**Barker College**

# 2001

## TRIAL
## HIGHER SCHOOL
## CERTIFICATE

# Physics

**General Instructions**

- Reading time —5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Board-approved calculators may be used
- Draw diagrams using pencil
- Show ALL relevant working in questions involving calculations (i.e. marks will be deducted for not showing working).
- A Periodic Table, a Data Sheet and Formulae Sheets are provided on the back pages of this paper. It may be necessary to you to refer to these to answer some of the questions in this examination paper.

**Part A Pages 2 – 6**
**Total marks (15)**
- Attempt Questions 1 – 15
- Allow about 25 minutes for this part
- Indicate all answers on the Answer Sheet provided

**Part B Pages 7-18**
**Total marks (70)**
- Attempt Questions 15—31
- Allow about 120 minutes for this part
- Write your answers m provided on the paper the spaces

**Part C Page 19**
**Total marks (15)**
- Attempt Question 32
- Allow about 25 minutes for this part
- Write your answers in the spaces provided on the paper

**1. Rockets work better in space than in the Earth's atmosphere**

**A in a vacuum there is nothing to push against**
**B momentum of the rocket and its burnt fuel is conserved**
**C the rocket has used most of its fuel and its mass is less**
**D friction drops to almost nothing.**

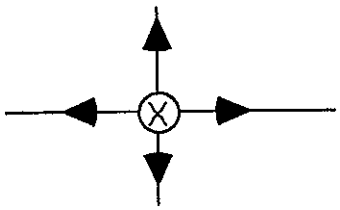
**2 The slingshot effect is used to increase the speed of a spacecraft as it approaches, swings around and leaves a planet. Which statement is correct?**

**A The energy of the planet stays constant.**
**B There is no energy loss or gain for the planet-spacecraft system.**
**C The momentum of the planet is constant.**
**D The potential energy of the spacecraft is constant.**

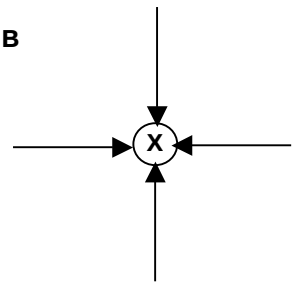
**3 It is not usually possible to communicate with spacecraft as they are reentering earth's atmosphere because**
**A the astronauts are too busy**
**B the spacecraft gets too hot as it reenters**
**C ionised air blocks any radio signal.**
**D any radio aerial would get ripped off.**

**4 A wire carrying a current is diagram perpendicular to the page, with current running into the page. Which diagram indicates the shape and direction of the magnetic field near the current?**

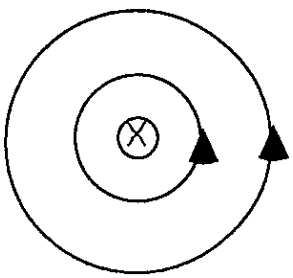
**A**



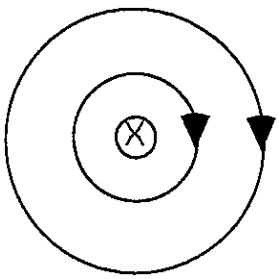
**B**




**C**



**D**



**5 A positive charge is moving parallel to a uniform magnetic field. Which of the following is true?**

**A There is no force on the charge**
**B The direction of a force is given by the right hand rule**
**C The force makes the particle move in a circular path**
**D The force makes the particle move in an helical path.**

**6 In an electric motor the purpose of the split ring commutator is to;**

**A change the AC supply to a DC supply**
**B reverse the flow of current though the coil**
**C provide a complete circuit for current to reach the coil**
**D anchors the ends of the coil.**

**7 W. H. Bragg and W. L. Bragg are of interest in the development of scientific ideas because they**

**A worked with Rutherford on alpha rays**
**B produced the technique of X-ray crystallography**
**C shared a Nobel prize in 1915**
**D showed the Australian government the importance of Science**

**8. The technical development that led to the production and investigation of cathode rays was;**

**A the invention of good vacuum pumps**
**B the building of high voltage batteries**
**C the use of photography to record results**
**D the ability to blow glass into thin tubes.**

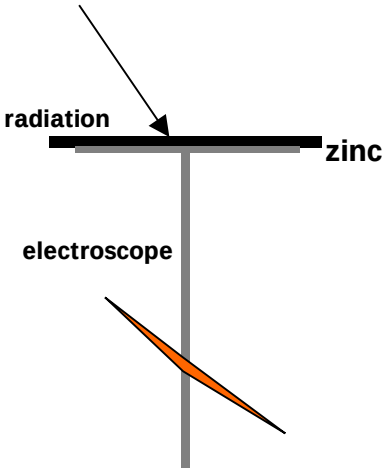
**9 Superconductors**

**A can operate in the region of large magnetic fields**
**B can carry currents without getting hot**
**C are easy to make into superconducting magnets**
**D need to be cooled to the temperature of liquid helium.**

**10 Doping of a piece of pure silicon with a small amount of phosphorus produces a semiconductor in which;**

**A electrons are positive charge carriers**
**B holes are positive charge carriers**
**C electrons are negative charge carriers**
**D holes are negative charge carriers**

**11 An electromagnetic radiation source is held above a clean strip of zinc connected to an electrically charged electroscope.**




**The electroscope is most likely to lose its charge if**

**A the light source produces red light and the electroscope is positively charged**
**B the light source produced red light and the electroscope is negatively charged**
**C the light source produces ultraviolet light and the electroscope is positively charged**
**D the light source produces ultraviolet light and the electroscope is positively charged**

**12 Radio waves are produced by**

**A electrons rapidly decelerating**
**B energy changes inside the nuclei of atoms**
**C charges jumping across energy levels in an atom**
**D oscillating electric charges.**

**13 The Zeeman effect is concerned with the splitting of spectral lines due to**

**A gravitational fields**
**B electric fields**
**C magnetic fields**
**D relative motion.**

**14 What is the structure of the atom $^{13}_{6}C$?**

**A 6 protons, 7 neutrons, 6 electrons**
**B 6 protons, 6 neutrons, 7 electrons**
**C 6 protons, 13 neutrons, 6 electrons**
**D 13 protons, 6 neutrons, 13 electrons**

**15 For the nuclear reaction $^{1}_{0}n + {}^{24}_{12}Mg$ à X à *Y* + $^{0}_{-1}e$**

**A X is magnesium, Y is aluminium**
**B X is magnesium, *Y* is sodium**
**C X is aluminium, *Y* is magnesium**
**D X is aluminium, *Y* is silicon**

## Part B

**Total marks (70)**

**Attempt Questions 15—31**

**Allow about 120 minutes for this part**

**Write your answers in the appropriate space on the paper. Marks allocated to each question are shown in parentheses following the question. Show all relevant working in questions involving calculations (i.e. marks will he deducted for not showing working).**

### Question 16 (4 marks)

**a Calculate the acceleration due to gravity on the surface of Mars.**

**Mass of Mars = $6.42 \times 10^{23}$ kg**
**Radius of Mars = $3.39 \times 10^{6}$ m**

.....

.....

.....

.....

**b For the moons of Jupiter, Ganymede and Io:**

**Radius of orbit of Ganymede = $1.07 \times 10^{6}$ km**

**Period for one revolution of Ganymede = 7.15 days**

**Radius of revolution of Io = $4.22 \times 10^{5}$ km**

**Calculate the period of revolution of Io about the planet Mars (in days).**

.....

.....

.....

.....

## Question 17 (3 marks)

**For the Moon:**

**Radius of orbit about the Earth = $3.84 \times 10^8$ m**

**Period for one revolution = $2.36 \times 10^6$ s**

**Calculate the value of the gravitational acceleration due to the Earth at the surface of the Moon.**

.....

.....

.....

.....

## Question 18 (2 marks)

**It is sometimes stated that the objects in a satellite orbiting the Earth are in 'free fall'.**

**Explain this term clearly.**

.....

.....

.....

.....

.....

## Question 19 (3 marks)

**A passenger of mass 60.0 kg is standing in a lift which is accelerating up at 1.00 m $s^{-2}$.**

**a Calculate the weight force of the passenger.**

.....

.....

**b Calculate the magnitude of the force exerted by the floor of the lift on the passenger.**

.....

.....

**Question 20 (5 marks)**

**A basketballer standing 8.00 m (horizontally) from the basket launches a ball from 1.50 m below the level of the basket and watches it begin to fall cleanly through the ring 1.20 s later.**

**a Calculate the horizontal velocity with which the ball was launched.**

.....

.....

.....

**b Calculate the vertical velocity with which the ball was launched.**

.....

.....

.....

.....

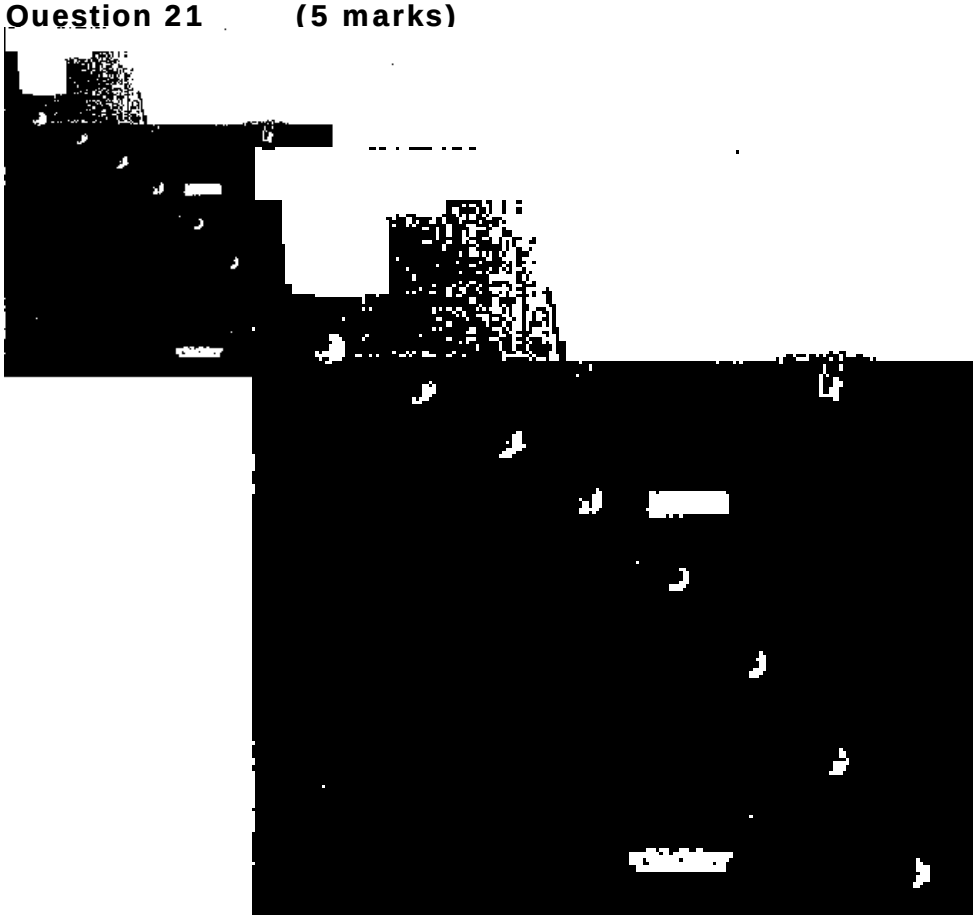
**c Calculate the angle at which the ball was projected.**

.....

.....

.....

## Question 21 (5 marks)



**The time between flashes of the strobe was 0.040 s and the scale was that 10.0 mm on the photo represented 0.106 m in reality.**

**a Determine the horizontal velocity of the ball.**

.....

.....

.....

.....

**b Determine the vertical acceleration due to gravity.**

.....

.....

.....

.....

## Question 22 (2 marks)

**The diagram represents 2 current carrying wires, with currents into the page.**
**Draw the shape of the resulting magnetic field that forms due to the overlap of the field of each wire.**

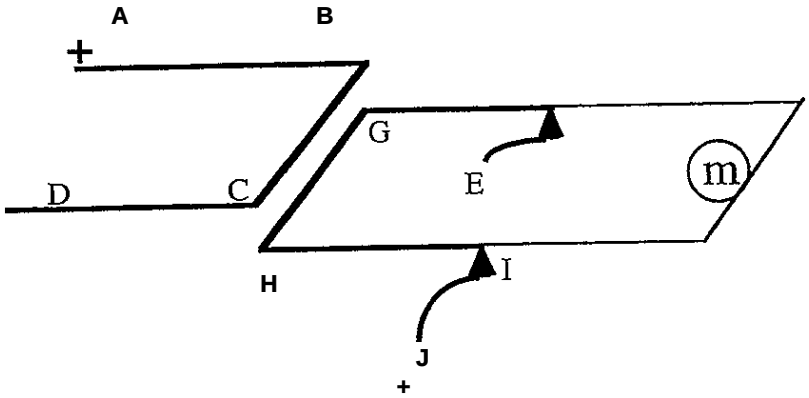
## Question 23 (5 marks)

**The diagram represents two circuits with 4.0 A of current flowing through each of them.**

**Section BC is 0.01 m vertically above section GH. Lengths BC and GH are each 0.03 m.**

**FGHI is a beam pivoted at F and I.**

**A mass, m, is placed on the other end at an equal distance from the pivot as GH.**




**a Calculate the magnetic force acting between BC and GH.**

.....

.....

.....

.....

**b Calculate the size of the mass m which should be placed to exactly balance this magnetic force.**

.....

.....

.....

.....

**c Explain why is it possible to ignore any forces between AD and GH.**

.....

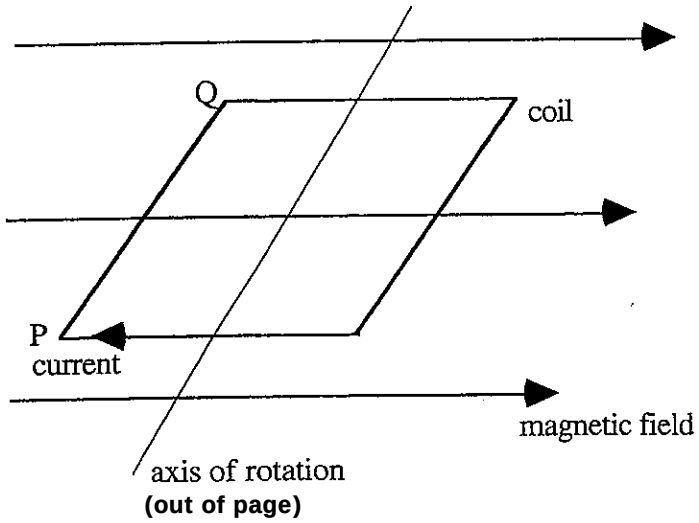
.....

.....

.....

## Question 24 (5 marks)

**A coil of 120 turns is placed between the poles of a magnet, producing a magnetic field in the plane of the page, as in the diagram. The magnetic field penetrating the coil is $3.00 \times 10^{-4}$ T. The coil is square, of side $4.00 \times 10^{-2}$ m.**




**a Calculate the force on side PQ when a current of 6.00 A flows through it.**

.....

.....

.....

.....

**b Calculate the torque causing the coil to turn when in the position shown.**

.....

.....

.....

.....

**c Describe a modification that might be used to make the torque of the coil constant.**

.....

.....

.....

## Question 25 (2 marks)

**Identify two advantages of AC induction motors compared to DC motors.**

.....

.....

.....

.....

.....

.....

## Question 26 (7 marks)

**a Describe an experiment of Michael Faraday which demonstrated that electricity could be generated using magnetism.**

.....

.....

.....

.....

.....

.....

**b A straight wire 2.0 m long is moved at 4.0 m $s^{-1}$ at right angles to a magnetic field of $3.0 \times 10^{-3}$ T.**
**Calculate the magnitude of the emf generated across the ends of the wire.**

.....

.....

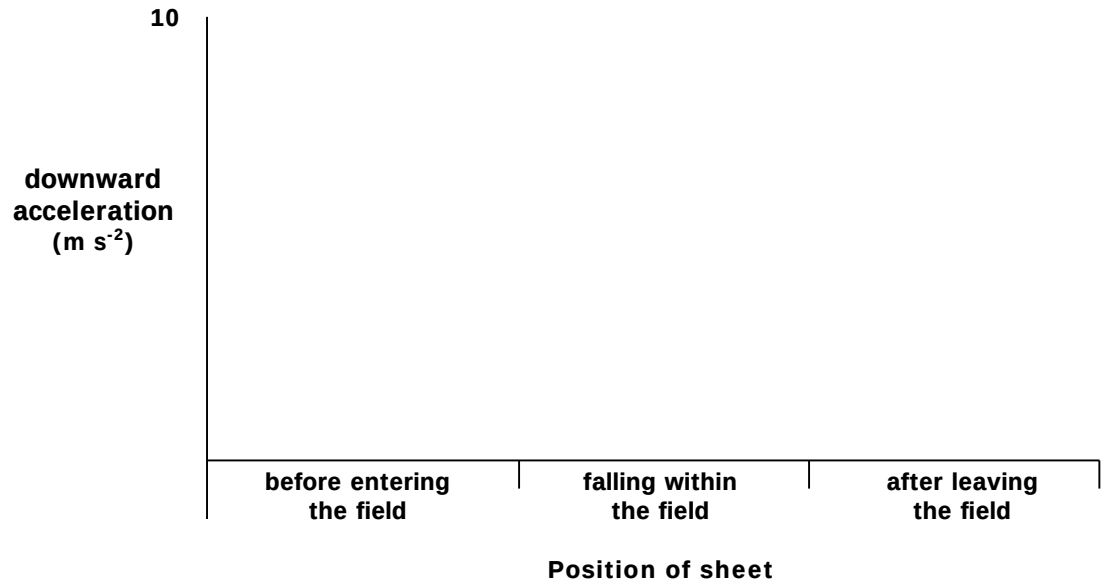
.....

.....

.....

**c A flat sheet of copper is held vertically and then dropped so that it enters a strong horizontal magnetic field.**

**Complete the graph showing the downward acceleration of the copper sheet.**




**Explain the shape of your graph.**

.....

.....

.....

.....

## Question 27 (4 marks)

**A transformer has 400 turns on the primary and 100 turns on the secondary.**

**If 240 V AC is applied to the primary and a current of 0.40 A flows through the primary**

**a Calculate the voltage available across the secondary coil.**

.....

.....

.....

.....

**b Calculate the maximum current available from the secondary coil.**

.....

.....

.....

.....

**c When electricity is carried across large distances it is conveyed by transmission lines operating at 110 000 volts or higher.**
**Identify an advantage that is gained by operating at such high voltages.**

.....

.....

.....

.....

## Question 28 (6 marks)

**With respect to the photoelectric effect:**

**a explain what was predicted by classical theory for light falling on a metal surface.**

.....

.....

.....

.....

.....

**b describe what is actually observed in photoelectric experiments.**

.....

.....

.....

.....

.....

**c explain how quantum theory can be used to reconcile the experimental observations.**

.....

.....

.....

.....

.....

.....

## Question 29 (8 marks)

**a** **Use band theory to explain the difference in electrical conductivity between metallic conductors and insulators.**

.....

.....

.....

.....

.....

.....

.....

**b** **Explain the effect of 'doping' have on the band structure of silicon atoms.**

.....

.....

.....

.....

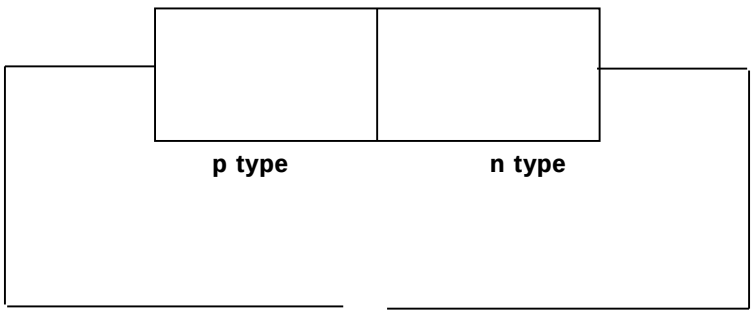
.....

.....

.....

**c** **Add 2 sets of positive + and negative - charges to indicate**
- **the movement of electric charge carriers**
- **the battery terminals**

**when a p-n junction is connected to a battery, as in the diagram.**



**d Outline 2 different applications of solid state devices (e.g. transistors, integrated circuits) which have changed or are changing our society.**

.....

.....

.....

.....

.....

.....

## Question 30 (2 marks)

**a Describe the purpose of the Miche1son-Morley experiment.**

.....

.....

.....

.....

**b Discuss how Einstein's relativity concept explains the result of the Michelson-Morley experiment.**

.....

.....

.....

.....

## Question 31 (6 marks)

**Sam is sitting on a railway station 200.00 m long.**

**Tom is in a train 200.00 m long, moving through the station.**

**If the train could travel at 0.01c (i.e. at 1% of the speed of light relative to the station), calculate**

**a how long Tom would perceive the station to be**

.....

.....

.....

.....

**b how long Sam would perceive the station to be**

.....

.....

.....

.....

**c how long Tom would observe the front of the train taking to pass through the station**

.....

.....

.....

.....

**d how long Sam would see the front of the train taking to pass through the station**

.....

.....

.....

.....

## Part C - From Quanta to Quarks Total marks (15)

## Attempt Question 32

## Allow about 25 minutes for this part

**(a) Identify THREE limitations of the Bohr model of the atom published in 1913.** **3**

.....

.....

.....

.....

.....

.....

**(b) Determine the wavelength of the radiation produced when an electron in the hydrogen atom moves from the fifth energy level to the third energy level.** **3**

.....

.....

.....

.....

**(c) Discuss the development of theories of the structure of the atom with reference to the work of all three of Thomson, Rutherford and Bohr.** **9**

**In each case, indicate one piece of experimental evidence which supported the idea.**

**END OF PAPER**