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Rutherford's Nuclear Atomic model →

(1) All the +ve charge in an atom is concentrated in a very small volume.

(2) Most of the mass of the atom is also concentrated in that small volume.

(3) That small vol. of +ve charge & mass is called **nucleus**.

(4) Electrons are revolving around the nucleus like planets revolve around stars.

(5) Estimated size of nucleus is about 10^{-15} m. (1-1.5 Fermi) → ~10 Fermi
(size of atom → 10^{-10} m) (nucleus size (linear) → 10^{-5} times atom size)

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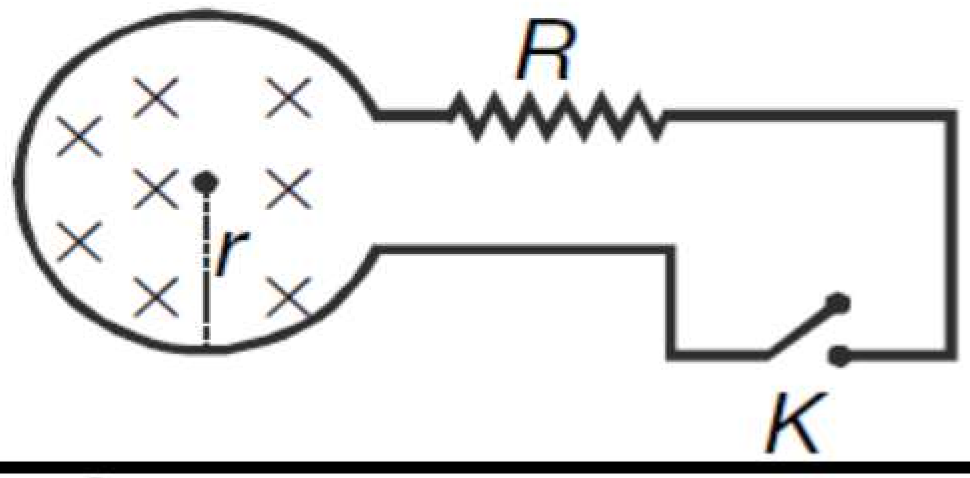
Shown in the figure is a circular loop of radius r and resistance R. A variable magnetic field of induction $B = B_o e^{-t}$ is established inside the coil. If the key (K) is closed, the electrical power developed right after clos- ing the switch is equal to



(a) $\dfrac{B_0^2 \pi r^2}{R}$ (b) $\dfrac{B_o 10 r^3}{R}$

(c) $\dfrac{B_0^2 \pi^2 r^4 R}{5}$ ✓(d) $\dfrac{B_0^2 \pi^2 r^4}{R}$

$emf_i = -\dfrac{d\phi}{dt}$

$= -\dfrac{d}{dt}\left((B_0 e^{-t}) \pi r^2\right)$

$= +\pi r^2 B_0 e^{-t}$

$E = \pi r^2 B_0 e^{-t}$

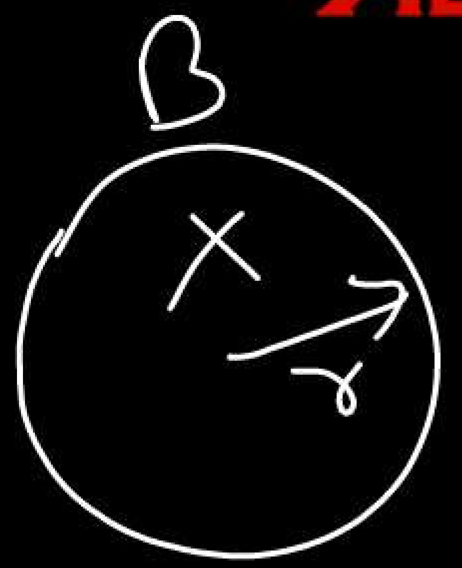
$i = E/R = \dfrac{\pi r^2 B_0 e^{-t}}{R}$

$P = E^2/R = \dfrac{\pi^2 r^4 B_0^2 e^{-2t}}{R}$

A conducting circular loop is placed in a uniform mag-netic field of induction B tesla with its plane normal to the field. Now the radius of the loop starts shrinking at the rate (dr/dt). Then, the induced emf at the instant when the radius is r, is

(a) $\pi r B(dr/dt)$ (b) $2\pi r B(dr/dt)$

(c) $\pi r^2(dB/dt)$ (d) $(\pi r^2/2)B(dr/dt)$



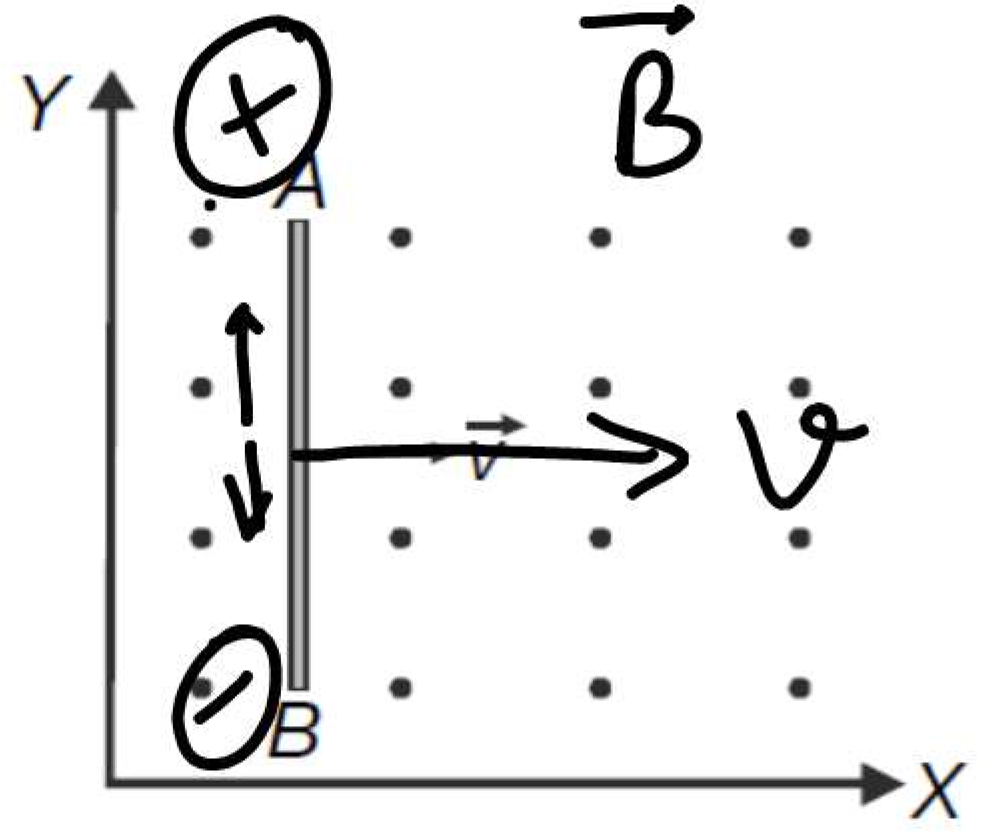
$\phi = B \cdot A$

$\phi = B \cdot \pi r^2$

$\frac{d\phi}{dt} = 2\pi r B \frac{dr}{dt}.$

A conductor rod AB moves parallel to x-axis in a uni- form magnetic field, pointing in the positive X-direction. The end A of the rod gets

(a) positively charged
(b) negatively charged
(c) neutral
(d) first positively charged and then-negatively charged



Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with constant speed v. The time period of the motion

(a) depends on both R and v

(b) is independent of both R and v ✓

(c) depends on R and not on v

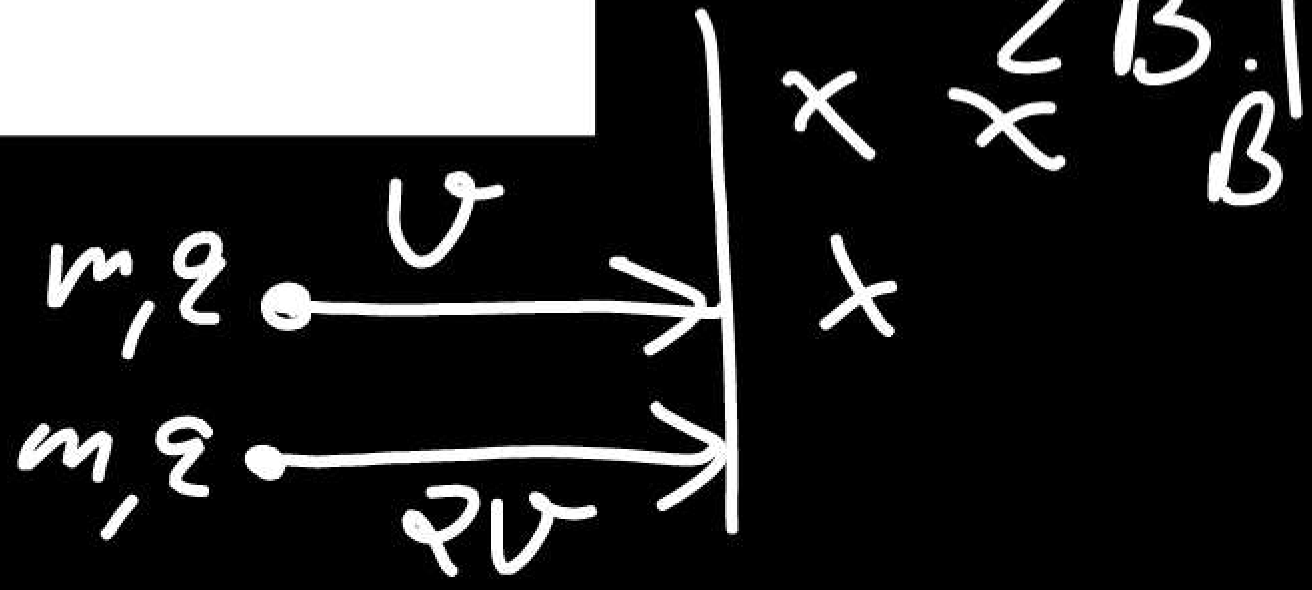
(d) depends on v and not on R

$$T = \frac{2\pi R}{v}$$

$$T = \frac{2\pi m}{qB}$$

$$R = \frac{mv}{qB}$$

$$\omega = \frac{qB}{m}$$



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✓ (b) is independent of both R and v

(c) depends on R and not on v

(d) depends on v and not on R

$$R = \frac{mv}{qB}$$

$$T = \frac{2\pi R}{v} = \frac{2\pi \times m}{qB}$$

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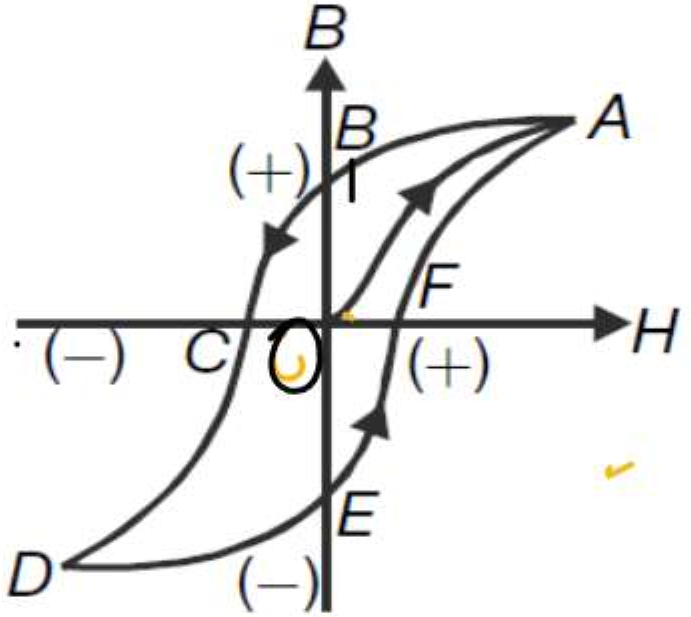
B, H, I →

B ↳ total M.F.

H → ext mag. field (magnetising)

$B = \frac{1}{\mu_0}(H + I) = \frac{1}{\mu_0}(1+\chi)H$

A ferromagnetic substance is placed in the vary-ing magnetising field H. The magnetic induction B is measure for various values of direct and reverse mag-netising field. Following graph has been plotted for B versus H. Choose the any wrong statement



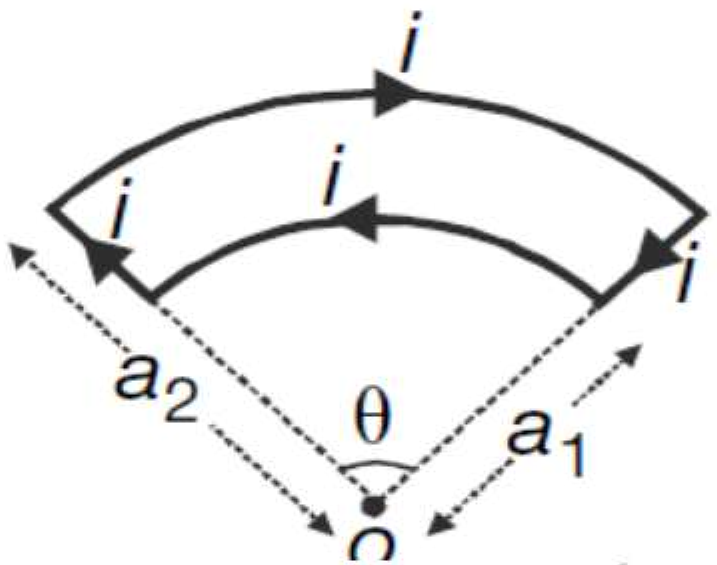
(a) There is a limit of direct and reverse external mag- netising field at which the magnetisation and hence the magnetic induction saturates

(b) Even after removing the external magnetising field some residual magnetisation called 'retentivity' is left over the substance

(c) On increasing the reverse magnetising field, the re- tentivity decreases to zero for a value of magnetis- ing field which is known as 'susceptibility'

(d) On increasing the reverse magnetising field the re- tentivity decreases to zero for a value of magnetis- ing field known as 'coercivity'

The magnetic induction at the centre O of the current loop shown in the adjoining diagram is



(a) $\frac{\mu_o i}{4\pi}\left(\frac{1}{a_1}-\frac{1}{a_2}\right)\theta$ ✓

(b) $\frac{\mu_o i}{2\pi}\left(\frac{1}{a_1}-\frac{1}{a_2}\right)\theta$

(c) $\frac{\mu_o i}{4\pi}\left(\frac{1}{a_1}+\frac{1}{a_2}\right)\theta$

(d) $\frac{\mu_o i}{2\pi}\cdot\frac{\theta}{a_2}$

$$|\vec{B}| = \left(\frac{\mu_0}{4\pi}\right)\cdot\frac{i\theta}{R}$$

K

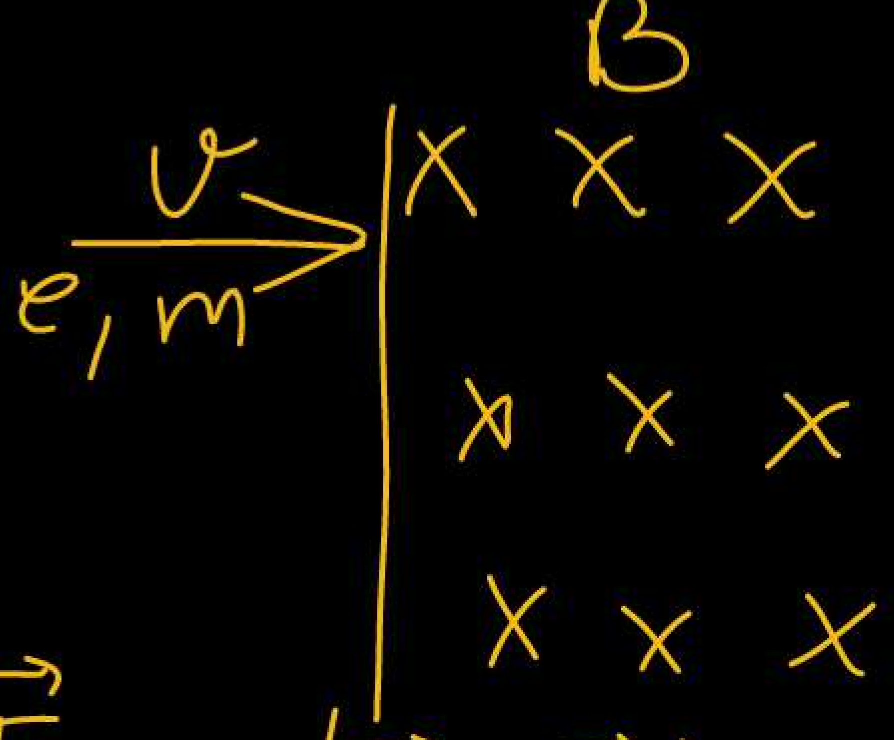
$$|\vec{B}| = \frac{\mu_0}{4\pi}\cdot i\theta\left(\frac{1}{a_1}-\frac{1}{a_2}\right)$$

⊙

An electron of charge e and mass m enters normally into a uniform magnetic field B. The radius of the circu- lar path of the electron is

(a) $\frac{eB}{mv}$ (b) $\frac{ev}{mB}$

(c) $\frac{mv}{eB}$ ✓ (d) $\frac{mB}{ev}$



$\vec{F}_M = q(\vec{v} \times \vec{B})$

$|\vec{F}_M| = evB$

$evB = \frac{mv^2}{R}$

$\Rightarrow R = \frac{mv}{eB}$

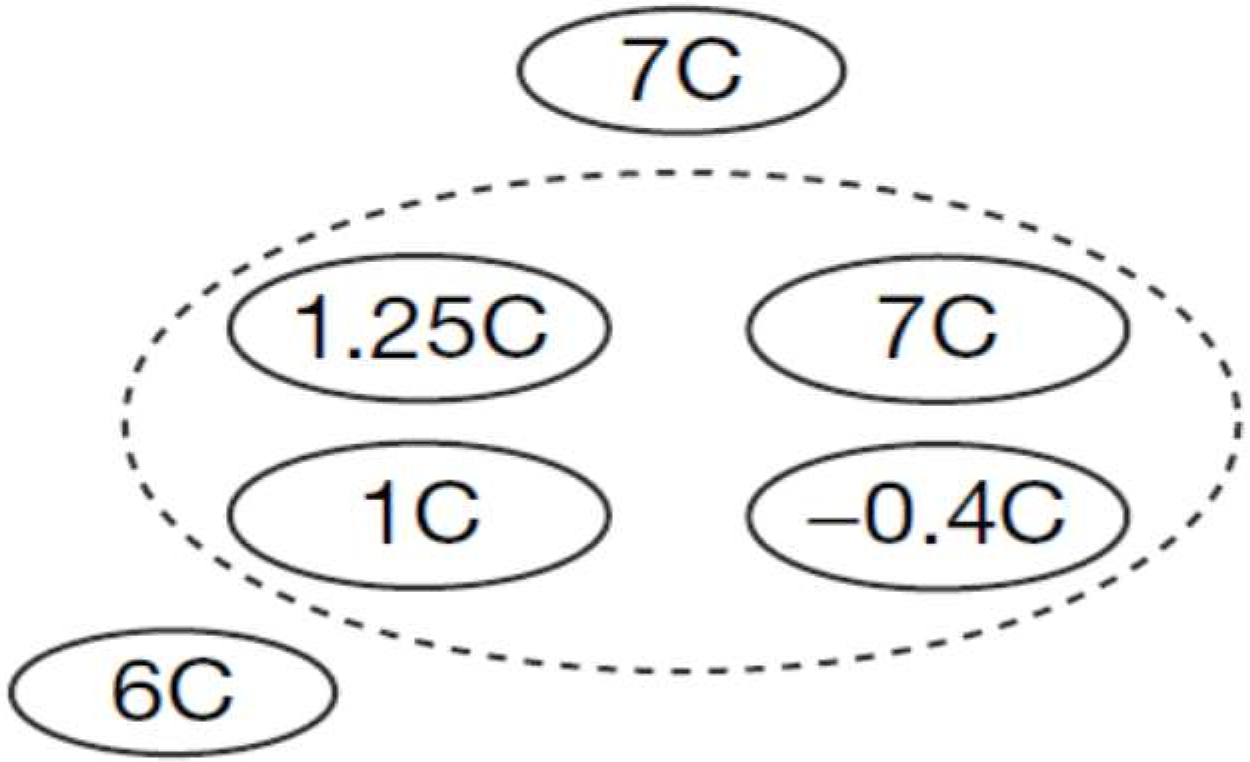
What is the electric flux linked with closed surface?

(a) 10^{11} N-m²/C

(c) 10^{10} N-m²/C

(b) 10^{12} N-m²/C ✓

(d) 8.86×10^{13} N-m²/C



$$\oint \vec{E} \cdot \vec{ds} = \frac{q_{in}}{\epsilon_0}$$

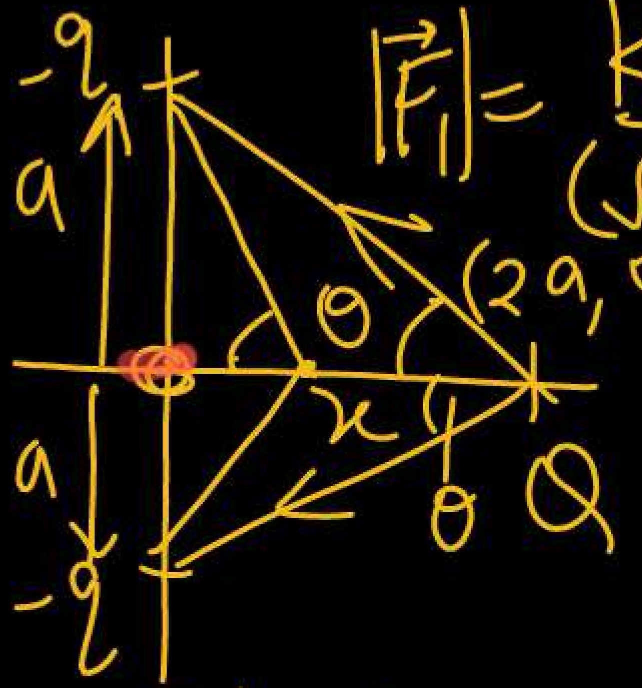
$$= \frac{(7+1+1.25-0.4)C}{\epsilon_0}$$

$$= \frac{8.85}{8.85 \times 10^{-12}} \text{ N-m}^2/\text{C}$$

$F_{net} = \frac{2kQqx}{(a^2+x^2)^{3/2}}$ $F \propto -x$

Two equal –ve charges –*q* are fixed at the point (0, *a*) and (0, – *a*) on the *y*-axis. A positive charge *Q* is released from rest at the point (2*a*, 0) on the *x*-axis. The charge will

(a) execute SHM about the origin
(b) move to the origin and remain at rest
(c) move to infinity
(d) execute oscillatory but not SHM ✓



$|\vec{F_1}| = \frac{kQq}{(\sqrt{a^2+x^2})^2}$

$(b, 0)$ $b \ll a$

$|\vec{F_2}| = \frac{kQq}{a^2+x^2}$

$(x = 2a)$

$F_{net} = 2|\vec{F_1}|\cos\theta = \frac{2kQq}{(a^2+x^2)}\frac{x}{\sqrt{a^2+x^2}}$

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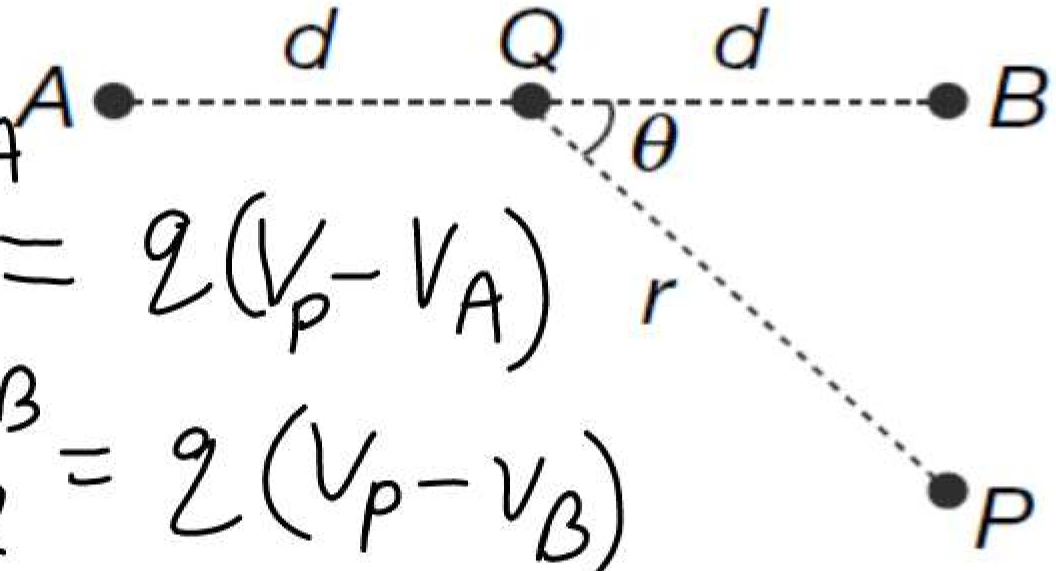
The work done in taking a unit positive charge from P to A is W_A and from P to B is W_B. Then

(a) $W_A > W_B$

(c) $W_A = W_B$

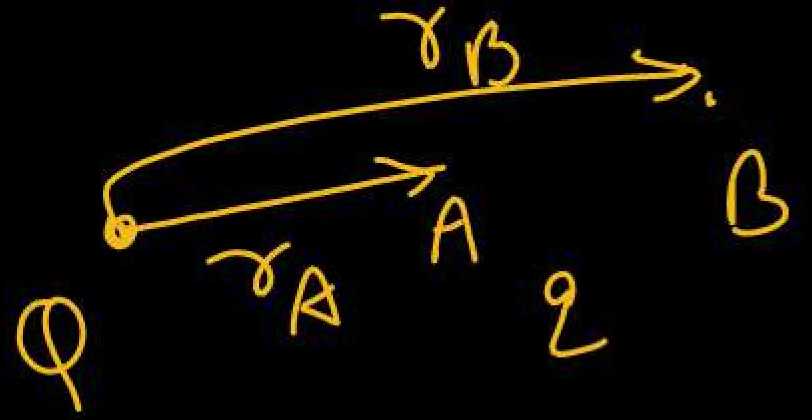
(b) $W_A < W_B$

(d) $W_A + W_B = 0$



$W_A = W_{el}^{PA} = q(V_P - V_A)$

$W_A = W_{el}^{PB} = q(V_P - V_B)$



$W_{el} = q(V_A - V_B)$

$W_{ext\,ag.} = -W_e$

$W_A - W_B = -q(V_A - V_B) = 0$

$\Rightarrow W_A = W_B$