Higher Electric Fields Answers

1. a) The electric field lines run parallel from R to S and are equally spaced.

The direction of the electric field is shown by arrows pointing from R to S.

b) Gain in E_P is the work done on the electron = 3.2×10^{-19}J.

2. E_K gained = E_W = 4.16×10^{-19}J.

3. V = 2000V.

4. a) There is a uniform electric field between the cathode and the anode.

An unbalanced force will act on the electrons in the electric field which will make them accelerate.

b) v = 2.96×10^{7}ms^{-1}.

5. a) i) E_K gained = 8×10^{-16}J.

ii) V = 5000V.

b) Plates P and Q must be given a positive voltage with Q being twice that of P.

6. a) 200kV = 200,000J given to each coulomb of charge.

b) Protons have a positive charge and travel in the direction of the electric field. **OR**

Protons have a positive charge are attracted to the negative plate.

c) i) E_W = 3.2×10^{-14}J.

ii) v = 6.2×10^{6}ms^{-1}.

d) No effect.

Q and V are constant. The speed of the proton at Q is only related to E_W.

7. a) $E_W = QV = 4 \times 10^{-15}$ J.

b) $v = 2.22 \times 10^{6} ms^{-1}$.

c) $F = 3.33 \times 10^{-15}$N.

8. a) Increase in $E_K = 3.05 \times 10^{-14} - 2.24 \times 10^{-14} = 8.1 \times 10^{-15}$J.

b) $V = 2.5 \times 10^{4}$V.

c) Same potential difference.

Charge is smaller.

Less work is done.

Smaller increase in kinetic energy.

9. Perpendicularly into the page.

10. a) Perpendicularly out of the page.

b) $r = 8.37 \times 10^{-2}$m.

11. a) i) Perpendicularly out of the page.

ii) Direction of the force acting on the particles is reversed.

b) 50 Transit gaps.

12. a) i) Force acts on the particle at right angles to the velocity/motion.

ii) $\mathbf{r = \frac{mv}{qB}} = \frac{1.673 \times 10^{-27} \times v}{1.6 \times 10^{-19} \times B} = \frac{1.05 \times 10^{-8} v}{B}$

b) The component of velocity at right angles to the field results in a circular motion.

The component of velocity parallel to the field is constant so no unbalanced force.

These two components together then provide the spiral or helix shape.