

# **Ch 28 HW Assignment: Answers & HW Hints (Pt. 1)**

**Part 1: Cross Products  
(Which is really back to Ch 3)**

**Pg. 55-56 #33b, 36a, 37, 44a, 35c**

# Answers

33b. 26.9 units in +z dir

36a. +2k

37a. 12

b. +z dir

c. 12

d. -z dir

e. 12

f. +z

44a. +31k

35c.  $5i - 11j - 9k$

## Ch 28 (3) #35c

I hope it's obvious that you need to start by adding  $B + C$ , and you should get  $1i - 2j + 3k$ . But for the next part, life gets a little harder because you've got to think about 3D vector components in your cross product. The best way for you to do this is to think about the "foil"ish thing that happens when you perform  $(a_x i + a_y j + a_z k) \times (b_x i + b_y j + b_z k)$ . You should see that three of your terms are zero, and the other six terms pair up to add (though there are negatives to consider). Good luck!

# **Ch 28 HW Assignment: Answers & HW Hints (Pt. 2)**

## **Part 2: Magnetic Forces and Fields**

**Pg. 757-758 #1-3, 5, 8, 7, 11**

# Answers

1a.  $6.24 \times 10^{-14}$  N in + z dir

b.  $6.24 \times 10^{-14}$  N in - z dir

2a.  $6.24 \times 10^{-18}$  N

b.  $9.46 \times 10^8$  m/s<sup>2</sup>

c. The same, because...

3a.  $4.0 \times 10^5$  m/s

b. 834.5 V

5. -2T

8. 3750 m/s

7.  $(-2.7 \times 10^{-4} \text{k})$  T

11.  $6.8 \times 10^5$  V/m

## Ch 28 #5

This one involves some backwards thinking about cross products. Start by setting up the magnetic force equation  $F = q (\mathbf{v} \times \mathbf{B})$  with the values you know and don't know, including the  $B_x$  terms. Then you should be able to perform a cross product that gives you the following equation...

$$6B_x - 4B_x = -4$$

This is obviously an easy equation to solve, so make sure you understand where it came from, and then you should be good.

## Ch 28 #7&11

For both of these, you'll be using the easy balanced-forces ideas you used on #8. The only difference is that you have to use other ideas ( $qV = \frac{1}{2}mv^2$ ) to get the particles' speeds before you can even think about balanced forces.

# **Ch 28 HW Assignment: Answers & HW Hints (Pt. 3)**

## **Part 3: Circular Motion in B-Fields**

**Pg. 759-760 #17-18, 21, 24, 27, 29, 36, 38a  
(Notice the difference from what was  
assigned in class.)**

# Answers

17a.  $2.05 \times 10^7$  m/s

b.  $4.67 \times 10^{-4}$  T

d.  $7.66 \times 10^{-8}$  s

c.  $1.31 \times 10^7$  Hz

18a.  $1.11 \times 10^7$  m/s

b.  $3.16 \times 10^{-4}$  m

21b. 0.965 m

a.  $9.78 \times 10^5$  Hz

24a.  $5.0 \times 10^6$  m/s

b. 0.007 m

c.  $8.8 \times 10^{-9}$  s

27.  $6.53 \times 10^4$  m/s

29a.  $3.58 \times 10^{-10}$  s

b.  $1.66 \times 10^{-4}$  m

c. 0.0015 m

36a.  $1.83 \times 10^7$  Hz

b. 17.2 MeV

38a. 0.79 T

## Ch 28 #17

**It shouldn't be too rough, but you'll notice that it's actually easier if you do part D before part C.**

## Ch 28 #21

**It shouldn't be too rough, but you'll notice that it's actually easier if you do part B before part A.**

## Ch 28 #24

Like the problem says, you'll need to decide whether it's an electron or a proton. But make sure you see that you have to make this decision (based on the right hand rule) before you start part B, because you have to plug in a mass value for this part.

## Ch 28 #27

This one might feel a little different than the one we did in class, because no angle is told to you. But you can use force ideas to solve for  $v_{\perp}$  and then separately solve for  $v_{\parallel}$ , and then put those two components together by using the Pythagorean theorem. Once you really get into it, you'll find that solving for  $v_{\parallel}$  is relatively involved, because you need to find  $r$  and also find  $T$ . Good luck.

## Ch 28 #29

**It might be helpful for you to know that a positron is the electron's antiparticle, meaning that it has the same mass as an electron, but has a positive instead of a negative charge. The rest of this problem should feel similar to the example that we did in class.**

## Ch 28 #36

Hopefully you were able to figure out from your reading that oscillation frequency is just the frequency at which the cyclotron needs to apply its voltage, in order to match the frequency at which the particle passes the gap between dees. So these problems are really just dealing with the frequency at which the particle moves around the circular path.

For part B of this one, just find the particle's speed, then its KE, then convert to eV.

## Ch 28 #38a

Just like #36, you're still dealing with frequency at which the particle completes its circular path. So you can basically just use frequency ideas like #17ish. One specific issue with this one is that you don't know the particle's speed, so do a little deriving. Solve  $r = (mv/qB)$  for  $v$ , and substitute this expression into the frequency expression.

# **Ch 28 HW Assignment: Answers & HW Hints (Pt. 4)**

## **Part 4: Magnetic Forces on Wires**

**Pg. 760 #39, 41, 43, 44, 45**

# Answers

39a. 0.467 A

b. Right

41a. 28.19 N

b. West

43.  $(- 2.5E^{-3} \mathbf{j} + 7.5E^{-4} \mathbf{k}) \text{ N}$

44a. 0.033 m/s

b. Left

\*45.  $B = 9.8 / (83.33\sin\theta + 50\cos\theta)$

\* See the hint for instructions.

## Ch 28 #41

**Make sure you understand that the wording is telling you that the B-field is pointing to the north just like the current, except the B-field isn't directed straight horizontally. It's instead pointing most of the way down toward the ground. (This would be true of the Earth's B-field at locations in northern Canada, near the Earth's magnetic south pole.)**

## Ch 28 #44

**This is asking you for the speed at which the wire is moving after a certain time interval. Realize that once you've used magnetic ideas to find the force pushing the wire to accelerate, the rest of the problem is just a mechanics/kinematics problem.**

## Ch 28 #45

**You don't need to actually solve this one, because it involves calculus beyond what we need to really practice. But you should still set it up to solve, based on these ideas...**

**If the magnetic field is oriented correctly, it can not only push the wire forward to overcome static friction, but also help lift the wire a little bit, which decreases the amount of static friction acting. So start by thinking of y-direction forces to find an expression for  $F_N$  in terms of  $B$  and  $\theta$ .**

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## Ch 28 #45 (cont.)

Then think about x-direction forces, where you'll substitute in your expression for  $F_N$ . If you solve this equation for B, your answer should match the answer given.

The way to finish the problem is to differentiate the equation with respect to  $\theta$ , and set the derivative equal to zero to solve for the best  $\theta$  value. It just seems like this derivative and solving process is longer and more difficult than you need to practice, so don't worry about doing it.