

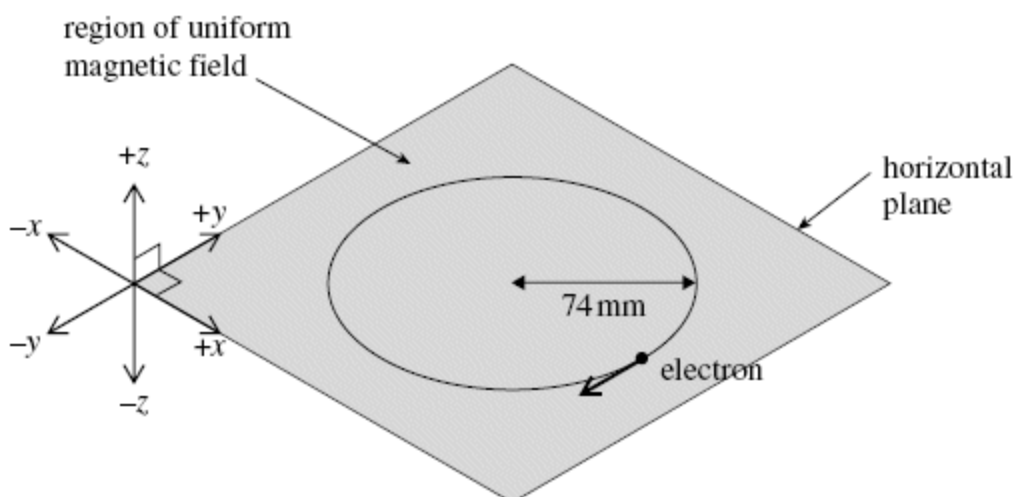
Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Q1.

When travelling in a vacuum through a uniform magnetic field of flux density 0.43 m T , an electron moves at constant speed in a horizontal circle of radius 74 mm , as shown in the figure below.



- (a) When viewed from vertically above, the electron moves clockwise around the horizontal circle. In which one of the six directions shown on the figure above, $+x$, $-x$, $+y$, $-y$, $+z$ or $-z$, is the magnetic field directed?

direction of magnetic field _____

(1)

- (b) Explain why the electron is accelerating even though it is travelling at constant speed.

(2)

- (c) (i) By considering the centripetal force acting on the electron, show that its speed is $5.6 \times 10^6 \text{ m s}^{-1}$.

(2)

(ii) Calculate the angular speed of the electron, giving an appropriate unit.

answer = _____

(2)

(iii) How many times does the electron travel around the circle in one minute?

answer = _____

(2)

(Total 9 marks)

Q2.

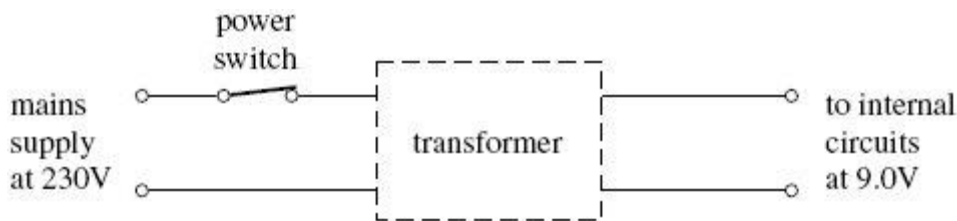
(a) (i) Outline the essential features of a step-down transformer when in operation.

(2)

(ii) Describe **two** causes of the energy losses in a transformer and discuss how these energy losses may be reduced by suitable design and choice of materials. The quality of your written communication will be assessed in this question.

(6)

- (b) Electronic equipment, such as a TV set, may usually be left in 'standby' mode so that it is available for instant use when needed. Equipment left in standby mode continues to consume a small amount of power. The internal circuits operate at low voltage, supplied from a transformer. The transformer is disconnected from the mains supply only when the power switch on the equipment is turned off. This arrangement is outlined in the diagram below.



When in standby mode, the transformer supplies an output current of 300 mA at 9.0V to the internal circuits of the TV set.

- (i) Calculate the power wasted in the internal circuits when the TV set is left in standby mode.

answer = _____ W

(1)

- (ii) If the efficiency of the transformer is 0.90, show that the current supplied by the 230 V mains supply under these conditions is 13 mA.

(2)

- (iii) The TV set is left in standby mode for 80% of the time. Calculate the amount of energy, in J, that is wasted in one year through the use of the standby mode.

$$1 \text{ year} = 3.15 \times 10^7 \text{ s}$$

answer = _____ J

(1)

- (iv) Show that the cost of this wasted energy will be about £4, if electrical energy is charged at 20 p per kWh.

(2)

- (c) The power consumption of an inactive desktop computer is typically double that of a TV set in standby mode. This waste of energy may be avoided by switching off the computer every time it is not in use. Discuss **one** advantage and **one** disadvantage of doing this.

(2)

(Total 16 marks)