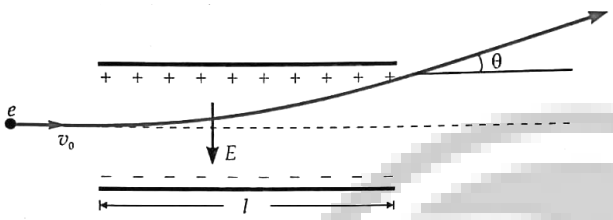
LAKSHYA (JEE)

Electric Charges and Field

DPP-10

1. An electric field is set up between the two parallel plates of capacitor, as shown in the fig. An electron enters the field symmetrically between the plates with a speed v_0. The length of each plate is 1. Find the angle of deviation of the path of electron.



2. A charged particle of charge 2 μC and mass 10 milligram, moving with a velocity of 1000 m/sec enters a uniform electric field of strength 10^3 NC^{-1} directed perpendicular to its direction of motion. Find the velocity and displacement, of the particle after 10 s.

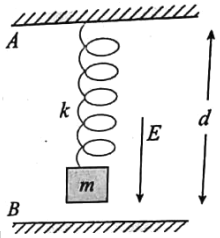
3. If an oil drop of weight 3.2×10^{-13} N is balanced in an electric field of 5×10^5 Vm^{-1}, find the charge on the oil drop.

4. Calculate the magnitude of the electric field, which can just balance a deutron of mass 3.2×10^{-27} kg.
(Take g = 10 ms^{-2}).

5. A proton falls down through a distance of 2 cm in a uniform electric field of magnitude 3.34×10^3 NC^{-1}.
Determine (i) the acceleration of the electron (ii) the time taken by the proton to fall through the distance of 2 cm, and (iii) the direction of the electric field. Mass of a proton is 1.67×10^{-27} kg.

6. A particle of mass 10^{-3} kg and charge 5 μC is thrown at a speed of 20 ms^{-1} against a uniform electric field of strength 2×10^5 NC^{-1}. How much distance will it travel before coming to rest momentarily?

7. A block of mass m is suspended vertically with a spring of spring constant k. The block is made to oscillate in a gravitation field. Its time period is found to be T. Now the space between the plates is made gravity free, and an electric field E is produced in the B downward direction. Now the block is given a charge q. The new time period of oscillation is

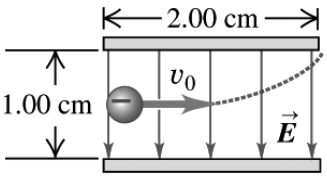


(a) T (b) $t + 2\pi\sqrt{\frac{qE}{md}}$

(c) $2\pi\sqrt{\frac{qE}{md}}$ (d) none

Paragraph Questions:

An electron is projected with an initial speed $v_0 = 1.60 \times 10^6$ ms^{-1} into the uniform field between the parallel plates as shown in figure. Assume that the field between the plates is uniform and directed vertically downward, and that the field outside the plates is zero. The electron enters the field at a point midway between the plates. Mass of electron is 9.1×10^{-31} kg.



8. If the electron just misses the upper plate, the time of flight of the electron up to this instant is
(a) 1.25×10^{-9} s
(b) 1.25×10^{-8} s
(c) 32.5×10^{-8} s
(d) 32.5×10^{-6} s

9. For the condition of the previous situation, the magnitude of electric field is
(a) 124 NC^{-1}
(b) 224 NC^{-1}
(c) 364 NC^{-1}
(d) 520 NC^{-1}

10. If instead of an electron, a proton were projected with the same speed, then compare the paths travelled by the electron and the proton.
(a) The proton will hit the upper plate.
(b) The proton will hit the lower plate.
(c) The proton will not hit either plate.
(d) None of these.

11. The vertical displacement traveled by the proton as it exits the region between the plates is (mass of proton is 1.67×10^{-27} kg.)
(a) 1.6×10^{-8} m
(b) 5.25×10^{-6} m
(c) 3.25×10^{-8} m
(d) 2.73×10^{-6} m

ANSWERS

1. $\theta = \tan^{-1} \frac{El}{mv_0^2}$

2. $10^3\sqrt{5}$ m/s, $10^4\sqrt{2}$ m

3. 0.64×10^{-18}

4. 2.0×10^7 NC^{-1}

5. 3.2×10^{11} ms^{-2}, 3.54×10^{-7} s, vertically downwards

6. 0.2 m

7. (a)

8. (b)

9. (c)

10. (c)

11. (d)

Note - If you have any query/issue

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