PHY 407 - Apr 2nd 2009 (b) - 30

Test 2 - Set 1

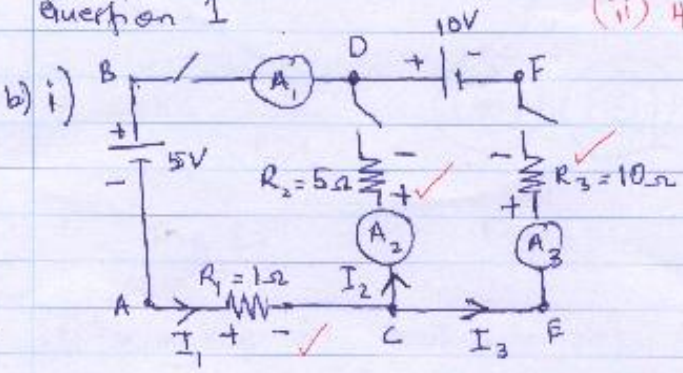
Question Number

(i) 3 (iii) 5+3+2+6+4+3

(ii) 4 = 23

Question 1

b) i)



3

(ii) At D; $\Sigma I_{in} = \Sigma I_{out}$. $I_2 + I_3 = I_1$ - [1] - 4

(iii) Loop BDCAB: $\Sigma V_{drop} = \Sigma V_{rise}$

$0 = 5I_2 + I_1 + 5V$ - [2] - 5

Loop DFECD: $\Sigma V_{drop} = \Sigma V_{rise}$

$10V + 5I_2 = 10I_3$ - [3] - 3

Substitute [1] into [2]: $-5V = 5I_2 + I_2 + I_3$ - 2

$-5V = 6I_2 + I_3$ - [4]

$10V = -5I_2 + 10I_3$ - [3]

Remove I_3. To multiply [4] by 10 then subtract [3]

$-50V = 60I_2 + 10I_3$ - [5]

$10V = -5I_2 + 10I_3$ - [3] 6

So, [5] - [3]: $-60V = 65I_2$; So, $I_2 = -\frac{60}{65} = \frac{-12}{13}$ A

Since I_2 is -ve, it indicates ~~out chor~~ the direction of I_2 is opposite the direction we chose.

Substitute I_2 into [4]: $-5V = -6\left(\frac{12}{13}\right) + I_3$. So, $I_3 = \frac{-65+72}{13}$ A

4

$I_3 = -\frac{7}{13}$ A. Again, I_3 is opposite the direction we initially chose.

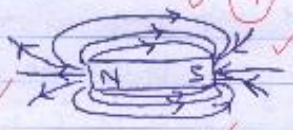
From [1], $I_1 = I_2 + I_3 = -\frac{12}{13} - \frac{7}{13} = -\frac{19}{13}$ A $= -1.46$ A. I_2 in opposite direction. 3

PHY 407 - April 2nd 2009

Question Number

Test 2 - Set 1

Question 2

(a)(i) 

4 ✓

Fig 3a

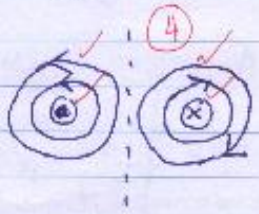
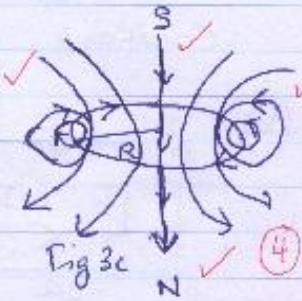

4 ✓

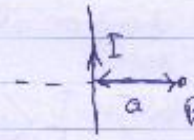
Fig 3b



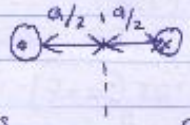
4 ✓

Fig 3c

(ii) For a long wire, B at a horizontal distance a from the wire is



$B = \mu_0 I / 2\pi a$ ✓ ✓ Eq, for the Fig 3b



B halfway is $B_1 = \frac{\mu_0 I}{2\pi(a/2)}$ ✓ ; $B_2 = \frac{\mu_0 I}{2\pi(a/2)}$ ✓

Both B's pointing up ✓ determined using 2nd RHR.

$B = B_1 + B_2 = \frac{\mu_0 I}{2\pi a}$ ✓

6

(iii) The wire loop behaves like a bar magnet and based on the field lines drawn, then South pole is above the wire ✓

At the center of the coil $B = \frac{\mu_0 I}{2R}$ ✓ 2

(a) - 12 + (b) - 26 = 38

Q1 - 38
Q1 - 38
74

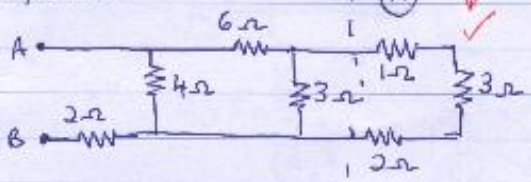
PHY 407 - Apr 2nd 2009 Question Number

Test 2 - Set 1 (a) - 8

either diagram or ✓

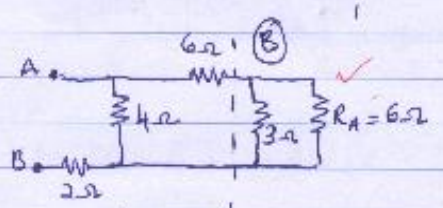
Question 1

a)



For section A, R in series.

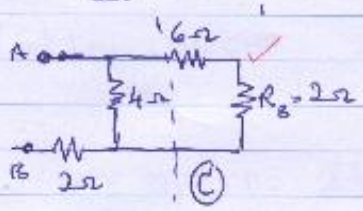
So, $R_A = 1\Omega + 3\Omega + 2\Omega = 6\Omega$ ✓



$R_A = 6\Omega$

R_B in parallel. So,

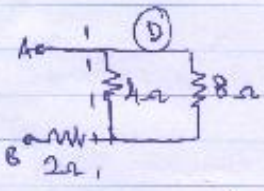
$\frac{1}{R_B} = \frac{1}{3\Omega} + \frac{1}{6\Omega} = \frac{2+1}{6\Omega} = \frac{1}{2\Omega}$, So $R_B = 2\Omega$ ✓



$R_B = 2\Omega$

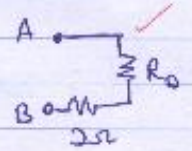
For section C, R in series.

So, $R_C = 6\Omega + 2\Omega = 8\Omega$ ✓



For section D, R in parallel

So, $\frac{1}{R_D} = \frac{1}{4\Omega} + \frac{1}{8\Omega} = \frac{3}{8\Omega}$. So, $R_D = \frac{8}{3}\Omega$ ✓



Hence between points A & B, we now have 2 resistors in series. So, $R_T = 2\Omega + \frac{8}{3}\Omega = \frac{14}{3}\Omega$

So, $R_T = \frac{14}{3}\Omega = 4.67\Omega$. ✓

(8) 10

Q1 (a) - 8/10 + (b) - 30 = 38

PHY 2407 - April 2nd 2009

Question Number

Test ~~Question~~ 2 - Set 1

Question 2

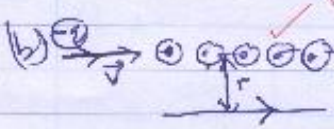
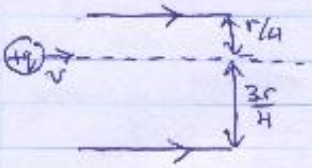
(b) 

Fig 5(i)

$B = \frac{\mu_0 I}{2\pi r}$ (or stating B out of page) ✓ . Using RHR #1, F downwards if q is +ve. Since q is -ve, then F is upwards. $F = qvB = qv\frac{\mu_0 I}{2\pi r}$ ✓ (6)



Along the line of motion B due to top wire is $B = \frac{\mu_0 I}{2\pi (r/4)}$ ✓ into the page, ⊗ ✓.

B due to bottom wire is, $B = \frac{\mu_0 I}{2\pi (3r/4)}$ ✓, out of page ✓.

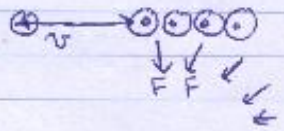
Let B into page is +ve

then $B = +\frac{\mu_0 I}{2\pi (r/4)} + \left(-\frac{\mu_0 I}{2\pi (3r/4)}\right) = \frac{\mu_0 I}{2\pi (r/4)}\left[1 - \frac{4}{3}\right] = -\frac{\mu_0 I}{2\pi r}\left(\frac{4}{3}\right)$ ✓ (out of page) ✓

OR

[Note; if choose B out of page as +ve then the answer is +ve which means out of page.]

Then F on the charged particle is $F = qvB = qv\left(\frac{2\mu_0 I}{3\pi r}\right)$ ✓ ✓ ✓ (down)



(7)

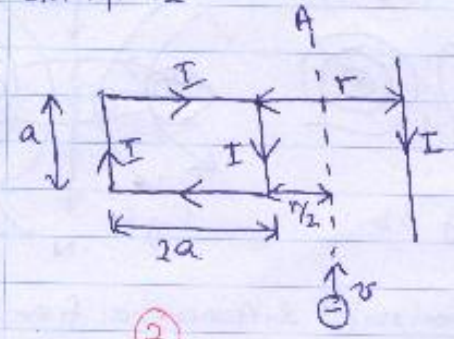
PHY 407 - Apr 2nd 2009

Question Number

Test 2 - Set 1

Question 2

(b)



choose into page as +ve.

So, along A, B due to long wire is $B_w = +\frac{\mu_0 I}{2\pi(\frac{r}{2})}$ into page (×)

(2)

For the loop, consider only wires that are parallel or antiparallel to direction of motion for charge.

For the right wire of loop; $B = \frac{\mu_0 I}{2\pi(r/2)}$ out of page.

For the left wire of the loop, $B = \frac{\mu_0 I}{2\pi(2a+\frac{r}{2})}$ into page.

(4)

Hence, $B = \frac{\mu_0 I}{2\pi(r/2)} + \frac{\mu_0 I}{2\pi(2a+r/2)} + \left(-\frac{\mu_0 I}{2\pi(r/2)}\right) = \frac{\mu_0 I}{2\pi(2a+r/2)}$ into page.

Then the force F on the charge is $F = qvB$ to the left if q is +ve.

Since q is −ve, then $F = qv\frac{\mu_0 I}{2\pi(2a+r/2)}$ to the left.

(7)

(b) − 6+7+13 = 26

10