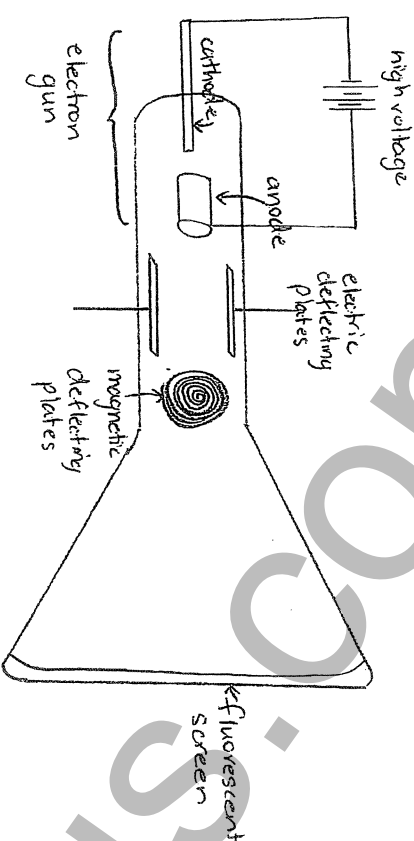
(a) (2 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 2-4

Criteria	Mark
• Appropriate diagram which includes all listed parts correctly labelled	2
• Diagram which does not include all of the listed parts correctly labelled	1

Sample Answer



(c) (2 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 4-6

Criteria	Marks
• Correct substitution into the correct equation	2
• Correct calculation of relativistic length	
• Correct substitution into the correct equation	1

Sample Answer

$$\begin{aligned}
 L_v &= L_0 \sqrt{1 - v^2/c^2} \\
 &= 25 \sqrt{1 - (0.2c)^2/c^2} \\
 &= 25 \sqrt{1 - (0.2)^2} c^2/c^2 \\
 &= 25 \sqrt{0.96} \\
 &= 24.5 \text{ cm}
 \end{aligned}$$

Question 26 (4 marks)

Outcomes Assessed: H2

Targeted Performance Bands: 2-4

Criteria	Marks
• Identifies Einstein's AND Planck's views on science research being removed from social and political forces	3-4
• Identifies how the issues are different for Einstein and Planck	
• Identifies either Einstein's OR Planck's views on science research being removed from social and political views	1-2

Sample Answer

Einstein and Planck were both German scientists, working on research during the rise of Hitler in Germany. Einstein felt uncomfortable about the direction the political forces in Germany were pushing the scientists towards the war effort. Planck felt that conducting scientific research was important, regardless of the driving force behind it, or to what use the research was going to be put to. Einstein did not think scientists should be helping to kill people. Einstein felt so strongly, he eventually left Germany to continue his research, trying to ensure that Germany would not be the first to develop horrific weapons. Planck remained in Germany having his research supported by the Government of the time.

(b) (2 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 4-6

Criteria	Mark
• Prediction of time variation in laboratory AND electron's frame of reference	2
• Prediction of mass variation in laboratory AND electron's frame of reference	
• Prediction of time variation in laboratory OR electron's frame of reference OR	
• Prediction of mass variation in laboratory OR electron's frame of reference OR	
• Identifies that mass increases and time dilates for moving objects	1

Sample Answer

To an observer in the laboratory frame of reference time passes more slowly for the electron and mass increases.

To the electron (as an observer) the laboratory's time passes more slowly and the mass of objects in it and more massive than when stationary relative to the electron. The electron never sees its own passage of time change nor does its mass change.

Question 27 (4 marks)

(a) (2 marks)

Outcomes Assessed: H12

Targeted Performance Bands: 3-5

Criteria	Marks
• Identifies TWO pieces of contradicting evidence about the nature of cathode rays	2
• Identifies ONE relevant piece of data about the nature of cathode rays	1

Sample Answer

Cathode rays create shadows when fired at a maltese cross – this is a wave property.
Cathode rays are able to make a paddle wheel spin, showing they have momentum, a particle property.

(b) (2 marks)

Outcomes Assessed: H11

Targeted Performance Bands: 2-4

Criteria	Marks
• Identifies ONE significant hazard appropriate for this investigation AND	2
• Identifies a precaution appropriate to the hazard nominated	
• Identifies ONE significant hazard appropriate for this investigation OR	1
• Identifies ONE precaution appropriate for this investigation	

Sample Answer

Cathode ray tubes need to be attached to an induction coil for this investigation. Induction coils produce a very high voltage across a spark gap, which produces x-rays which may cause damage to human cells.
For this reason, this investigation is a teacher demonstration with students no closer than 3m from the induction coil.

Question 31 – Quanta to Quarks (25 marks)

(a) (i) (2 marks)

Outcomes Assessed: H7, H10

Targeted Performance Bands: 2-3

Criteria	Marks
• Correct substitution into correct equation	2
• Correct calculation of wavelength	
• Correct substitution into correct equation	1

Sample answer

$$n_i = 4$$

$$n_f = 2$$

$$1/\lambda = R(1/n_f^2 - 1/n_i^2)$$

$$= 1.097 \times 10^7 (1/2^2 - 1/4^2)$$

$$= 2.057 \times 10^6$$

$$\lambda = 4.862 \times 10^{-7} \text{ m}$$

DISCLAIMER

The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible trial questions. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

DISCLAIMER

The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible trial questions. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

(a)(ii)(3 marks)

Outcomes Assessed: H7, H10

Targeted Performance Bands: 3-6

Criteria	Marks
• Correct substitution into correct equation • Correct calculation of wavelength • Gives reason for this electron being part of particular atom	2-3
• Correct substitution into correct equation	1

Sample answer

$$v = 6.5 \times 10^5 \text{ m/s}$$

$$\text{circumference} = 4.48 \times 10^{-9} \text{ m}$$

$$\text{de Broglie } \lambda = h/mv$$

$$= \frac{6.626 \times 10^{-34}}{9.109 \times 10^{-31} \times 6.5 \times 10^5}$$

$$= 1.12 \times 10^{-9} \text{ m}$$

$$4.48 \times 10^{-9} \div 1.12 \times 10^{-9} = 4.0$$

This wavelength is $\frac{1}{4}$ of circumference, which is an integer, hence it is possible for this electron to be part of this particular atom.

(b) (i) (3 marks) *Outcomes Assessed: H12*

Targeted Performance Bands: 2-4

Criteria	Marks
• Identifies at least TWO methods of checking the validity of a secondary source • States the positive result for the validity methods • Identifies ONE method for checking the validity of a source	2-3 1

Sample answer

The validity of a secondary source can be checked by determining the credentials of the author of that source. If the author has university qualifications in the physics or represents a reputable institution like a university, then the source would be deemed valid.

The validity can also be checked by determining the date of publication. The more recent the publication date, the more valid the source.

(b) (ii) (3 marks)

Outcomes Assessed: H1, H6, H10

Targeted Performance Bands: 2-6

Criteria	Marks
• Identifies at least TWO consequences of the Manhattan Project • Gives reasons for this being significant to society • Identifies at least ONE consequence of the Manhattan Project	2-3 1

Sample answer

The Manhattan Project resulted in the first atomic bomb being detonated above Hiroshima. This led to the nuclear arms race, where countries, mainly Russia and USA, tried to manufacture as many atomic bombs as they could.

After the Manhattan Project many scientists thought all nuclear weapons should cease to be produced. Eventually sustained nuclear reactions were put to other uses – power generation, radioisotopes for use in medicine and industry, etc.

The Manhattan Project certainly had a significant impact on society – both positive and negative.

DISCLAIMER

The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

DISCLAIMER

The information contained in this document is intended for the professional assistance of teaching staff. It does not constitute advice to students. Further it is not the intention of CSSA to provide specific marking outcomes for all possible Trial HSC answers. Rather the purpose is to provide teachers with information so that they can better explore, understand and apply HSC marking requirements, as established by the NSW Board of Studies. No guarantee or warranty is made or implied with respect to the application or use of CSSA Marking Guidelines in relation to any specific trial exam question or answer. The CSSA assumes no liability or responsibility for the accuracy, completeness or usefulness of any Marking Guidelines provided for the Trial HSC papers.

(c) (7 marks)

Outcomes Assessed: H2, H7, H10

Targeted Performance Bands: 2-6

Criteria	Marks
- Describes both Heisenberg's and Pauli's contribution to atomic theory. - Applies a judgement of the value of the contribution of both Heisenberg's and Pauli's to atomic theory and how they are inter-related - Applies a judgement of how our understanding of the atom has changed due to Heisenberg and Pauli's work. - Outlines both Heisenberg's and Pauli's contribution to atomic theory. - Applies a judgement of the value of the contribution of Heisenberg's or Pauli's to atomic theory. - Outlines a contribution of Heisenberg or Pauli to atomic theory. - Identifies a contribution of Heisenberg or Pauli to atomic theory.	6-7
	4-5
	2-3
	1

Sample answer

Both Heisenberg and Pauli made significant contributions to the development of atomic theory. Pauli utilised Heisenberg's ground-breaking ideas to better account for the structure of atoms.

Heisenberg rejected Bohr's classical model of the atom and developed a model based on quantum mechanics. He went on to develop the uncertainty principle which stated that the momentum & position of an electron cannot be accurately determined at any given time.

Pauli applied Heisenberg's quantum mechanical model to the hydrogen atom and theoretically derive the Rhydborg constant and went on to develop the Balmer equation. Pauli also developed the exclusion principle which proposed that no two electrons possess the same quantum numbers and hence provided a theoretical basis for the electron configuration of atoms.

Hence both Heisenberg and Pauli help develop our modern view of the atom, from Bohrs' model to their model, further increasing our understanding of the atom – how it works and how it can be applied to other fields of physics and chemistry.

(d) (i) (1 mark)

Outcomes Assessed: H3, H7, H10

Targeted Performance Bands: 2-3

Criteria	Marks
Identifies a property of a named radioisotope that makes it useful for medicine or industry	1

Sample answer

Tc-99m emits gamma radiation which can be used to form images of the functioning of inside the human body. It has a half life of 6 hours which makes it suitable for use in the human body.

(d) (ii) (3 marks)

Outcomes Assessed: H7, H10

Targeted Performance Bands: 2-6

Criteria	Marks
- Identifies the requirements for a controlled nuclear chain reaction - Identifies the requirements for an uncontrolled nuclear chain reaction. - Identifies similarities AND differences between the TWO requirements - Identifies the requirements for a controlled nuclear chain reaction OR - Identifies the requirements for an uncontrolled nuclear chain reaction.	2-3
	1

Sample answer

A chain reaction is one which produces a particle which will take part in another nuclear reaction.

An uncontrolled chain reaction occurs when there is a critical mass of fuel which can sustain a chain reaction and the numbers of fission reactions increases exponentially, resulting in an explosion (huge release of energy).

A controlled nuclear chain reaction modifies the number of neutrons available for fission. It reduces the number of neutrons or modifies the speed of the neutron so the reaction does not get out of control.

(d) (iii) (3 marks)

Outcomes Assessed: H6, H7, H9, H10

Targeted Performance Bands: 2-6

Criteria	Marks
- Identifies the properties of at least TWO particle accelerators - Identifies the similarities and differences of the properties of these TWO accelerators for investigating the structure of matter - Identifies the properties of at least ONE particle accelerator	2-3
	1

Sample answer

There are linear accelerators and cyclotrons.

Linear accelerators accelerate charged particles to travel in a straight line.

Cyclotrons accelerate charged particles in a circle.

Both accelerators use varying magnetic fields to accelerate charged particles.

When the particles are accelerated they are smashed into other particles. The result of the collision is analysed and the structure of the particles can be determined.