1

We name the currents I_1, I_2, and I_3 as shown.

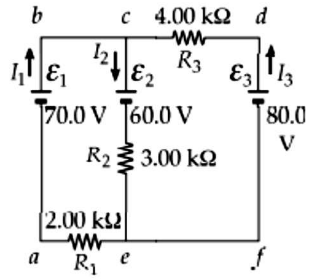

FIG. P28.24

[1] $70.0 - 60.0 - I_2(3.00\text{ k}\Omega) - I_1(2.00\text{ k}\Omega) = 0$

[2] $80.0 - I_3(4.00\text{ k}\Omega) - 60.0 - I_2(3.00\text{ k}\Omega) = 0$

[3] $I_2 = I_1 + I_3$

(a) Substituting for I_2 and solving the resulting simultaneous equations yields

$I_1 = \boxed{0.385\text{ mA}}$ (through R_1)

$I_3 = \boxed{2.69\text{ mA}}$ (through R_3)

$I_2 = \boxed{3.08\text{ mA}}$ (through R_2)

(b) $\Delta V_{cf} = -60.0\text{ V} - (3.08\text{ mA})(3.00\text{ k}\Omega) = \boxed{-69.2\text{ V}}$

$\boxed{\text{Point } c \text{ is at higher potential.}}$

2

65. In the steady state situation, the capacitor voltage will equal the voltage across R_2 = 15 kΩ:

$$V_0 = R_2 \frac{\varepsilon}{R_1 + R_2} = (15.0\text{ k}\Omega)\left(\frac{20.0\text{V}}{10.0\text{ k}\Omega + 15.0\text{ k}\Omega}\right) = 12.0\text{V}.$$

Now, multiplying Eq. 27-39 by the capacitance leads to $V = V_0 e^{-t/RC}$ describing the voltage across the capacitor (and across R_2 = 15.0 kΩ) after the switch is opened (at t = 0). Thus, with t = 0.00400 s, we obtain

$$V = (12)e^{-0.004/(15000)(0.4\times10^{-6})} = 6.16\,\text{V}.$$

Therefore, using Ohm's law, the current through R_2 is 6.16/15000 = 4.11×10^{-4} A.

3.

P29.66 Let v_x and $v_\perp$ be the components of the velocity of the positron parallel to and perpendicular to the direction of the magnetic field.

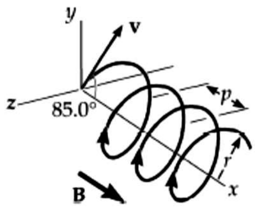

FIG. P29.66

(a) The pitch of trajectory is the distance moved along x by the positron during each period, T (see Equation 29.15)

$$p = v_x T = (v\cos 85.0°)\left(\frac{2\pi m}{Bq}\right)$$

$$p = \frac{\left(5.00\times 10^{6}\right)(\cos 85.0°)(2\pi)\left(9.11\times 10^{-31}\right)}{0.150\left(1.60\times 10^{-19}\right)} = \boxed{1.04\times 10^{-4}\ \text{m}}$$

(b) From Equation 29.13,

$$r = \frac{mv_\perp}{Bq} = \frac{mv\sin 85.0°}{Bq}$$

$$r = \frac{\left(9.11\times 10^{-31}\right)\left(5.00\times 10^{6}\right)(\sin 85.0°)}{(0.150)\left(1.60\times 10^{-19}\right)} = \boxed{1.89\times 10^{-4}\ \text{m}}$$

4.

Consider a longitudinal filament of the strip of width dr as shown in the sketch. The contribution to the field at point P due to the current dI in the element dr is

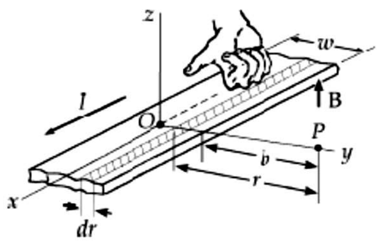

FIG. P30.49

$$dB = \frac{\mu_0 dI}{2\pi r}$$

where $dI = I\left(\frac{dr}{w}\right)$

$$\mathbf{B} = \int d\mathbf{B} = \int_b^{b+w} \frac{\mu_0 I\,dr}{2\pi w r}\hat{\mathbf{k}} = \boxed{\frac{\mu_0 I}{2\pi w}\ln\left(1+\frac{w}{b}\right)\hat{\mathbf{k}}}.$$

5.

For a counterclockwise trip around the left-hand loop, with $B = At$

$$\frac{d}{dt}\left[At\left(2a^2\right)\cos 0°\right] - I_1(5R) - I_{PQ}R = 0$$

and for the right-hand loop,

$$\frac{d}{dt}\left[Ata^2\right] + I_{PQ}R - I_2(3R) = 0$$

where $I_{PQ} = I_1 - I_2$ is the upward current in QP.

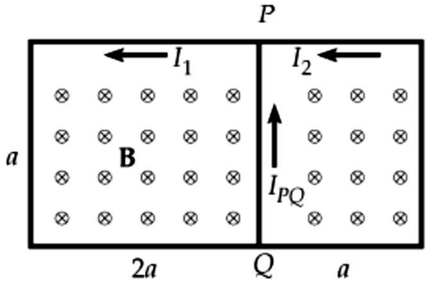

FIG. P31.11

Thus, $$2Aa^2 - 5R\left(I_{PQ} + I_2\right) - I_{PQ}R = 0$$

and $$Aa^2 + I_{PQ}R = I_2(3R)$$

$$2Aa^2 - 6RI_{PQ} - \frac{5}{3}\left(Aa^2 + I_{PQ}R\right) = 0$$

$I_{PQ} = \dfrac{Aa^2}{23R}$ upward, and since $R = (0.100\ \Omega/\text{m})(0.650\ \text{m}) = 0.065\,0\ \Omega$

$$I_{PQ} = \frac{\left(1.00 \times 10^{-3}\ \text{T/s}\right)(0.650\ \text{m})^2}{23(0.065\,0\ \Omega)} = \boxed{283\ \mu\text{A upward}}.$$