Chapter 26 example.
To:- Haseen Uallah Jan
By:- Maaz Habib
section:- CSE/C

Q) 26.1:-
A Solid ...... length is l.
Solution:-

$$V_b - V_a = \int_a^b \vec{E} \cdot d\vec{s}$$

$$V_b - V_a = -\int_a^b E \cdot dr = -2k_e\lambda \int_a^b \frac{dr}{r} = -2k_e\lambda \ln\left(\frac{b}{a}\right)$$

$$C = \frac{Q}{\Delta V} = \frac{Q}{(2k_eQ/L)\ln(b/a)} = \boxed{\frac{L}{2k_e\ln(b/a)}}$$

Q 26.2:-
A spherical .... device.
Solution:-

$$V_b - V_a = -\int_a^b \vec{E} \cdot d\vec{s}$$

$$V_b - V_a = -\int_a^b E_r dr = -k_eQ\int_a^b \frac{dr}{r^2} = k_eQ\left[\frac{1}{r}\right]_a^b$$

① $V_b - V_a = k_eQ\left(\cancel{b}1/b - 1/a\right) = k_eQ\frac{a-b}{ab}$

$$C = \frac{Q}{\Delta V} = \frac{Q}{|V_b - V_a|} \boxed{= \frac{ab}{k_e(b-a)}}$$

Example 26.3:-
Find ...... microfarads.
Solution:-

$C_{eq} = C_1 + C_2 = 4.0\mu F$

$C_{eq} = C_1 + C_2 = 8.0\mu F$

$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_1} = \frac{1}{40} + \frac{1}{40} = \frac{1}{2.0\mu F}$

$\boxed{C_{eq} = 2.0\mu F}$

$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{8\mu F} + \frac{1}{8.0\mu F} = \frac{1}{4.0\mu F}$

$\boxed{C_{eq} = 4.0\mu F}$

$C_{eq} = C_1 + C_2 = \boxed{6.0\mu F}$

Q) 26.4:-

Two .... S_1 and S_2 are then closed.

Solution:- (A)

(1) $Q_i = Q_{1i} + Q_{2i} = C_1 \Delta V_i - C_2 \Delta V_i = (C_1 - C_2)\Delta V_i$

(2) $Q_1 = Q_{1f} + Q_{2f} = C_1 \Delta V_f + C_2 \Delta V_f = (C_1 + C_2)\Delta V_f$

$Q_f = Q_i \rightarrow (C_1 + C_2)\Delta V_f = (C_1 - C_2)\Delta V_i$

(3) $\Delta V_f = \boxed{\left(\frac{C_1 - C_2}{C_1 + C_2}\right)\Delta V_i}$

(B):-

(4) $U_i = \frac{1}{2}C_1(\Delta V_i)^2 + \frac{1}{2}C_2(\Delta V_i)^2 = \frac{1}{2}(C_1 + C_2)(\Delta V_i)^2$

$U_f = \frac{1}{2}C_1(\Delta V_f)^2 + \frac{1}{2}C_2(\Delta V_f)^2 = \boxed{\frac{1}{2}(C_1 + C_2)(\Delta V_f)^2}$

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5) $U_f = \frac{1}{2}(C_1+C_2)\left[\left(\frac{C_1-C_2}{C_1+C_2}\right)\Delta V_i\right]^2 = \frac{1}{2}\frac{(C_1-C_2)^2(\Delta V)^2}{(C_1+C_2)}$

$$\frac{U_f}{U_i} = \boxed{\frac{\frac{1}{2}(C_1-C_2)^2(\Delta V_i)^2/(C_1+C_2)}{\frac{1}{2}(C_1+C_2)(\Delta V_i)^2}}$$

6) $$\boxed{\frac{U_f}{U_i} = \left(\frac{C_1-C_2}{C_1+C_2}\right)^2}$$

example 26.5:-

A parallel .... inserted.

Solution:-

$$U_0 = \frac{Q_0^2}{2C_0}$$

$$U = \frac{Q_0^2}{2C}$$

$$\boxed{U = \frac{Q_0^2}{2kC_0} = \frac{U_0}{k}}$$

example 26.6:-

The water ..... to the field.

Solution:-

$$\Delta U = W$$

$$W = U_{90} - U_0 = (-NpE\cos 90) - (-NPE\cos 0^\circ)$$

$$= NPE = (10^{21})(6.3\times10^{-30}\,C\cdot m)(2.5\times10^5\,N/C)$$

$$\boxed{= 1.6\times10^{-3}\,J}$$

example 26.7:-

A parallel ..... plates.

Solution:- A

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{\left[\frac{\epsilon_0 A}{(d-a)/2}\right]} + \frac{1}{\left[\frac{\epsilon_0 A}{(d-a)/2}\right]}$$

$$\boxed{C = \frac{\epsilon_0 A}{d-a}}$$

(b):-

$$C = \lim_{a \to 0} \left(\frac{\epsilon_0 A}{d-a}\right) \boxed{= \frac{\epsilon_0 A}{d}}$$

Example 26.8

A parallel ...... is a fraction between 0 & 1.

Solution:-

$$C_1 = \frac{k\epsilon_0 A}{fd} \quad \text{and} \quad C_2 = \frac{\epsilon_0 A}{(1-f)d}$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{fd}{k\epsilon_0 A} + \frac{(1-f)d}{\epsilon_0 A}$$

$$\frac{1}{C} = \frac{fd}{k\epsilon_0 A} + \frac{k(1-f)d}{k\epsilon_0 A} = \frac{f+k(1-f)}{k}\frac{d}{\epsilon_0 A}$$

$$C = \frac{k}{f+k(1-f)}\frac{\epsilon_0 A}{d} = \boxed{\frac{k}{f+k(1-f)}C}$$

Physics chapter 27
By:- Maaz Habib
To:- Haseen Ullah Jan
Sec:- CSE / C

Example 27.1:-
The ...... 8.92 g/cm³

Solution:-

$$V = \frac{m}{\rho} = \frac{63.5 g}{8.92 g/cm^3} = 7.12 cm^3$$

$$n = \frac{6.02 \times 10^{23} \text{ electron}}{7.12 cm^3} \left(\frac{1.00 \times 10^6 cm^3}{1 m3} \right.$$

$$= 8.46 \times 10^{28} \text{ electron}/m^3$$

$$V_d = \frac{I_{avg}}{nqA} = \frac{I}{nqA}$$

$$V_d = \frac{I}{nqA} = \frac{10.0 A}{(8.46 \times 10^{28} m^{-3})(1.60 \times 10^{-19} C)(3.31 \times 10^{-6} m^2)}$$

$$\boxed{= 2.23 \times 10^{-4} m/s}$$

Example 27.2:-
The .... of this wire

Solution:- (A):-

$$\frac{R}{L} = \frac{\rho}{A} = \frac{\rho}{\pi r^2} = \frac{1.5 \times 10^{-6} \Omega \cdot m}{\pi (0.321 \times 10^{-3} m)^2}$$

$$\boxed{= 4.6 \Omega/m}$$

(B)

$$I = \frac{\Delta V}{R} = \frac{\Delta V}{(4.6 \Omega/m) l} = \frac{10 V}{(4.6 \Omega/m)(1 m)} \boxed{= 2.2 A}$$

example 27.3:-

coaxial......two conductors:-

Solution:-

$$dR = \frac{\rho}{2\pi r L}\,dr$$

$$1)\ R = \int dR = \frac{\rho}{2\pi L}\int_a^b \frac{dr}{r} = \frac{\rho}{2\pi L}\ln(b/a)$$

$$R = \frac{1.0\times10^{15}\,\Omega.m}{2\pi(0.150\,m)}\ln\left(\frac{1.75\,cm}{0.500\,cm}\right) = \boxed{1.33\times10^{13}\,\Omega}$$

example 27.4:-

An ..... heater.

Solution:-

$$I = \frac{\Delta V}{R} = \frac{120\,V}{8.00\,\Omega} = \boxed{15.0\,A}$$

$$P = I^2R = (15.0)^2(8.00\,\Omega) = 1.80\times10^3\,W$$

$$= 1.80\,kW$$

example 27.5:-

An ...... 110V.

Solution:- A

$$P = \frac{(\Delta V)^2}{R} = \frac{Q}{\Delta t}$$

$$\frac{(\Delta V)^2}{R} = \frac{mc\Delta T}{\Delta t} \rightarrow R = \frac{(\Delta V)^2\Delta t}{mc\Delta T}$$

$$R = \frac{(110\,V)^2(600\,s)}{(1.50\,kg)(4186\,J/kg.^\circ C)(50.0^\circ C - 10.0^\circ C)}$$

$$\boxed{R = 28.9\,\Omega}$$

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(B) :. Estimate the cost of heating the water.

$$P\Delta t = \frac{(\Delta V)^2}{R}\Delta t = \frac{(110V)^2}{28.9\Omega}(10.0min)\left(\frac{1h}{60.0min}\right)$$

$$= 69.8Wh = 0.0698kWh$$

$$cost = (0.0698kWh)(\$0.1/kWh)$$
$$= 0.007\$ = \boxed{0.7¢}$$

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Chapter 28 Examples:

By = Maaz Habib
To = Haseen Ullah Jan
Sec = CSE/C

Example 28·1:-
A battery ...... of 3.00Ω

Solution:- (A)

$$I = \frac{\mathcal{E}}{R+r} = \frac{12.0V}{(3.00\Omega + 0.05\Omega)} = \boxed{3.93A}$$

$$\Delta V = \mathcal{E} - Ir = 12.0 - (3.93)(0.05)\Omega = \boxed{11.8V}$$

$$\Delta V = IR = (3.93A)(3.00\Omega) = \boxed{11.8V}$$

(B):- calculate ..... battery.

$$P_R = I^2R = (3.93A)^2(3.00\Omega) = \boxed{46.3W}$$

$$P_r = I^2R = (3.93A)^2(0.05\Omega) = \boxed{0.772W}$$

$$P = P_R + P_r = 46.3W + 0.772W = \boxed{47.1W}$$

example 28·2:-
Find ..... Active figure.

Solution:-

(1) $$P = I^2R = \frac{\mathcal{E}^2R}{(R+r)^2}$$

$$\frac{dP}{dR} = \frac{d}{dR}\left[\frac{\mathcal{E}^2R}{(R+r)^2}\right] = \frac{d}{dR}\left[\mathcal{E}^2R(R+r)^{-2}\right] = 0$$

$$[\varepsilon^2 (R+r)^{-2}] + [\varepsilon^2 R(-2)(R+r)^{-3}] = 0$$

$$\frac{\varepsilon^2 (R+r)}{(R+r)^3} - \frac{2\varepsilon^2 R}{(R+r)^3} = \frac{\varepsilon^2 (r-R)}{(R+r)^3} = 0$$

$$\boxed{R = r}$$

example 28.4:

Four ..... show in fig.

Solution (A) :-

$$R_{eq} = 8.0\,\Omega + 4.0\,\Omega = 12.0\,\Omega$$

$$\frac{1}{R_{eq}} = \frac{1}{6.0\,\Omega} + \frac{1}{3.0\,\Omega} = 3/6.0\,\Omega$$

$$R_{eq} = 2.0\,\Omega$$

$$R_{eq} = 12.0\,\Omega + 2.0\,\Omega = \boxed{14.0\,\Omega}$$

(B) what ..... between a and c?

$$I = \frac{\Delta V_{ac}}{R_{eq}} = \frac{42V}{14.0\,\Omega} = \boxed{3.0A}$$

$$\Delta V_1 = \Delta V_2 \rightarrow (6.0\,\Omega) I_1 = (3.0\,\Omega) I_2 \rightarrow I_2 = 2I_1$$

$$I_1 + I_2 = 3.0A \rightarrow I_1 + 2I_1 = 3.0A \rightarrow \boxed{I_1 = 1.0A}$$

$$I_2 = 2I_1 \rightarrow 2(1.0A) = \boxed{2.0\,A}$$

example 28·5 :.

Three ...... point a and b.

Solution:- (A) :.

$$\frac{1}{R_{eq}} = \frac{1}{3.00\Omega} + \frac{1}{6.00\Omega} + \frac{1}{9.00\Omega} = \frac{11.0}{18.0\Omega}$$

$$R_{eq} = \frac{18.0\Omega}{11.0} = \boxed{1.64\Omega}$$

(B) Find the current in each resistor.

$$I_1 = \frac{\Delta V}{R_1} = \frac{18.0V}{3.00\Omega} = \boxed{6A}$$

$$I_2 = \frac{\Delta V}{R_2} = \frac{18.0V}{6.00\Omega} = \boxed{3A}$$

$$I_3 = \frac{\Delta V}{R_3} = \frac{18.0V}{9.00\Omega} = \boxed{2A}$$

(C) calculate .... of resistors:

3Ω : $P_1 = I_1^2 R_1 = (6A)^2 (3\Omega) = \boxed{108W}$

6Ω : $P_2 = I_2^2 R_2 = (3A)^2 (6\Omega)$ $\boxed{54W}$

9Ω : $P_2 = I_3^2 R_3 = (2A)^2 (9\Omega)$ $\boxed{36W}$

example 28·6 :-

A single ...... circuit.

Solution :-

$$\Sigma \Delta V = 0 \rightarrow \varepsilon_1 - IR_1 - \varepsilon_2 - IR_2 = 0$$

$$(1)\ I = \frac{\varepsilon_1 - \varepsilon_2}{R_1 + R_2} = \frac{6.0V - 12V}{8.0\Omega + 10\Omega} = \boxed{-0.33A}$$

(P.T.O)

example 28.7:-

Find . . . . . . shown in fig.

Solution:-

1) $I_1 + I_2 - I_3 = 0$

2) $10.0V - (6.0\Omega)I_1 - (2.0\Omega)I_3 = 0$

abcda

befcb $\rightarrow -(4.0\Omega)I_2 - 14.0V + (6.0\Omega)I_1 - 10.0V = 0$

3) $-24.0V + (6.0\Omega)I_1 - (4.0\Omega)I_2 = 0$

$10.0V - (6.0\Omega)I_1 - (2.0\Omega)(I_1 + I_2) = 0$

4) $10.0V - (8.0\Omega)I_1 - (2.0\Omega)I_2 = 0$

5) $-96.0V + (24.0\Omega)I_1 - (16.0\Omega)I_2 = 0$

6) $30.0V - (24.0\Omega)I_1 - (6.0\Omega)I_2 = 0$

$-66.0V - (22.0\Omega)I_2 = 0$

$\boxed{I_2 = -3.0A}$

$-24.0V + (6.0\Omega)I_1 - (4.0\Omega)(-3.0A) = 0$

$-24.0V + (6.0\Omega)I_1 + 12.0V = 0$

$\boxed{I_1 = 2.0A}$

$I_3 = I_1 + I_2 = 2.0A - 3.0A = \boxed{-1.0A}$

example 28·8:-

Many ...... capacitor?

Solution:-

The wipers are part of an RC circuit whose time constant can be varied by selecting different values of R through a multiposition switch. As the voltage across the capacitor increases, the capacitor reaches a point at which it discharges and triggers the wipers. The circuit then begins another charging cycle. The time ~~time~~ interval between the individual sweeps of the wispers is determined by the value of the time constant.

example 28·9:-

An ..... function of time.

Solution:-

$$T = RC = (8.00\times10^{5}\,\Omega)(5.00\times10^{-6}F)$$

$$\boxed{T = 4.00\,s}$$

$$Q = C\mathcal{E} = (5.00\,\mu F)(12.0\,V) = 60.0\,\mu C$$

$$I_i = \frac{\mathcal{E}}{R} = \frac{12.0\,V}{8.0\times10^{5}\,\Omega} = 15.0\,\mu A$$

$$q(t) = (60.0\,\mu C)(1 - e^{-t/4.00s})$$

$$\boxed{I(t) = (15.0\,\mu A)e^{-1/4.00s}}$$

example 28.10:-

consider ------ Active fig.

Solution (A):.

$$\frac{\cancel{Q}}{4} = \cancel{Q} e^{-t/RC}$$

$$\frac{1}{4} = e^{-t/RC}$$

$$-\ln 4 = -\frac{t}{RC}$$

$$t = RC\ln 4 = 1.39\,RC$$

$$\boxed{t = 1.39\tau}$$

(B) The ...... value?

$$u(t) = \frac{q^2}{2C} = \frac{Q^2}{2C} e^{-2t/RC}$$

$$\frac{1}{4}\frac{Q^2}{2C} = \frac{Q^2}{2C} e^{-2t/RC}$$

$$\frac{1}{4} = e^{-2t/RC}$$

$$-\ln 4 = \frac{-2t}{RC}$$

$$t = \frac{1}{2} RC\ln 4$$

$$= 0.639\,RC$$

$$\boxed{t = 0.693\tau}$$

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Example 28.11:-

A . . . . capacitor?

solution:-

$$\Delta U + \Delta E_{int} = 0$$

$$(0 - U_C) + (E_{int} - 0) = 0 \rightarrow E_R = U_C$$

$$E_R = \frac{1}{2} C \mathcal{E}^2$$

$$E_R = \frac{1}{2}(5.00 \times 10^{-6} F)(800 V)^2 = \boxed{1.60 J}$$

$$P = \frac{dE}{dt} \rightarrow E_R \int_0^\infty P dt$$

$$E_R = \int_0^\infty I^2 R dt$$

$$E_R = \int_0^\infty \left(-\frac{Q}{RC} e^{-t/RC}\right)^2 R dt.$$

$$= \frac{Q^2}{RC^2} \int_0^\infty e^{-2t/RC} dt = \frac{\mathcal{E}^2}{R} \int_0^\infty e^{-2t/RC} dt$$

$$\boxed{E_R = \frac{\mathcal{E}^2}{R}\left(\frac{RC}{2}\right) = \frac{1}{2} C \mathcal{E}^2}$$

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Physics
Assissment (Numerical problems)
By: Maaz Habib / 273 / C
: 1st semester
: chapter 29 Q/A

example (1):-
An electron - - - - - - - - force on electron

Sol:-

$$F_B = |q| vB\sin\theta$$
$$= (1.6\times10^{-19}C)(8.0\times10^6 m/s)(\sin 60^\circ)(0.025T)$$
$$\boxed{= 2.8\times10^{-14}N}$$

example (2):-
A protorn ..... of the protron.

Sol:-

$$v = \frac{qBr}{m_p}$$
$$v = \frac{(1.60\times10^{-19}C)(0.35T)(0.14m)}{1.67\times10^{-27}kg}$$
$$\boxed{= 4.7\times10^6 m/s}$$

example (3):-
In .... measured to be 7.5 cm.

Solution:- (a)

$$\Delta k + \Delta u = 0$$
$$(\frac{1}{2}mv^2 - 0) + (q\Delta V) = 0$$
$$v = \sqrt{\frac{-2q\Delta V}{m_e}}$$

$$V = \sqrt{\frac{-2(-1.60\times10^{-19}C)(350V)}{9.11\times10^{-31}kg}} = 1.11\times10^{7} m/s$$

$$B = \frac{m_e V}{e r}$$

$$B = \frac{(9.11\times10^{-31}kg)(1.11\times10^{7}m/s)}{(1.60\times10^{-19}C)(0.075m)} = \boxed{8.4\times10^{-4}T} \text{ Ans}$$

(b) what ...... electrons?

Sol:

$$\omega = \frac{v}{r} = \frac{1.11\times10^{7} m/s}{0.075m}$$

$$\boxed{= 1.5\times10^{8} rad/s} \text{ Ans}$$

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(4) :- A wire .... portion.

Sol:-

$$\vec{F}_1 = I\int_a^b \vec{ds}\times\vec{B} = I\int_0^{2R} B\,ds\,\hat{k} = 2IRB\hat{k}$$

1) $dF_2 = I ds \times B = -IB\sin\theta\, ds\,\hat{k}$

2) $ds = R d\theta$

$$F_2 = -\int_0^{\pi} IRB\sin\theta\, d\theta\,\hat{k} = -IRB\int_0^{\pi}\sin\theta\, d\theta\,\hat{k}$$

$$= -IRB\left[-\cos\theta\right]_0^{\pi}\hat{k}$$

$$= IRB(\cos\pi - \cos 0)\hat{k} = IRB(-1-1)\hat{k}$$

$$\boxed{= -2IRB\hat{k}}$$ Ans

(5) :- A rectangular ...... coil.

(A) Sol :-

$$\mu_{coil} = NIA = (25)(1.50)(0.0540m)(0.0850m)$$

$$\boxed{= 1.72\times 10^{-3} A\cdot m^2}$$

(B) What ..... lop?

Sol :-

$$T = \mu_{coil} B = (1.72\times 10^{-3} A\cdot m^2)(0.350T)$$

$$\boxed{= 6.02\times 10^{-4} N\cdot m}$$ Ans

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(6) - consider ...... vertical ?

$$\vec{T}_B = \mu \times B = -\mu B \sin(90 - \theta)\hat{k}$$
$$= -IAB\cos\hat{k} = -Iab B\cos\theta\hat{k}$$

$$\vec{T}_g = r \times mg = mg\frac{b}{2}\sin\theta\hat{k}$$

$$\Sigma\vec{T} = -Iab B\cos\theta\hat{k} + mg\frac{b}{2}\sin\theta\hat{k} = 0$$
$$IabB\cos\theta = mg\frac{b}{2}\sin\theta \Rightarrow \tan\theta = \frac{2Iab}{mg}$$

$$\theta = \tan^{-1}\left(\frac{2IaB}{mg}\right)$$

$$= \tan^{-1}\left[\frac{2(3.50A)(0.200m)(0.010T)}{(0.050kg)(9.80m/s^2)}\right] = \boxed{1.64}^\circ$$

(7) - A rectangular ...... strip

soln

$$\Delta V_H = \frac{IB}{nqt}$$

$$= \frac{(5.0A)(1.2T)}{(8.46\times10^{28}m^{-3})(1.6\times10^{-19}C)(0.001m)}$$

$$\boxed{\Delta V_H = 0.44\mu V}$$ Ans.

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chapter $\boxed{30}$

Numerical problems.

(1) Consider .... current.

$$ds \times r = |ds \times r| k = [dx \sin(\tfrac{\pi}{2} - \phi)] \hat{k}$$

$$= (dx \cos\phi) k$$

(1) $$dB = (dB) k = \frac{\mu_0 I}{4\pi} \frac{dx \cos\theta}{r^2} \hat{k}$$

(2) $$r = \frac{a}{\cos\phi}$$

$$x = -a \tan\phi$$

(3) $$dx = -a \sec^2\phi \, d\phi = \frac{a \, d\phi}{\cos^2\phi}$$

(4) $$dB = -\frac{\mu_0 I}{4\pi} \frac{(a \, d\phi) \cos\phi \cos^2\phi}{a^2 \cos^2\phi}$$

$$= -\frac{\mu_0 I}{4\pi a} \cos\phi \, d\phi$$

$$B = -\frac{\mu_0 I}{4\pi a} \int_{\phi_1}^{\phi_2} \cos\phi \, d\phi$$

$$\boxed{= \frac{\mu_0 I}{4\pi a} (\sin\phi_1 - \sin\phi_2)}$$ Ans

② Calculate ...... angle θ

Sol:

$$dB = \frac{\mu_0 I ds}{4\pi a^2}$$

$$B = \frac{\mu_0 I}{4\pi a^2}\int ds = \frac{\mu_0 I}{4\pi a^2} s$$

$$B = \frac{\mu_0 I}{4\pi a^2}(a\theta) = \boxed{\frac{\mu_0 I}{4\pi a}\theta}$$ Ans.

③ Consider ...... loop.

Sol:

$$dB = \frac{\mu_0 I}{4\pi}\frac{|ds \times \hat{r}|}{r^2} = \frac{\mu_0 I}{4\pi}\frac{ds}{a^2+x^2}$$

$$dB_x = \frac{\mu_0 I}{4\pi}\frac{ds}{a^2+x^2}\cos\theta$$

$$B_x = \oint dB_x = \frac{\mu_0 I}{4\pi}\oint\frac{ds\cos\theta}{a^2+x^2}$$

$$B_x = \mu_0 I \oint\frac{ds}{a^2+x^2}\frac{a}{(a^2+x^2)^{1/2}}$$

$$= \frac{\mu_0 I}{4\pi}\frac{a}{(a^2+x^2)^{3/2}}\oint ds$$

$$B_x = \frac{\mu_0 I}{4\pi}\cdot\frac{a}{(a^2+x^2)^{3/2}}(2\pi a) = \boxed{\frac{\mu_0 I a^2}{2(a^2+x^2)^{3/2}}}$$

(4) Two infinitely ..... triangle ?

Sol:

$$\vec{F}_B = 2\left(\frac{\mu_0 I_1 I_2}{2\pi a} L\right)\cos 30.0^\circ \hat{k} = 0.866 \frac{\mu_0 I_1 I_2}{\pi a}$$

$$F_g = -mg k$$

$$\Sigma \vec{F} = F_B + F_g = 0.866 \frac{\mu_0 I_1 I_2}{\pi a} (k - mg k) = 0$$

$$I_2 = \frac{mg\pi a}{0.866 \mu_0 I_1 L}$$

putting values

$$\boxed{I_2 = 113 A} \text{ Ans.}$$

(5) A long ..... $r < R$.

Sol:

$$\oint B \cdot ds = B \oint ds = B(2\pi r)$$

$$= \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$\frac{I'}{I} = \frac{\pi r^2}{\pi R^2}$$

$$I' = \frac{r^2}{R^2} I$$

$$\boxed{B = \left(\frac{\mu_0 I}{2\pi R^2}\right) r} \text{ Ans.}$$

⑥ A device ..... center.

Sol:

$$\oint B \cdot ds = B\oint ds = B(2\pi r) = \mu_0 N I$$

$$\boxed{B = \frac{\mu_0 N I}{2\pi r}} \text{ Ans}$$

⑦ A rectangular ..... wire.

Sol:

$$\Phi_B = \int B \cdot dA = \int B\,dA = \int \frac{\mu_0 I}{2\pi r}\,dA$$

$$\Phi_B = \int \frac{\mu_0 I}{2\pi r}\,b\,dr = \frac{\mu_0 I b}{2\pi}\int \frac{dr}{r}$$

$$\Phi_B = \frac{\mu_0 I b}{2\pi}\int_c^{a+c} \frac{dr}{r} = \frac{\mu_0 I b}{2\pi} \ln r \Big|_c^{a+c}$$

$$= \frac{\mu_0 I b}{2\pi} \ln\left(\frac{a+c}{c}\right)$$

$$\boxed{= \frac{\mu_0 I b}{2\pi} \ln\left(1+\frac{a}{c}\right)} \text{ Ans}$$