1.

25 - 1, 13, 28, 42, 55, 68, 84

26 - 6, 23, 25, 31, 33, 67, 84

27 - Q1, Q7, Q12, 4, 17, 15, 49 56, 66

$\boxed{25-1}$ $I = \Delta Q/\Delta t$

$\Delta Q = I\,\Delta t = 25000(40 \cdot 10^{-6}) = 1\ C$

$\boxed{25-13}$ $R = \rho L/A = (1.72 \cdot 10^{-9})\ 2/\pi(.814 \cdot 10^{-3})^2 = 1.65 \cdot 10^{-3}\ \Omega$

$V = IR = (12.5 \cdot 10^{-3})R = 2.07 \cdot 10^{-5}\ V$

Silver has $\rho = 1.47 \cdot 10^{8}$ instead of $1.72 \cdot 10^{8}$; same calculation

$\boxed{25-28}$ $24 - 4r = 21.2\ V$ $\qquad r = 0.7\ \Omega$

$24 - 4r - 4R = 0$ $\qquad R = 5.3\ \Omega$

$\boxed{25-42}$ $P = VI = 9(.13) = 1.17$ Watts

$\boxed{25-55}$ $R = \rho L/A \rightarrow \rho = AR/L$

a) $\rho = \pi(1.25 \cdot 10^{-3})^2(.104)/14 = 3.64 \cdot 10^{-8}$

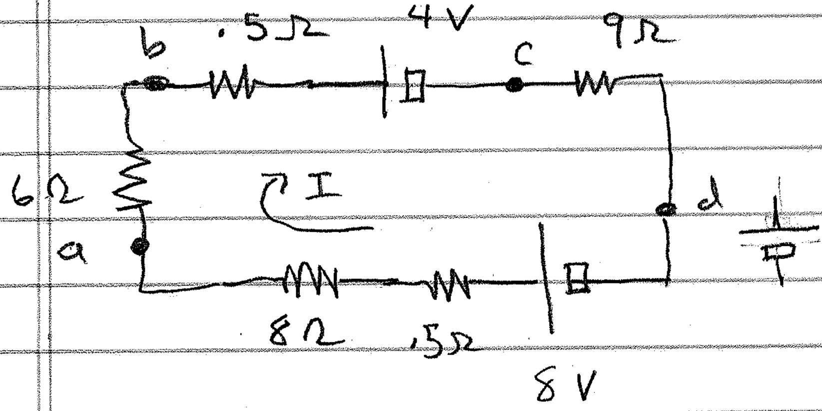
b) $V = Ed = (1.28)(14)$ $\qquad I = V/R = 17.9/.104 = 172$ Amps

c) $I = nqvA$ $\qquad v = 172/8.5 \cdot 10^{28}(1.6 \cdot 10^{-19})\pi(1.25 \cdot 10^{-3})^2$

$= 2.58 \cdot 10^{-3}\ m/s$

2.

$\boxed{25\text{-}68}$ Compute I first



$+8 - 24I - 4 = 0$

Sum of all R

$I = 1/6\ A$

a) $V_d + 8 - 8.5I = V_a$ $\qquad V_a - V_d = 6.58$ Volts

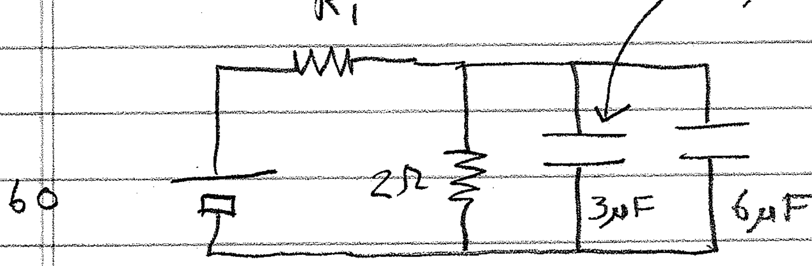
b) $V_b - .5(\frac{1}{6}) - 4 = V_c$ $\qquad V_b - V_c = 4.08$ Volts

c) $+8 - 24I - 4 - 10.3 = 0$

$I = {}^-0.27$ Amps

$V_b - .5(-.27) - 4 = V_c$ $\qquad V_b - V_c = 3.86$ Volts

$\boxed{25\text{-}84}$



Voltage across capacitors must be identical

$C = Q/V$

$V = Q_1/C_1 = 18\mu C/3\mu F = 6$

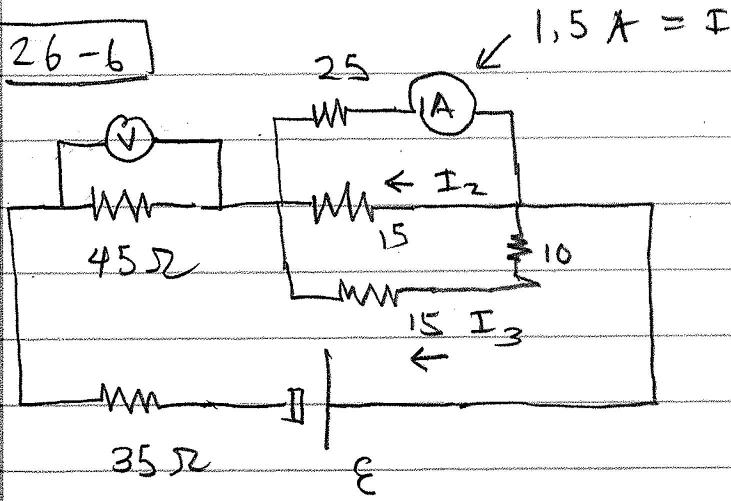
$Q_2 = C_2 V = 36\mu C$

Voltage across 2Ω resistor must also be 6 Volts so $I = 3$ A

Then $60 - 3R_1 - 6 = 0$ $\qquad R_1 = 18\ \Omega$

3.

$\boxed{26-6}$



$$I_2 = 2.5\text{ A}$$
$$I_3 = 1.5\text{ A}$$

$$25(1.5) = 15\,I_2 = 25\,I_3$$

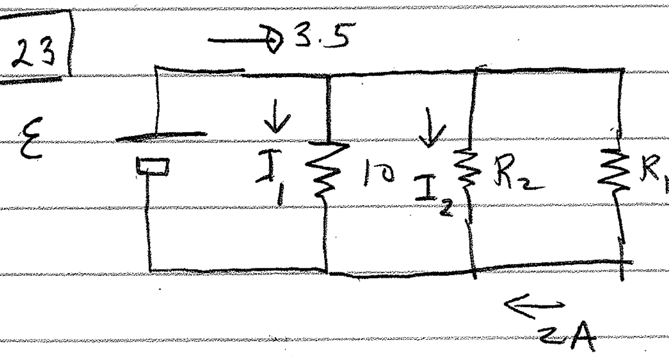
Total current $= I_1 + I_2 + I_3 = 5.5\text{ A}$

Voltmeter reads $45(5.5) = 248$ Volts

$$\mathcal{E} - 25(1.5) - 248 - 35(5.5) = 0$$

$$\mathcal{E} = 478 \text{ Volts}$$

$\boxed{26-23}$



$$3.5 = I_1 + I_2 + 2$$
$$2R_1 = I_2 R_2$$
$$③ \rightarrow 2R_1 = I_1\,10$$
$$\mathcal{E} - 10 I_1 = 0$$
$R_1 = 20$? Assume ?

5 Unknowns $\mathcal{E}, I_1, I_2, R_1, R_2$

$I_1 = 4\text{ A}$ from ③

4.

$I \quad R_1 = 20$

26.23 cont'd $\quad P = 2(20) = 40$ Watts

$40 \text{ Watts} = 40\ J/s = 9.57\ cal/s \qquad 1\ cal = 4.18\ J$

$\Delta Q = c m \Delta T = \left(1 \frac{cal}{g\,°C}\right)(100\,g)(48) = 4800\ cal$

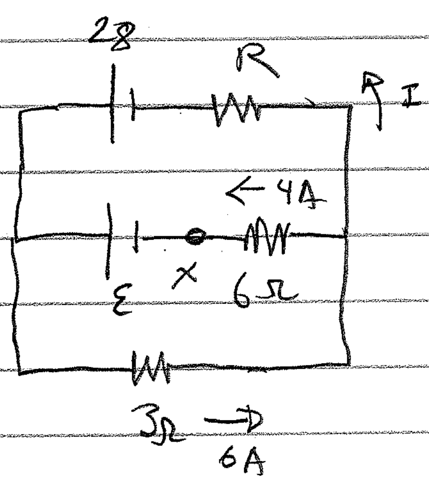
$\Delta t = \dfrac{4800\ cal}{9.57\ cal/sec} = 502\ sec$

Can also compute $\mathcal{E}, I_2, R_2$ if wanted:

From ① $\quad 3.5 = 4 + I_2 + 2 \qquad I_2 = -2.5\ A$

This problem doesn't make sense, at least if we assume $R_1 = 20\ \Omega$.

$\boxed{26\text{-}25}$



a) $6 = 4 + I$

$I = 2A$

b) $-2R + 28 - 3(6) = 0$

$R = 5\ \Omega$

c) $28 - \mathcal{E} + 24 - 5(2) = 0$

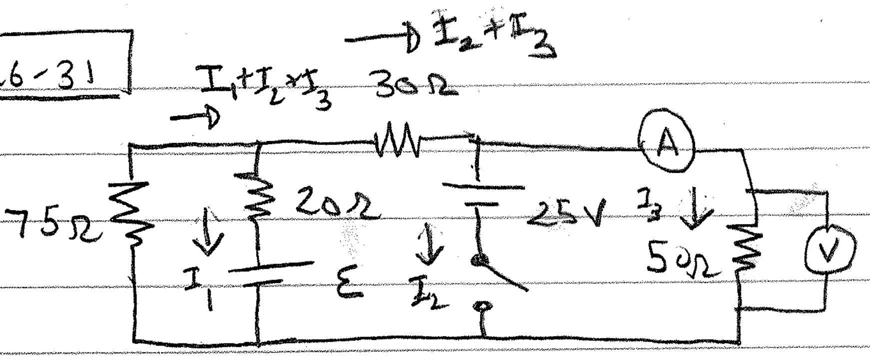
$\mathcal{E} = 42$ Volts

d) $\quad 28 - I(5) - I(3) = 0$

$I = 3.5\ A$

5.

$\boxed{26-31}$



a) S open: $V = 15\,V \Rightarrow I_3 = 15/50 = 0.3$ Amp

$I_2 = 0$

$$\varepsilon + 20 I_1 - 30(\cancel{I_2}^{\,0} + I_3) - 50 I_3 = 0$$

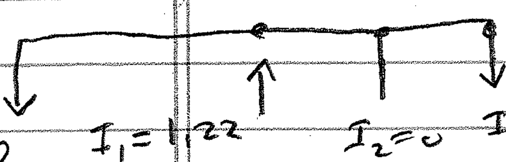
$$\varepsilon + 20I_1 - 80(.3) = \varepsilon + 20I_1 - 24 = 0$$

$$\varepsilon + 20I_1 + 75(I_1 + \underbrace{I_3}_{0.3}) = 0$$

$$\varepsilon + 95I_1 + 22.5 = 0$$
$$\varepsilon + 20I_1 - 24 = 0$$

$$75 I_1 + 46.5 = 0 \qquad I_1 = -0.62A$$

$$\varepsilon = 36.4 \text{ Volts}$$

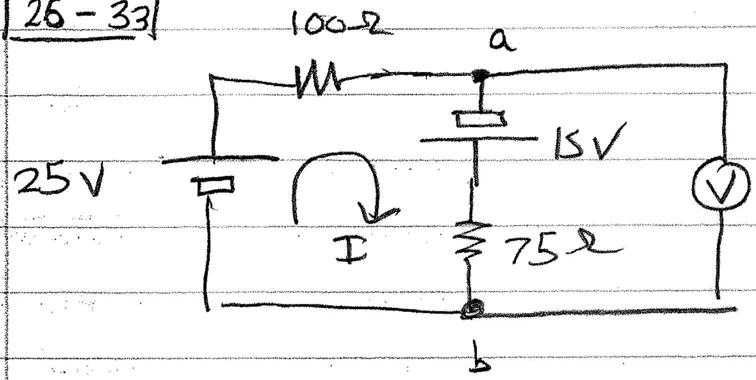


Check $36.4 - 20(0.62) - 75(0.32) = 0$ ✓✓

b) $I = 25/50 = 1/2$ Amp

6.

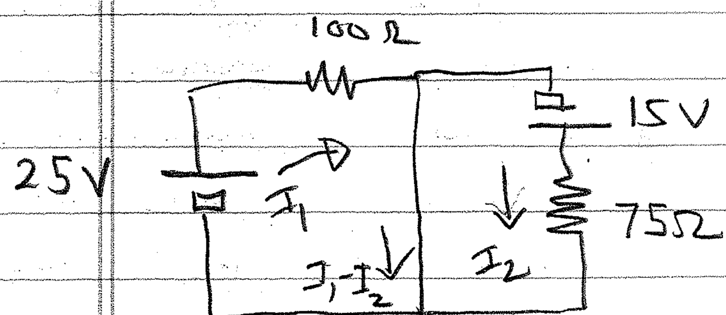
$\boxed{26-33}$



$25 - 100I + 15 - 75I = 0 \qquad I = \frac{40}{175} = 0.23\ A$

$V = 15 - 75(.23) = 7.86\ V$

b is at higher potential



$25 - 100 I_1 = 0$

$I_1 = 0.25\ A$

$15 - 75 I_2 = 0$

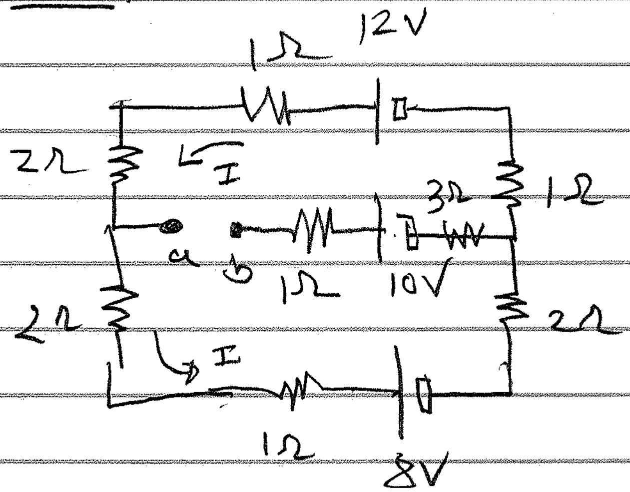
$I_2 = 0.20\ A$

Through switch $I_1 - I_2 = 0.05 A$

7.

$\boxed{26\text{-}67}$

a)



$+12 - 1I - 2I - 2I - 1I$

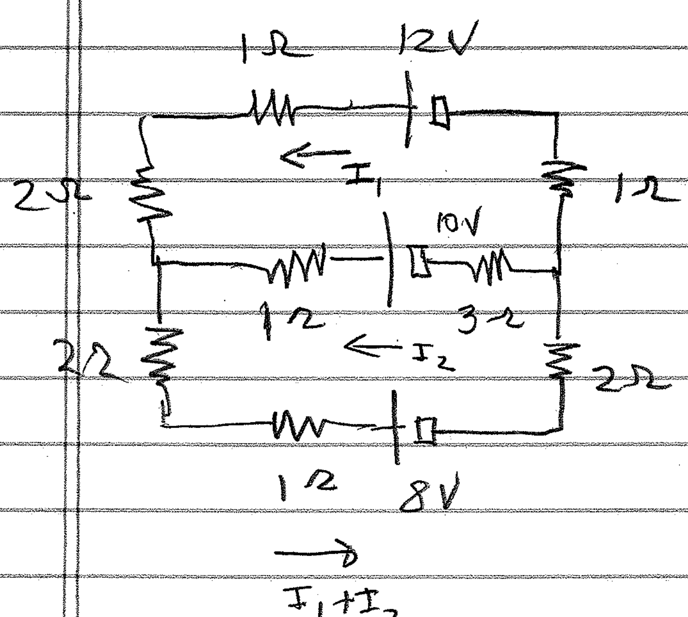
$-8 - 2I - 1I = 0$

$4 - 9I = 0$

$I = 4/9\ A$

Choosing $V_b = 0$ || $V_a = 0 - 1(0) - 10 - 3(0)$ $- 1(4/9) + 12 - 1(4/9) - 2(4/9) = 0$

$V_a = 12 - 16/9 = 2/9$ Volts



$12 - I_1 - 2I_1 - 2(I_1 + I_2)$

$- (I_1 + I_2) - 8 - 2(I_1 + I_2)$

$- I_1 = 0$

$4 - 9I_1 - 5I_2 = 0$

$12 - I_1 - 2I_1 + I_2 - 10 + 3I_2$

$- I_1 = 0$

$2 - 4I_1 + 4I_2 = 0$

2 2 $4 - 9I_1 - 5I_2 = 0$

9 5 $1 - 2I_1 + 2I_2 = 0$

$13 - 28I_1 = 0$

$I_1 = 13/28$ $I_2 = -1/28$

$-1 - 28I_2 = 0$

8.

$\boxed{25\text{-}84}$ a) $U = Q^2/2C = (6.9\cdot10^{-3})^2/2(4.62\cdot10^{-6})$

$= 5.15$ J

$Q(t) = Q_0 e^{-t/RC}$ $I(t) = -Q_0/RC \; e^{-t/RC}$

b) $P_0 = I_0 V_0 = \dfrac{(6.9\cdot10^{-3})^2}{850(4.62\cdot10^{-6})^2} = 2624$ Watts

$I_0 = \dfrac{Q_0}{RC}$, $V_0 = \dfrac{Q_0}{C}$

c) If U is 1/2 its initial value the charge must be $1/\sqrt{2}$ of Q_0, i.e. $e^{-t/RC} = 1/\sqrt{2}$

$P = |IV| = \frac{1}{RC} Q_0 e^{-t/RC} \dfrac{Q_0 e^{-t/RC}}{C} = \dfrac{Q_0^2}{RC^2} \underbrace{(e^{-t/RC})^2}_{1/2}$

So power is 1/2 that in part (b), 1312 Watts.

Notice that total energy dissipated in resistor is

$$U_{lost} = \int_0^\infty P\,dt = \int_0^\infty |IV|\,dt = \int_0^\infty +\frac{Q_0}{RC}e^{-t/RC}\,\frac{Q_0 e^{-t/RC}}{C}\,dt$$

$$= \frac{Q_0^2}{RC^2}\underbrace{\int_0^\infty e^{-2t/RC}\,dt}_{-\frac{RC}{2}e^{-2t/RC}\Big|_0^\infty} = \frac{Q_0^2}{RC^2}\,\frac{RC}{2} = \frac{Q_0^2}{2C}$$

$= U_0$

9.

$\boxed{27\text{-}Q1}$ Since $\vec{F} = q\vec{v}\times\vec{B}$

$$|\vec{F}| = q|\vec{v}||\vec{B}|\sin\theta$$

angle between $\vec{v}$ and $\vec{B}$

If $\vec{v} \parallel \vec{B}$ $\theta = 0$ and $|\vec{F}| = 0$

so, yes, there can be no force if $\vec{v} \parallel \vec{B}$

$\boxed{27\text{-}Q7}$ $F_{tot} = q\vec{E} + q\vec{v}\times\vec{B} = m\vec{a}$

if $\vec{v}$ = constant $\vec{a} = 0$ so $\vec{E} + \vec{v}\times\vec{B} = 0$

If $\vec{B} = 0$ we conclude $\vec{E} = 0$

However if $\vec{E} = 0$ all we can say is $\vec{v}\times\vec{B} = 0$

See Q1.

$\boxed{27\text{-}Q12}$ a) $q\vec{v}\times\vec{B} = q v_0 \hat{y} \times B_0 \hat{x} = -q v_0 B_0 \hat{z}$

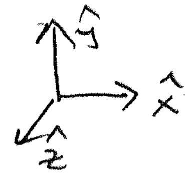
b) $q\vec{v}\times\vec{B} = q v_0 \hat{z} \times B_0 \hat{x} = q v_0 B_0 \hat{y}$

c) $q\vec{v}\times\vec{B} = -q v_0 \hat{x} \times B_0 \hat{x} = \emptyset$

d) $q\cdot\vec{v}\times\vec{B} = q v_0 \frac{1}{\sqrt{2}}(\hat{x} - \hat{z}) \times B_0 \hat{x} = -q v_0 B_0/\sqrt{2}\, \hat{y}$

e) $q\vec{v}\times\vec{B} = q v_0 \frac{1}{\sqrt{2}}(\hat{y} - \hat{z}) \times B_0\hat{x} = \frac{q v_0 B_0}{\sqrt{2}}(-\hat{z} - \hat{x})$

10.



$\boxed{27-4}$ $\vec{a} = \vec{F}/m = q\vec{v} \times \vec{B}/m$

$$= \frac{1{,}22 \cdot 10^{-8}}{181 \cdot 10^{-3}} \left(3 \cdot 10^{4}\, \hat{y} \times \left(1{,}63\, \hat{x} + 0.980\, \hat{y}\right)\right)$$

$\hat{y} \times \hat{x} = -\hat{z}$ $\quad \hat{y} \times \hat{y} = 0$

$$= -0.33\, \hat{z} \;\; m/s^2$$

$\boxed{27.14}$ $\Phi_B = |\vec{B}|\, A \cos\theta$ if $\vec{B}$ is uniform

angle between normal to surface and $\vec{B}$

a) $\Phi_B = (0.128)(.3)(.4) \cdot \cos 90° = 0$

$\hat{n} = \hat{x} \perp B\hat{z}$

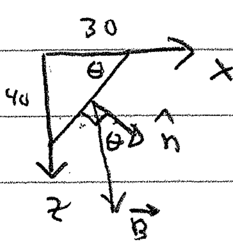
use outward normal $\hat{n} = -\hat{z}$

b) $\Phi_B = (0.128)(.3)(.3) \cdot \cos 180 = -.115 \;\; T \cdot m^2$

c) $\Phi_B = (0.128)(.3)(.5) \cos\theta$

$3/5$

$= +.115 \;\; T m^2$



d) flux through abe and dcf $= 0$ since $\hat{n} = \hat{y} \perp \vec{B}$

Total flux $= 0$.

11.

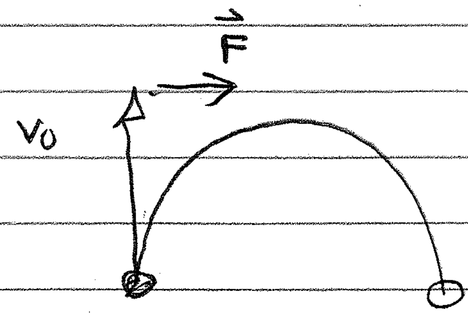
circular motion $a = v^2/r$

$\boxed{27\text{-}15}$ a) $\underbrace{mv^2/r = qvB}_{F_{mag}}$

$$B = mv/qr = \frac{(9.11\cdot 10^{-31})(1.41\cdot 10^{6})}{(1.6\cdot 10^{-19})(.1)} = 8.10\cdot 10^{-5}\ T$$

$= 0.8$ Gauss

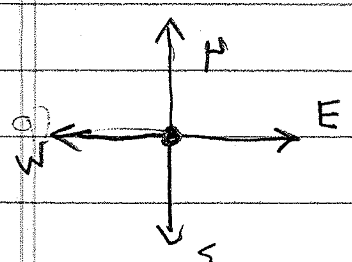
want force to right, so $\vec{B}$ must be out of paper.



b) $T = 2\pi r/v = 2\pi(.1)/1.41\cdot 10^{6} = 4.46\cdot 10^{-7}$ sec

$\boxed{27\text{-}40}$ $|\vec{F}| = I\,l\,B\sin\theta$

angle between wire and B



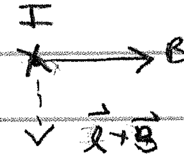
I is into paper ("downward")

In all a, b, c $\theta = 90^\circ$ so $\sin\theta = 1$

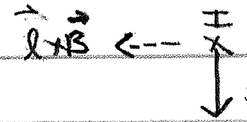
$|\vec{F}| = \underbrace{(1.2)}_{I}\underbrace{(.01)}_{l}\underbrace{(0.588)}_{B} = 7.06\cdot 10^{-3}\ N$

27-40 cont'd

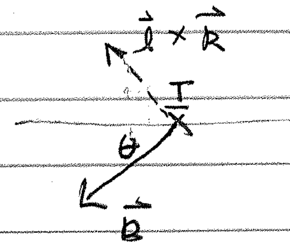
a) direction is South



b) direction is West



c) direction is

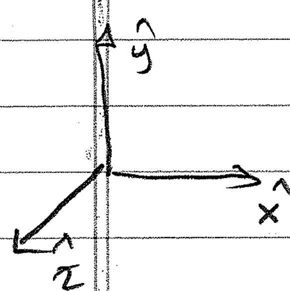


60° N of West.

$\boxed{27\text{-}56}$ $q\vec{v}\times\vec{B}$

$$= (9.45\cdot10^{-8})\left(-1.68\cdot10^{4}\,\hat{x} - 3.11\cdot10^{4}\,\hat{y} + 5.85\cdot10^{4}\,\hat{z}\right)$$

$$\times\ 0.65\,\hat{x}$$

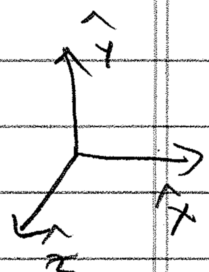


$$\hat{x}\times\hat{x} = 0$$
$$\hat{y}\times\hat{x} = -\hat{z}$$
$$\hat{z}\times\hat{x} = +\hat{y}$$

$$= 1.91\cdot10^{-3}\,\hat{z} + 3.60\cdot10^{-3}\,\hat{y}$$

13.

$\boxed{27-66}$ $\vec{F} = F_0(3\hat{x} + 4\hat{y})$ $\quad\quad \vec{V} = v\hat{z}$



$$3F_0\hat{x} + 4F_0\hat{y} = q\, v\hat{z} \times (B_x\hat{x} + B_y\hat{y} + B_z\hat{z})$$

$$= qv(B_x\hat{y} - B_y\hat{x})$$

a) We see $B_x = 4F_0/qv$

$$B_y = -3F_0/qv$$

We get no information about B_z.

b) $$|B|^2 = \frac{36F_0^2}{q^2v^2} = B_x^2 + B_y^2 + B_z^2$$

$$= \frac{F_0^2}{q^2v^2}\{16 + 9\} + B_z^2$$

$$B_z^2 = 11F_0^2/q^2v^2$$

We cannot tell sign of B_z