Physics 161 Spring 2008 Dr Morrison

TEST 3 Solutions

1) (D)

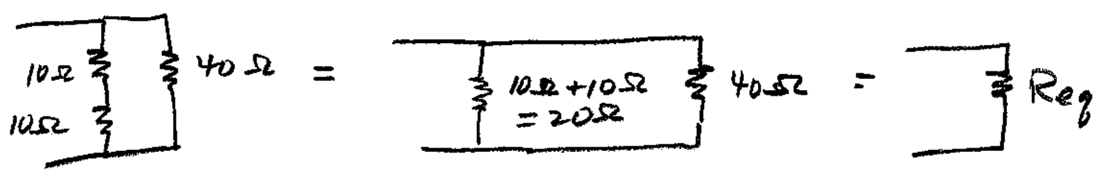
2) (E)

3) $P = I^2 R$ so if $I \to I/2$, $P \to P/4 = 15\,W$ (A)

4) $V_{ab} = \mathcal{E} - IR \Rightarrow I = \frac{\mathcal{E} - V_{ab}}{R} = \frac{31.0V - 17.4V}{2\,\Omega}$

$= 6.8A$ from b to a (D)

5)



where $\frac{1}{R_{eq}} = \frac{1}{20\Omega} + \frac{1}{40\Omega} = \frac{3}{40\Omega} \Rightarrow R_{eq} = \frac{40}{3}\,\Omega$ (B)

6) $V = IR$, ie The 40Ω resistor has a voltage of 180V across it, so

$$I = V/R = \frac{180V}{40\Omega} = \frac{9}{2}A = 4.5A \quad (A)$$

7) Capacitor discharging $q(t) = q(0)\,e^{-t/RC}$

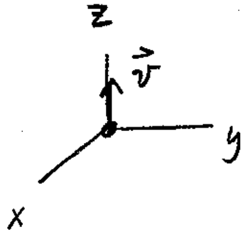
But $q(0) = C\,V(0) = 16\mu F \cdot 80V = 1280\mu C = 1.28\,mC$

Then at time t, $V(t) = q(t)/C = \frac{1280\mu C}{16\mu F} e^{-t/\tau}$

where $\tau = RC = 3.6M\Omega \cdot 16\mu F = 57.6\,s$

So $V(40.0s) = \frac{1280\mu C}{16\mu F} \exp\left(-40.0s/57.6s\right)$

$= 40V$ (B)

8) 

$$\vec{F} = q\vec{v}\times\vec{B} = q\vec{v}\times(\hat{\imath}B_x+\hat{\jmath}B_y+\hat{k}B_z)$$

If $\vec{v} = v\hat{k}$, then $\vec{v}\times(\hat{k}B_z) \equiv 0$

so we cannot tell anything about B_z, ie (D)

9) If particle is undeflected, $\vec{F}_E + \vec{F}_M = 0$

$$q\vec{E} + q\vec{v}\times\vec{B} = 0 \Rightarrow \vec{E} = -\vec{v}\times\vec{B}$$

Since $\vec{v}\perp\vec{B}$, the magnitude of E is

$$E = vB \qquad \text{but} \quad V = \int\vec{E}\cdot d\vec{l} = Ed$$

so $\frac{V}{d} = vB$ or $V = vBd$

$$V = \left(5\times10^{5}\tfrac{m}{s}\right)(0.3T)\left(8mm \times 10^{-3}\tfrac{m}{mm}\right)$$

$$V = 1200V \quad (E)$$

10) For uniform circular motion of a charged particle in a uniform magnetic field

$$F = qvB = m\frac{v^2}{R} \Rightarrow R = \frac{mv}{qB}$$

But the particle reached speed v by being accelerated in a potential V, ie

$$qV = \tfrac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2q}{m}V}$$

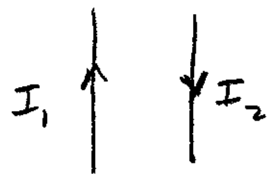
if $V \to 3V \Rightarrow v \to \sqrt{3}\,v$

$$\Longrightarrow R \to \sqrt{3}\,R \quad (B)$$

11) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{net}$

But $I_{net} = 0$ for paths a and c $\Rightarrow$ (C)

12)



Since $I_1 = I_2$, there is no region where $\vec{B} = 0$ (E)

13) As done in class last Friday

$$B_{inside} = \frac{\mu_0 I}{2\pi a^2} r$$

$$B_{outside} = \frac{\mu_0 I}{2\pi r}$$

ie (1st plot) or (A)