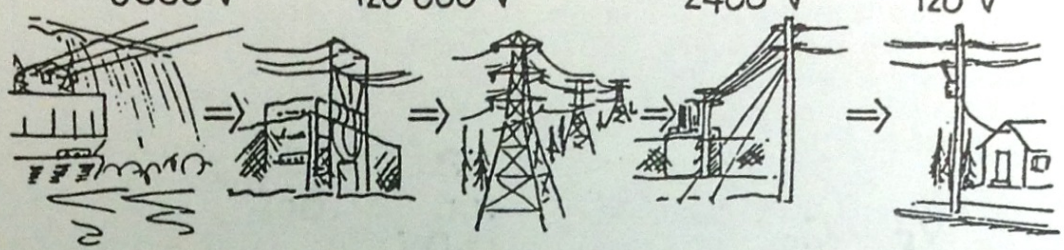
Name Period Date

Concept-Development Practice Page **37-2**

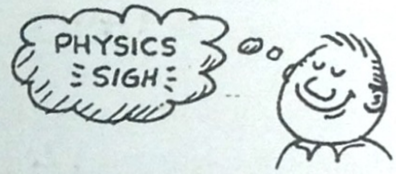
Power Transmission



Many power companies provide power to cities that are far from the generators. Consider a city of 100 000 persons who each use continually use 120 W of power (equivalent to the operation of two 60-W light bulbs per person). The power constantly consumed is 100 000 persons x 120 W / person = 12 million W (12 MW).

1. What current corresponds to this amount of power at the common 120 V used by consumers?

$$P = IV$$
$$12\,000\,000 \text{ W} = I \times 120 \text{ V}$$
$$I = \frac{12000000}{120} \frac{\text{W}}{\text{V}} = 100000 \text{ A}$$



This is an enormous current, more than can be carried in the thickest of wires without overheating. More power would be dissipated in the form of heat than would reach the faraway city. Fortunately the important quantity is *IV* and not *I* alone. Power companies transmit power over long distances at very high voltages so that the current in the wires is low and heating of the power lines is minimized.

2. If the 12 MW of power is transmitted at 120 000 V, the current in the wires is

$$I = \frac{P}{V} = \frac{12\,000\,000}{120\,000} \frac{\text{W}}{\text{V}} = 100 \text{ A}$$

This amount of current can be carried in long-distance power lines with only small power losses due to heating (normally less than 1%). But the corresponding high voltages wired to houses would be very dangerous. So step-down transformers are used in the city.

3. What ratio of primary turns to secondary turns should be on a transformer to step 120 000 V down to 2400 V? 50:1

$$\frac{V_P}{V_S} = \frac{C_P}{C_S} \quad \frac{120000}{2400} = \frac{50}{1}$$

4. What ratio of primary turns to secondary turns should be on a transformer to step 2400 V down to 120 V used in household circuits? 20:1

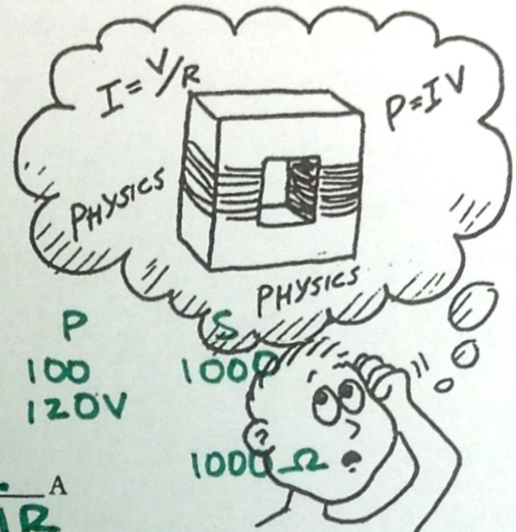
$$\frac{2400}{120} =$$

5. What is the main benefit of ac compared to dc power?

transformers!

Conceptual PHYSICS

Transformers



Consider a simple transformer that has a 100-turn primary coil and a 1000-turn secondary coil. The primary is connected to a 120-V AC source and the secondary is connected to an electrical device with a resistance of 1000 ohms.

P
100
120V

S
1000
1000 Ω

1. What will be the voltage output of the secondary? 1200 V $\frac{V_S}{V_P} = \frac{C_S}{C_P}$

2. What current flows in the secondary circuit? 1.2 A V=IR

3. Now that you know the voltage and the current, what is the power in the secondary coil? 1440 W P=IV

4. Neglecting small heating losses, and knowing that energy is conserved, what is the power in the primary coil? 1440 W

5. Now that you know the power and the voltage across the primary coil, what is the current drawn by the primary coil? 12 A P=IV

Circle the correct answers:

6. The results show voltage is stepped (up) (down) from primary to secondary, and that current is correspondingly stepped (up) (down).

7. For a step-up transformer, there are (more) (fewer) turns in the secondary coil than the primary. For such a transformer, there is (more) (less) current in the secondary than in the primary.

8. A transformer can step up (voltage) (energy and power), but in no way can it step up (voltage) (energy and power).

9. If 120 V is used to power a toy electric train that operates on 6 V, then a (step up) (step down) transformer should be used that has a primary to secondary turns ratio of (1/20) (20/1).

10. A transformer operates on (dc) (ac) because the magnetic field within the iron core must (continually change) (remain steady).

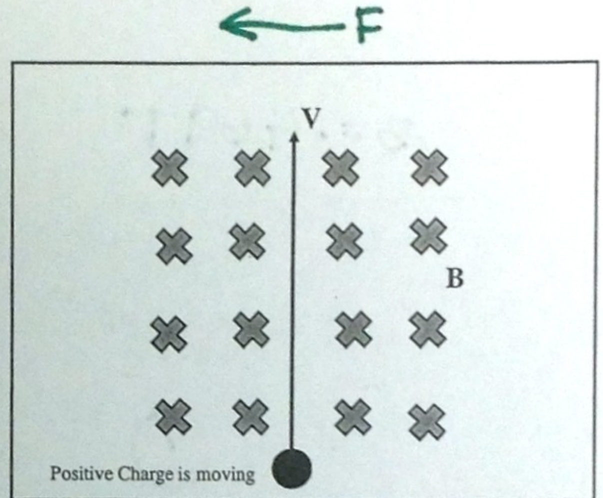
Conceptual PHYSICS

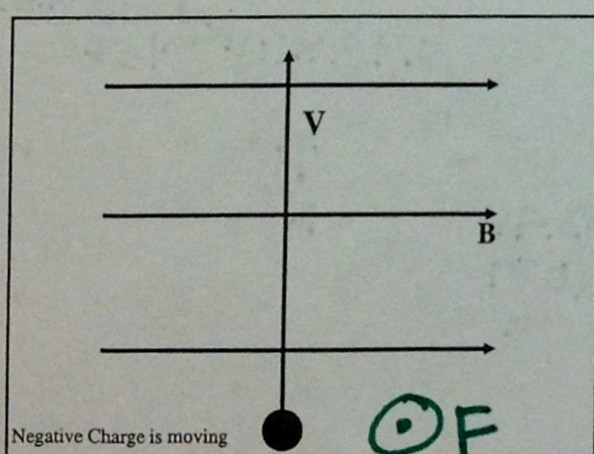
F=BIL

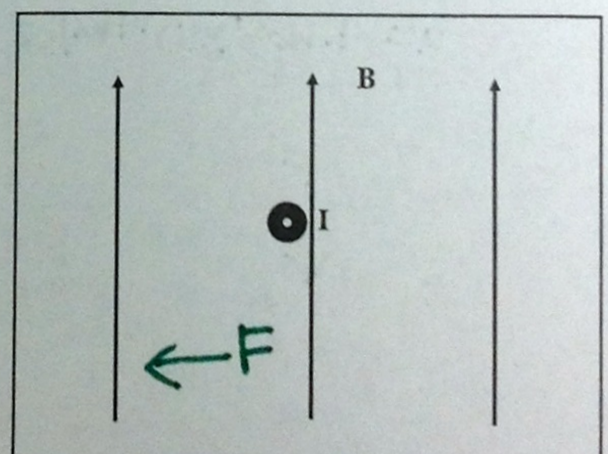
Or is it…..

F=qvB

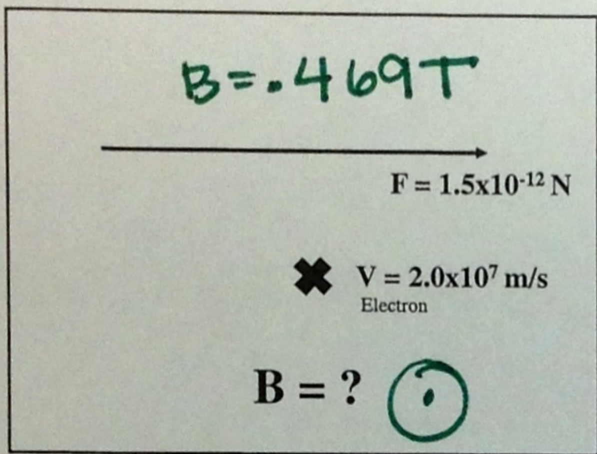
Also Determine the direction of the Force! ☺

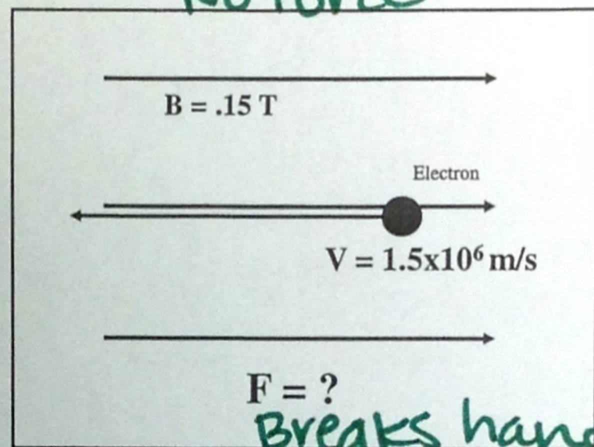






NO Force





Breaks hand!

$F = qvB$

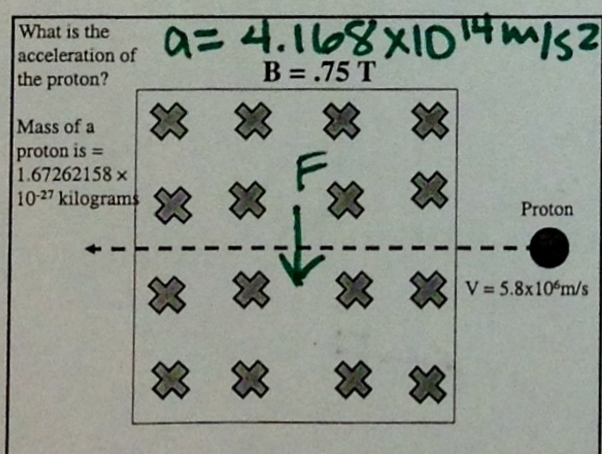
$(1.5\times10^{-12}\,N) = (1.6\times10^{-19}C)(2.0\times10^{7}\,m/s)B$

$B = .46875T$

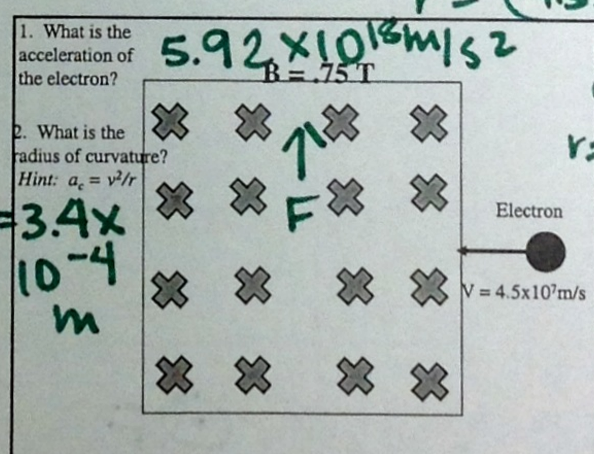
$a = \frac{v^2}{r}$ $r = \frac{v^2}{a}$

$r = \frac{(4.5\times10^{7}\,m/s)^2}{(5.9\times10^{18})}$

$r = 3.4\times10^{-4}$ m



r=3.4x 10^{-4} m



$F_B = ma$ $a = \frac{qvB}{m}$

$qvB = ma$

$a = \frac{(1.6\times10^{-19})(5.8\times10^{6})(.75)}{(1.67\times10^{-27})}$

$a = 4.168\times10^{14}\,m/s^2$

$a = \frac{qvB}{m}$

$a = \frac{(1.6\times10^{-19})(4.5\times10^{7})(.75)}{9.11\times10^{-31}\,kg}$

$a = 5.92\times10^{18}\,m/s^2$

[redacted]

Physics 432
Spring 2012
Rodino

Name key

Date____________

Magnetism

Practice Problems

1. An electron moves at right angles to a magnetic field of 0.18 T. What is its speed if the force exerted on it is 8.9 x 10^{-15} N?

$F = QVB$

$8.9 \times 10^{-15} N = (1.6 \times 10^{-19} C)(v)(.18 T)$

$v = 309027.78 \text{ m/s}$

2. What is the acceleration of a proton moving with a speed of 6.5 m/s at right angles to a magnetic field of 1.6 T?

$ma = QVB$

$a = \frac{QVB}{m} = \frac{(1.6 \times 10^{-19})(6.5 \text{ m/s})(1.6 T)}{(1.67 \times 10^{-27} kg)}$

$a = 9.96 \times 10^{8} \text{ m/s}$

3. An electron moving with a speed of 4.2 x 10^{5} m/s in to the right experiences zero magnetic force. When it moves up it experiences a force of 2.0 x 10^{-13} N that points into the page. What are the direction and magnitude of the magnetic field?

B to the left

$F = QVB$

$2 \times 10^{-13} N = (1.6 \times 10^{-19} C)(4.2 \times 10^{5} \text{ m/s}) B$

$B = 2.97 T$

4. Find the radius of a proton's orbit when it moves perpendicular to a magnetic field of 0.66 T with a speed of 6.27 x 10^5 m/s.

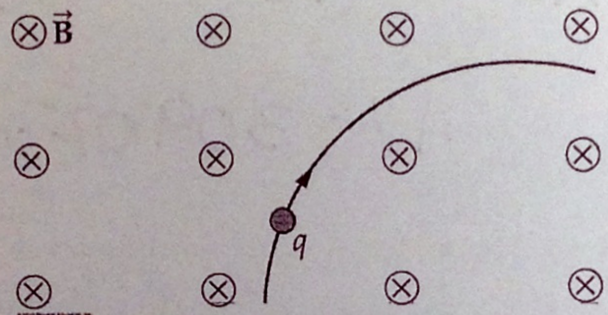
$$\frac{mv^2}{r} = QvB$$

$$\frac{mv^{\not 2}}{Q\not vB} = r$$

$$\frac{(1.6\times10^{-27}kg)(6.27\times10^5)}{(1.6\times10^{-19})(.66T)}$$

$$\boxed{r = .0099\ m}$$

5. When a charged particle enters a region of uniform magnetic field, it follows a circular path as indicated in the figure.



a. Is the particle positively or negatively charged? Explain.

negative

F →

b. Suppose that the magnetic field has a magnitude of 0.180T, the particle' speed is 6.0 x 10^6 m/s, and the radius of its path is 52.0 cm. What is the mass of the particle, given that its charge has a magnitude of 1.60 x 10^{-19} C.

$$\frac{mv^2}{r} = QvB$$

$$m = \frac{Q\not vBr}{v^{\not 2}}$$

$$m = \frac{(1.6\times10^{-19})(.18T)(.52m)}{(6\times10^6 m/s)}$$

$$\boxed{m = 2.496\times10^{-27}\ kg}$$