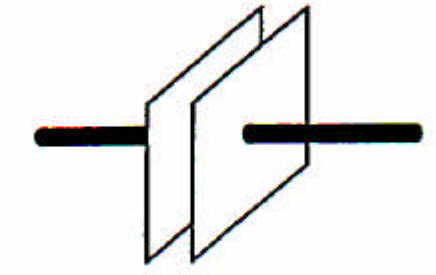
Chapter 16
Multiple choice and quick questions

1. The diagram shows a pair of insulated, charged, parallel plates. There is a uniform electric field in the central region between the plates.



Which of the statements about the central region between the plates is/are correct?

1: The potential is constant in the region

2: There is a uniform potential gradient in the region

3: Equipotentials are evenly spaced in the region

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

2. An electron is moved in an electric field from a point P to a point Q. The value of the electric field strength E and the potential V at P and Q are given below.

	E/NC^{-1}	V/V
P	2×10^4	8×10^3
Q	2×10^4	2×10^3

The charge on the electron is 1.6×10^{-19} C

Using only the data given, which one of **A** to **D** below can be found for the electron when at P?

A the force on the electron

B the momentum of the electron

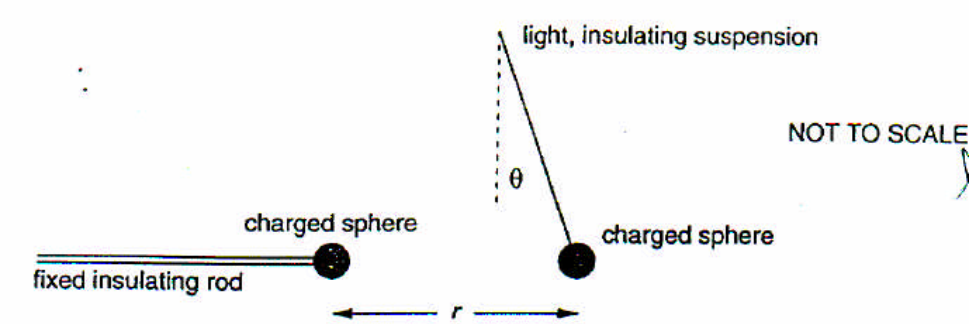
C the kinetic energy of the electron

D the total energy of the electron

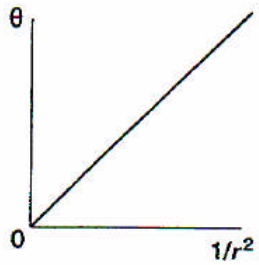
3. Which one of **A** to **D** below is the energy required in eV to move the electron from P to Q?

A zero **B** 5×10^3 **C** 6×10^3 **D** 1×10^7

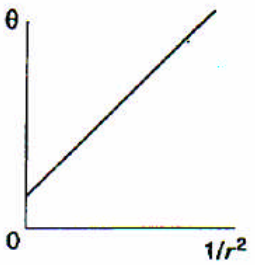
4. The diagram show apparatus used to investigate the electrostatic force between two identical small conducting spheres whose centres are a distance *r* apart. For small angles of deflection, 0 is proportional to the horizontal force acting on the hanging sphere. The spheres have equal positive charge.



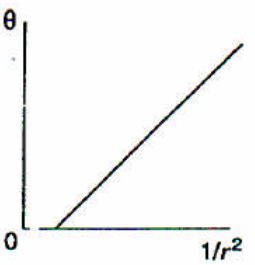
Which one of the graphs below **A** to **E** would you expect from the experiment?



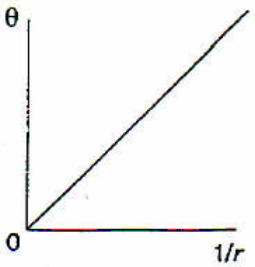
A



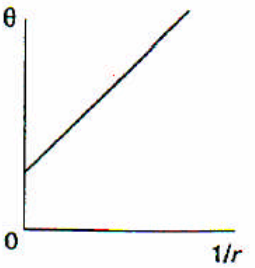
B



C



D



E

5. When a uniform horizontal electric field is introduced, acting from left to right, which one of the graphs above **A** to **E** would you now expect from the experiment?

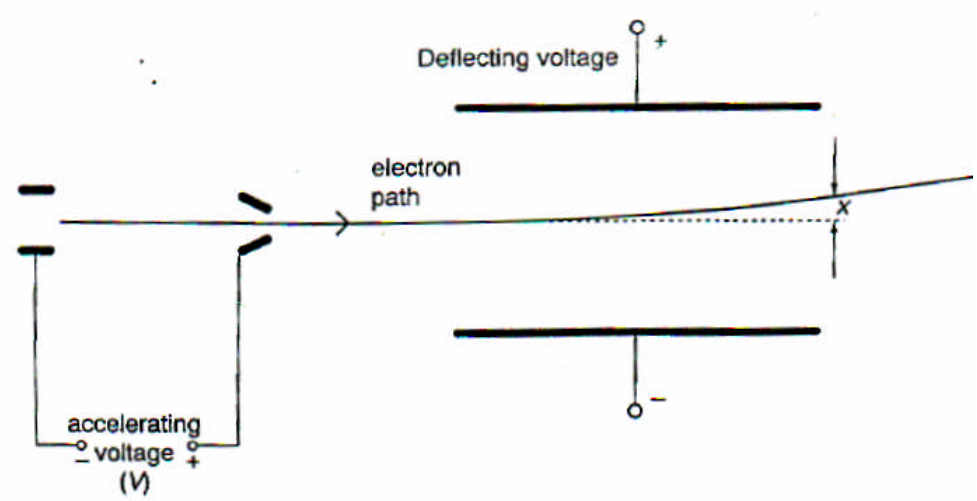
6. Differently charged ions of several isotopes are all being accelerated in the same uniform electric field.

Which one of the ions A to D below has the greatest acceleration?

A $^{14}_{7}N^{2+}$ **B** $^{14}_{7}N^{+}$ **C** $^{6}_{3}Li^{2+}$ **D** $^{12}_{6}C^{2+}$

7. The diagram shows part of an evacuated tube in which a stream of electrons from an electron gun passes between a pair of parallel deflecting plates.

The vertical displacement of the electron beam as it leaves the parallel plates is x.



Which one of **A** to **E** below will not change the displacement x of the beam as it leaves the parallel plates?

A increasing the accelerating voltage

B increasing the deflecting voltage

C increasing the distance between the electron gun and the deflecting plates

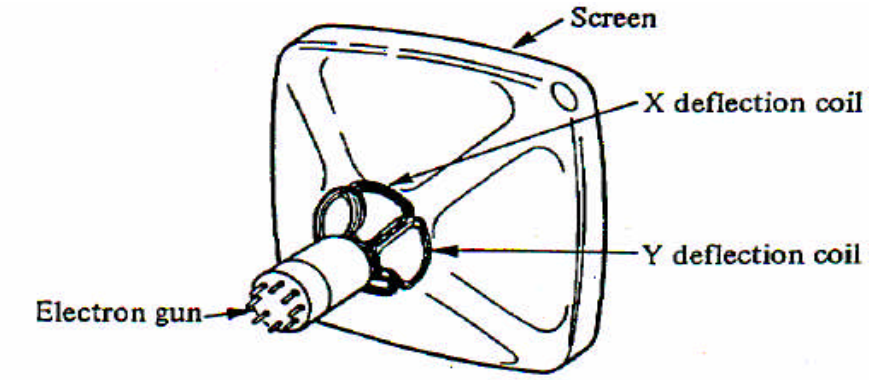
D increasing the distance between the two deflecting plates

E increasing the length of the deflecting plates

8. When the accelerating voltage is V the speed of the electrons emerging from the gun is v. Which one of **A** to **E** is the speed of the electrons when the accelerating voltage is doubled?

A $\sqrt{v}$ **B** v **C** $v\sqrt{2}$ **D** $2v$ **E** $4v$

9. This question is about the motion of electrons in a monochrome television tube, Figure 6.



Electrons are accelerated to high speeds as they move through a large potential difference.

(i) Show that acceleration through a p.d. of 10kV should give electrons a speed of about 6×10^7 m s^{-1}.

(ii) State one assumption you made in order to calculate this speed.

10. This question is about the motion of charged particles in magnetic fields.

(a) Explain why a charged particle moving with constant speed *v* perpendicular to a uniform magnetic field of strength *B* will follow a circular path.

(b) Show that for a particle of mass *m* and charge *q* the radius of the circular path is given by the expression:

$$r = \frac{mv}{Bq}$$

(c) Hence, show that the frequency of this circular motion, known as the cyclotron frequency, is given by the expression:

$$f = \frac{qB}{2pm}$$