Cheltenham Girls High School

Physics

2 unit

HSC
Trial Exam
2002

Time allowed: 3 hours

Student Number: _____ . _____

This task is worth 40% of the total HSC Course assessment.

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Board approved calculators may be used.
- Write using black or blue pen
- Draw diagrams using pencil
- A Data Sheet, Formulae Sheets and Periodic Table are provided at the back of this paper.
- Write your student name on the top of every page.

Section I – Pages 2-12
Total marks (75)
This section has two parts, Part A and part B

Part A
Total marks (15)   Attempt questions 1-15
Allow about 30 minutes for this part.

Part B
Total marks (60)   Attempt questions 16-33
Allow about 1 hour and 45 minutes for this part.

Section II – Page 13
Total marks (25)
Attempt all parts of this question.
Allow about 45 minutes for this section.

Part A

Total marks (15)
Attempt Questions 1 – 15
Allow about 30 minutes for this part

Use the multiple-choice answer sheet provided

1. The weight of an object on Earth is 740 N. The same object on planet Bolton has a weight of 1480 N. The acceleration due to gravity on planet Bolton is

(a) 9.8 ms^{-2}.
(b) 19.6 ms^{-2}.
(c) 4.9 ms^{-2}.
(d) 2 ms^{-2}.

2. Ignoring air resistance, the shape of the trajectory of a projectile on Earth is

(a) Exponential.
(b) Circular.
(c) Hyperbolic.
(d) Parabolic.

3. At a particular moment, a positively charged particle is moving with a velocity v in a magnetic field as shown. The force is
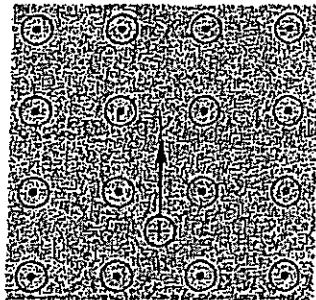
(a) Bqv to the left.
(b) Zero.
(c) Bqv to the right.
(d) Unable to be determined.

4. Geostationary satellites are most commonly used for communications. These satellites have:

	Period	Altitude
(a)	24 hours	High
(b)	24 hours	Low
(c)	7 hours	High
(d)	7 hours	Low

5. An observer on Earth sees a space ship moving past the Earth at a speed of 0.8 C. Length and time on Earth, as observed from the spacecraft appear

|	Length	Time
(a)	Contracted	Dilated
(b)	Lengthened	Dilated
(c)	Contracted	Same
(d)	Lengthened	Same

6. Electromagnetic induction occurs when

   (a) a conductor is accelerating in a magnetic field.
   (b) a conductor moves parallel to a magnetic field.
   (c) a conductor moves at right angles to a magnetic field.
   (d) a conductor moves with a large constant velocity in a magnetic field.

7. Transformers are used in our domestic electricity grid are mainly step-down transformers. They are necessary to

   (a) decrease the voltage in the secondary circuit.
   (b) increase the power in the secondary circuit.
   (c) decrease the current in the secondary circuit.
   (d) increase the resistance in the secondary circuit.

8. Two types of generator are shown
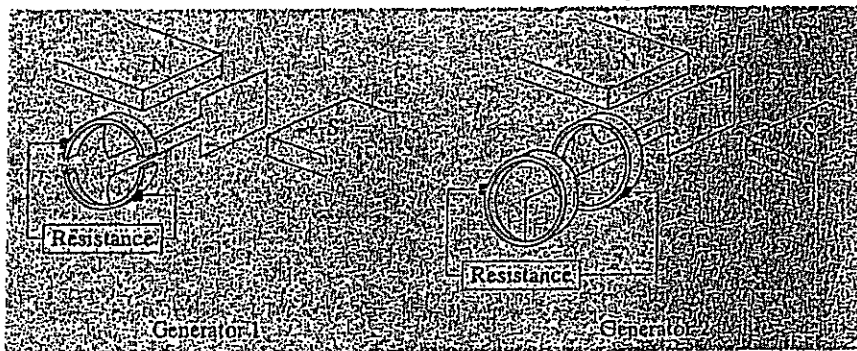
Correct statements about each are:

	Generator 1		Generator 2	
(a)	Split-ring commutator	AC produced	Split-ring commutator	DC produced
(b)	Slip-ring commutator	AC produced	Slip-ring commutator	DC produced
(c)	Split-ring commutator	DC produced	Slip-ring commutator	AC produced
(d)	Slip-ring commutator	DC produced	Split-ring commutator	AC produced

3

9. A student has four tubes, all of equal internal diameter, two made of aluminium and two are plastic. One of each material has a slot along its length and the other two do not. The tubes are held vertically and a strong magnet is dropped down inside them.
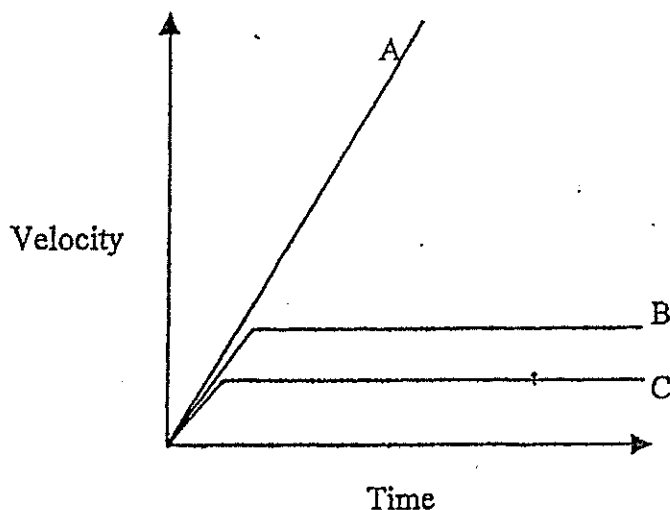
The graph labelled "C" refers to

(a) The aluminium tube without a slot in it.
(b) The aluminium tube with a slot in it.
(c) The plastic tube without a slot in it.
(d) The plastic tube with a slot in it.

10. The diagram below shows a pair of charged parallel plates.
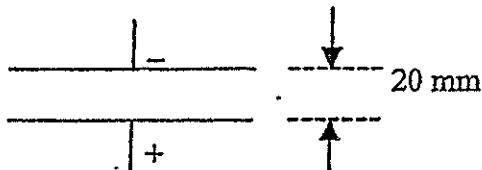
The potential difference across the plates is 186.3 V. The magnitude and direction of the resulting electric field is

(a) 9.315 NC^{-1} up.
(b) 9315 NC^{-1} down.
(c) 9.315 NC^{-1} down.
(d) 9315 NC^{-1} up.

11. Which of the following actions could be used to demonstrate the production of alternating current?

(a) Move a magnet in and out of a solenoid that is part of a closed circuit.
(b) Spin a magnet near a piece of aluminium.
(c) Move a wire that is part of a closed circuit down through a magnetic field.
(d) Drop a magnet down a metal tube.

4

12. Which of the following gives the main reason why X Rays rather than UV or visible light are normally used to investigate crystal structure.

   (a)   Each X Ray photon has more energy than either UV or visible light.
   (b)   X Rays more easily release electrons from atoms.
   (c)   X Rays were discovered long before UV or visible light.
   (d)   The atomic separation of crystals is approximately equal to the wavelength of X Rays.

13. This question refers to the following graph.
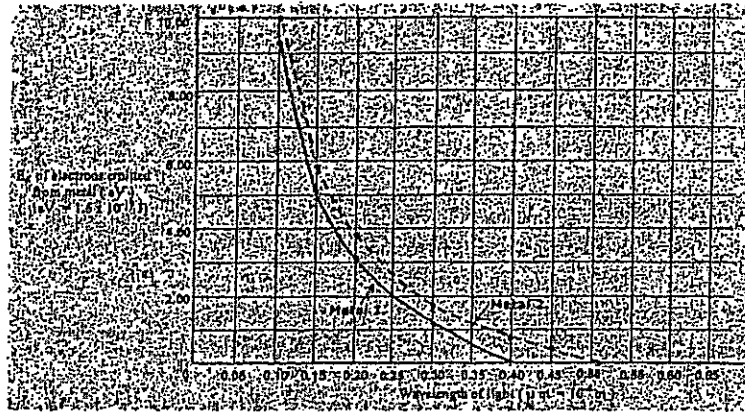
   Using information from the graph, which of the following statements is correct?

   (a)   The greater the kinetic energy of the electrons, the shorter their wavelength.
   (b)   The slope of the line represents Planck's constant.
   (c)   The work function of Metal 1 is greater then Metal 2.
   (d)   The intensity of the light used for Metal 2 is greater than that used for Metal 1.

14. In which case will the induced EMF in the ring cause the current to follow in the direction indicated by the arrow labelled "I"?
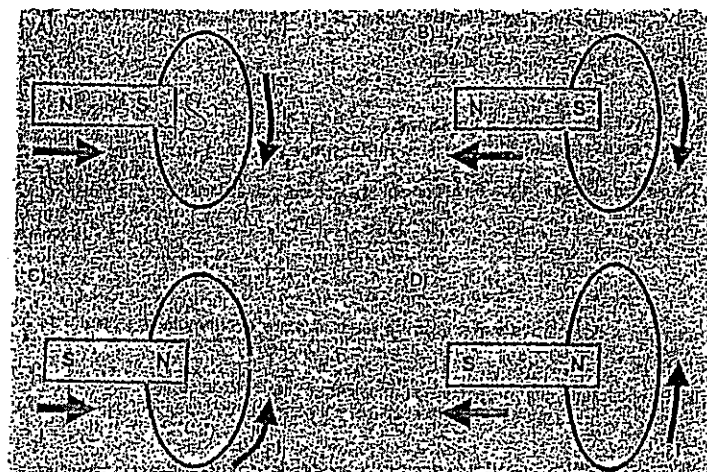
15. "Gravity-assist" or "Slingshot Effect" trajectories are often used by NASA to send space probes to distant planets. This type of trajectory is useful because

   (a)   Distant planets are larger and so provide a much greater gravity-assist.
   (b)   It increases the kinetic energy of the space probe.
   (c)   The total distance travelled by the probe is reduced.
   (d)   It reduces the forces on the fragile equipment carried by the probe.

Write your answers on this sheet

16. The following question refers to the graph below, which shows the g-forces experienced an astronaut during the launch of a spacecraft.
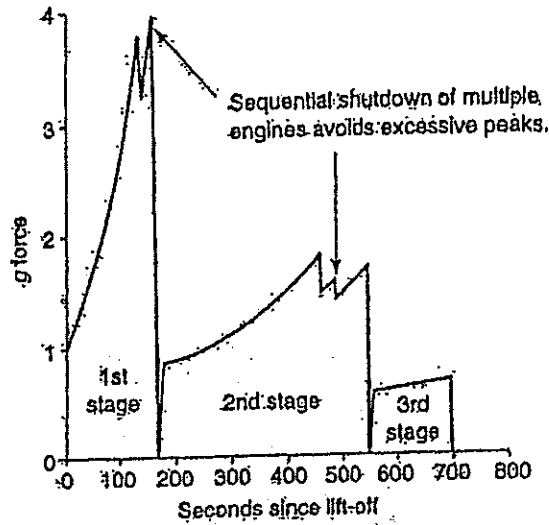
a) What is the maximum force experienced by the astronauts during launch?   1

b) Explain clearly why the "g" forces change with time.   4

18. In the course of your studies, you investigated the contribution of a scientist to the development of space exploration.

   a) Name the scientist.   1

   b) Assess the importance of the contribution of the scientist that you named.   3

19. The radius of the Earth's orbit around the Sun is 150×10^6 km. The radius of Mars' orbit is 229×10^6 km. Calculate the period of Mars' orbit around the Sun in Earth years.   2

20.   a)   Define inertial and non-inertial frames of reference.   2

b) Describe an investigation that would enable you to distinguish between these two frames of reference.   2

21. Below is a diagram of a simple electric motor.
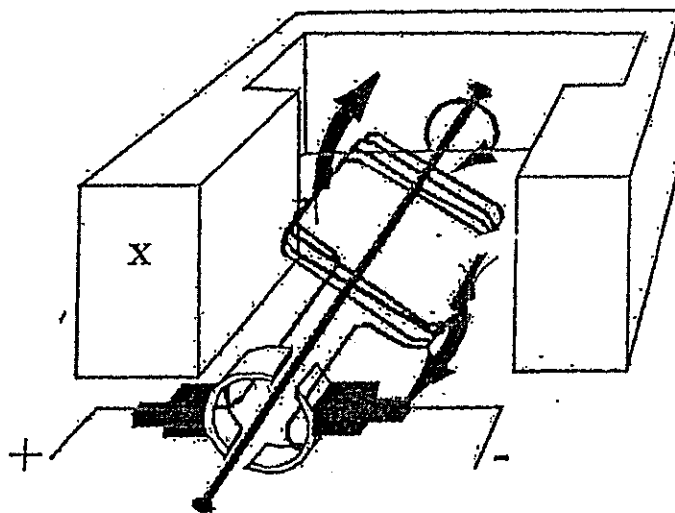
(a) i)   Determine the polarity of side "X" of the magnet. Explain your answer   2

ii)   What is the function of the commutator?   1

(b) The coil has an area of 0.05 m^2 and has 4 turns. A current of 0.2 A current flows through the coil. Determine the maximum torque on the coil if the magnetic field strength is 0.3 T.   2

(c) At what point is the torque on the coil zero?   1

22. Discuss the relationship between back EMF and Lenz's Law.   2

23. (a) Explain the role of transformers in the electrical distribution network, showing clearly the need for transformers.   3

(b) An ideal transformer is designed to provide a 10 V output from a 240 V input. The primary coil is fitted with a 1.0 Amp fuse.

(i) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil.   1.

....

....

(ii) What is the maximum current that can be delivered from the output terminals?   2

....

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24. Explain clearly how induction cook tops or electric ranges work. 2

25. Describe an experiment that you performed to demonstrate the production of an electric current in a conductor. In your answer, describe the factors that affected the size of the current produced. 4
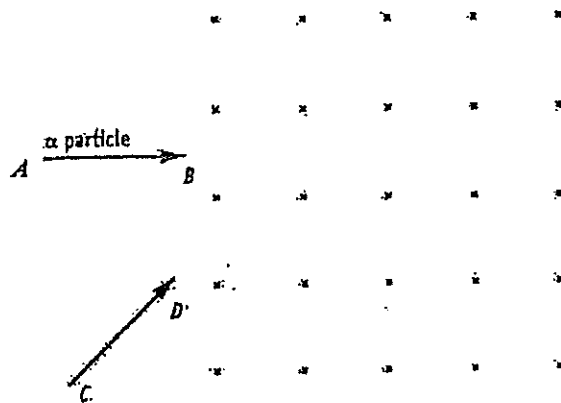
26. Why, when cathode rays were first discovered, was there a debate as to whether they were charged particles or electromagnetic waves? 3

20. a) Define inertial and non-inertial frames of reference. 2

27. An α particle (Helium nucleus) is fired into a uniform magnetic field of strength 2×10^{-1} T, along the line AB, as shown below at a speed of 4×10^5 ms^{-1}.

a) What is the force experienced by the α particle?   3

b) Compare this force with the force experienced by

   (i) An electron moving at the same speed in the same direction in the field.   2

   (ii) An α particle entering the field along the line CD in the same plane at 45^0 to α particle moving along A-B.   2

28. a) What is the photoelectric effect?   1

   b) Discuss how Einstein's explanation of the Photoelectric effect increased our understanding of the quantum theory.   2

29. Describe the de Broglie model of electrons around nuclei. 1

30. Explain why silicon became the preferred material for transistors. 1

31. Discuss why solid-state devices replaced thermionic devices. 2

32. Explain why a magnet is able to hover over a superconducting material. 2

33. Discuss the view that superconductivity is a new state of matter. 1

SECTION II – Options

- Write your answers in the booklet provided.
- Write your Student Number on the cover.
- This section is worth 25%
- Allow about 45 minutes for this question.
- Attempt all parts of this question.
- Show all relevant working in questions involving calculations.

Question 34: Quanta to Quarks

a) Discuss Rutherford's major contributions to our understanding of the structure of the atom.   4

b) List the difficulties with the Rutherford-Bohr atomic model.   4

c) The emission spectra produced by heated gases was well known when in 1885 Balmer, developed an equation showing the relationship between the wavelengths of the four lines in the visible light region of the Hydrogen spectrum.

   (i) State the equation and explain each term of the equation   3

   (ii) Why was the Balmer series of spectral lines the first to be discovered?   1

   (iii) Calculate the longest wavelength of visible light in the Balmer series.   2

   (iv) The Balmer equation also enables scientists to calculate wavelengths of spectral lines outside the visible part of the spectrum. Calculate the shortest possible wavelength.   2

c) The Rutherford model of the atom is sometimes likened to a planetary system, with electrons orbiting the nucleus. Bohr used Rutherford's model of the atom as a starting point for his own theory of atomic structure. One of Bohr's postulates was that an atom could exist in any one of a number of stationary states from which no emission of radiation takes place.

(i) Why was this assumption necessary?   2

(ii) 19th Century Physicists noted that for hydrogen, the frequency of any spectral line was always equal to the sum or difference of the frequencies of other spectral lines of hydrogen.
Using the diagram below and with reference to Bohr's second postulate, explain this observed relationship.   3
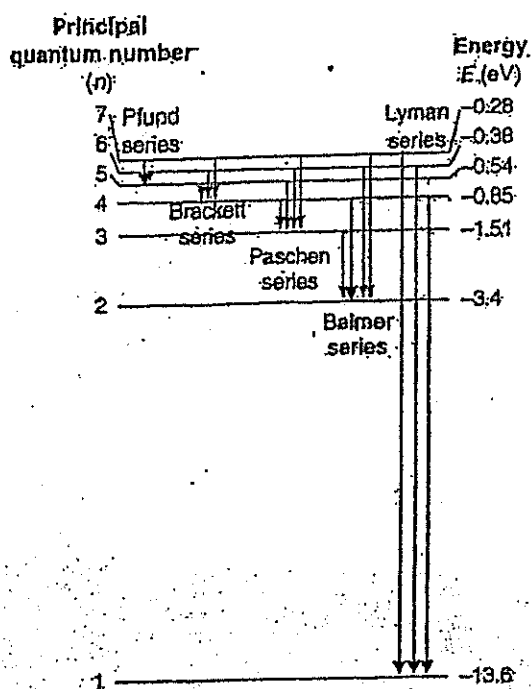
d) Why were the contributions of (i) Heisenberg and (ii) Pauli important to the development of atomic theory?   2

e) Explain why electron microscopes have a much greater resolution than conventional light microscopes.   2

29. Describe the de Broglie model of electrons around nuclei.   1