PHYS 202 Spring 2016 Test #3 Name: KEY

A. Select the correct answer for the multiple choices questions and write your answer in the line next to the question number. Write down your answers for other questions/problems.

c 1. The angle that the magnetic field of the earth makes with respect to the surface at any point is:

a 2. The angular difference between the magnetic north and the geographical north is called the

a. angle of declination b. angle of rotation
c. angle of dip d. angle of latitude

3-4) The magnetic force, F on a moving charge in a magnetic field is given by:

$$F = qVB \sin\theta$$

b 3. What is V in the above equation?

a. Voltage b. Velocity c. Volume d. Vector

e 4. The SI unit for magnetic field, T is equivalent to:

a. $\frac{N.m}{C.s}$ b. $\frac{kg.s}{C}$ c. $\frac{N}{C.s}$ d. $\frac{N.m}{C}$ e. $\frac{kg}{C.s}$

$B = \frac{F}{qV\sin\theta} = \frac{N}{C\,m/s} = \frac{N\cdot s}{C\cdot m} = \frac{kg\frac{m}{s^2}s}{Cm} = \frac{kg}{C\cdot s}$

c 5. At a location near the equator, the earth's magnetic field is horizontal and points north. An electron is moving vertically upward from the ground. What is the direction of the magnetic force that acts on the electron?

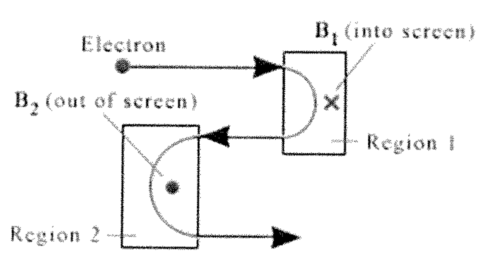
use Left hand

a. North b. South c. East d. West
e. Vertically upward f. Vertically downward

a 6. In a velocity selector the charged particles experience a magnetic force that is,

a. equal in magnitude but opposite in direction to that of the electric force
b. equal to that of the electric force
c. different in magnitude and direction to that of the electric force

b 7. An electron passes through two rectangular regions that contain uniform magnetic fields, B_1 and B_2. Each field fills the region completely. Which one of the following is a correct statement?



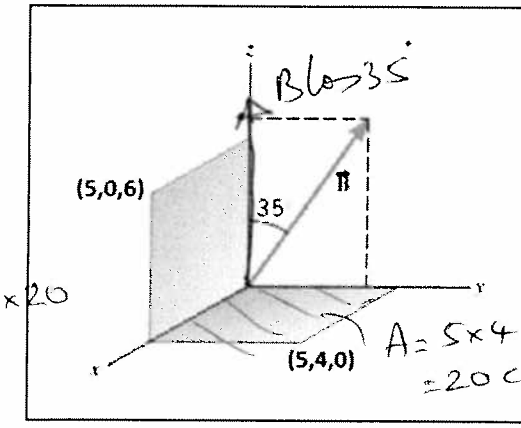
a. Fields are the same in both regions.
b. B_1 is stronger than B_2, because the electron bends more in region 1.
c. B_2 is stronger than B_1, because the electron bends less in region 2.
d. B_1 is stronger than B_2, because the electron bends less in region 1.
e. B_2 is stronger than B_1, because the electron bends more in region 2.

Magnetic flux is given below; $\Phi = B_{\perp} A$.

b 8. Two surfaces and a magnetic field (B = 0.5T) are shown in the xyz coordinate system. The coordinates of the corners: (5,0,6) and (5,4,0) are in cm. What is the magnetic flux through the surface in the xy plane?

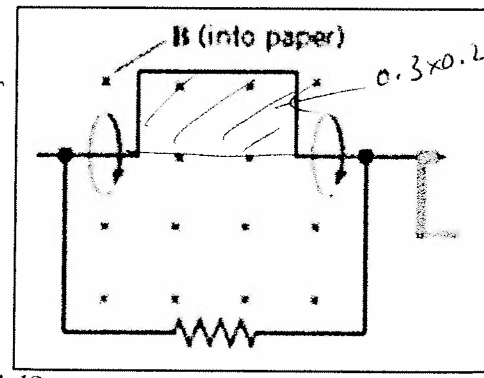
a. 5.74 $T.cm^2$ b. 8.19 $T.cm^2$
c. 10.0 $T.cm^2$ d. 11.5 $T.cm^2$
e. 15.0 $T.cm^2$ f. 16.4 $T.cm^2$
g. 17.2 $T.cm^2$ h. 24.6 $T.cm^2$

$\Phi = (B\cos 35) \times 20 = 8.19$



C 9. A loop of wire has the shape shown in the drawing. The top part of the wire is bent into a rectangle of length 0.30 m and width 0.20 m. A constant magnetic field of magnitude 0.80 T is directed into the paper. What is the change in magnetic flux when the rectangular side is rotated through ¼ of a revolution, starting from the position shown?

a. 0.012 $T.m^2$ b. 0.024 $T.m^2$
c. 0.048 $T.m^2$ d. 0.096 $T.m^2$



e 10. Which one of the following is not a ferromagnetic material?

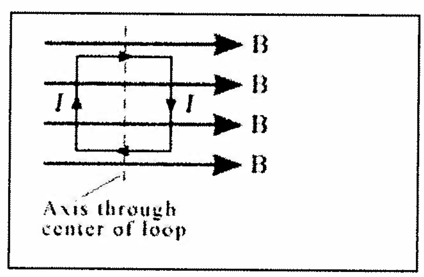
a. iron b. nickel c. cobalt d. alnico e. copper

e 11. Which one of the following is the same between the primary and secondary coils of an ideal transformer?

a. voltage b. current c. magnetic flux d. resistance e. power

C 12. A square current-carrying loop is placed in a uniform magnetic field **B** with the plane of the loop parallel to the magnetic field (see the drawing). The dashed line is the axis of rotation. There is ______________

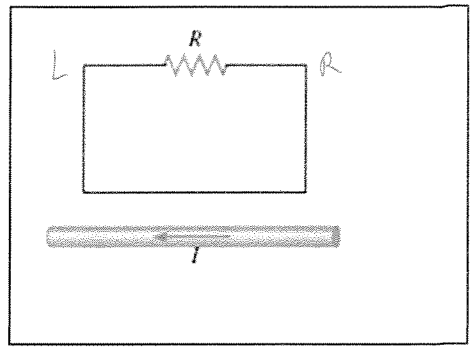
a. a net force and a net torque on the loop.
b. a net force, but not a net torque, on the loop.
c. a net torque, but not a net force, on the loop.
d. neither a net force nor a net torque on the loop.



E 13. A pyroelectric thermometer measures body temperature by determining the amount of __________ radiation emitted by the eardrum and surrounding tissue.

A. radio wave B. ultraviolet C. Gamma D. X-ray E. Infrared

14-16) The drawing shows a straight wire carrying a current I. Above the wire is a rectangular loop that contains a resistor R.



b 14. What is the direction of the magnetic field inside the loop?
a. coming out (·) b. going in (X)

c 15. If the current I is constant, what is the direction of the induced current through the resistor R?

b 16. If the current I is increasing in time, what is the direction of the induced current through the resistor R?

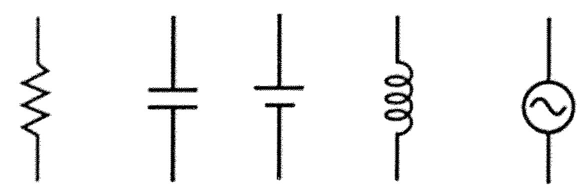
Answers for 15 & 16
a. left to right b. right to left c. no current

A 17. A truck driver is broadcasting at a frequency of 26.96×10^6 Hz with a CB (citizen's band) radio. Determine the wavelength of the electromagnetic wave being used. Assume a speed of 2.998×10^8 m/s for the electromagnetic waves. Speed of light = $C = \lambda f$

A. 11.12 m B. 8.993 m C. 8.083×10^{15} m D. 26.96 m E. 2.998 m

$$\chi_C = \frac{1}{2\pi f C}. \quad \chi_L = 2\pi f L. \quad Z = \sqrt{(R^2 + (\chi_L - \chi_C)^2}. \quad I = \frac{V}{Z}. \quad f_0 = \frac{1}{2\pi\sqrt{LC}}.$$

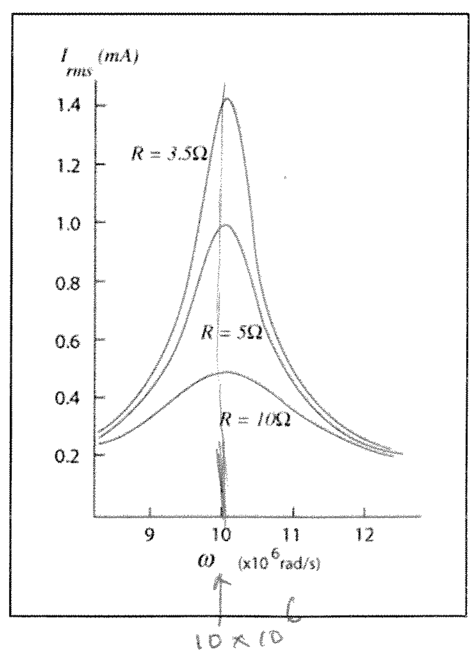
E 18. Identify the ac source among the circuit elements shown below:



A B C D E

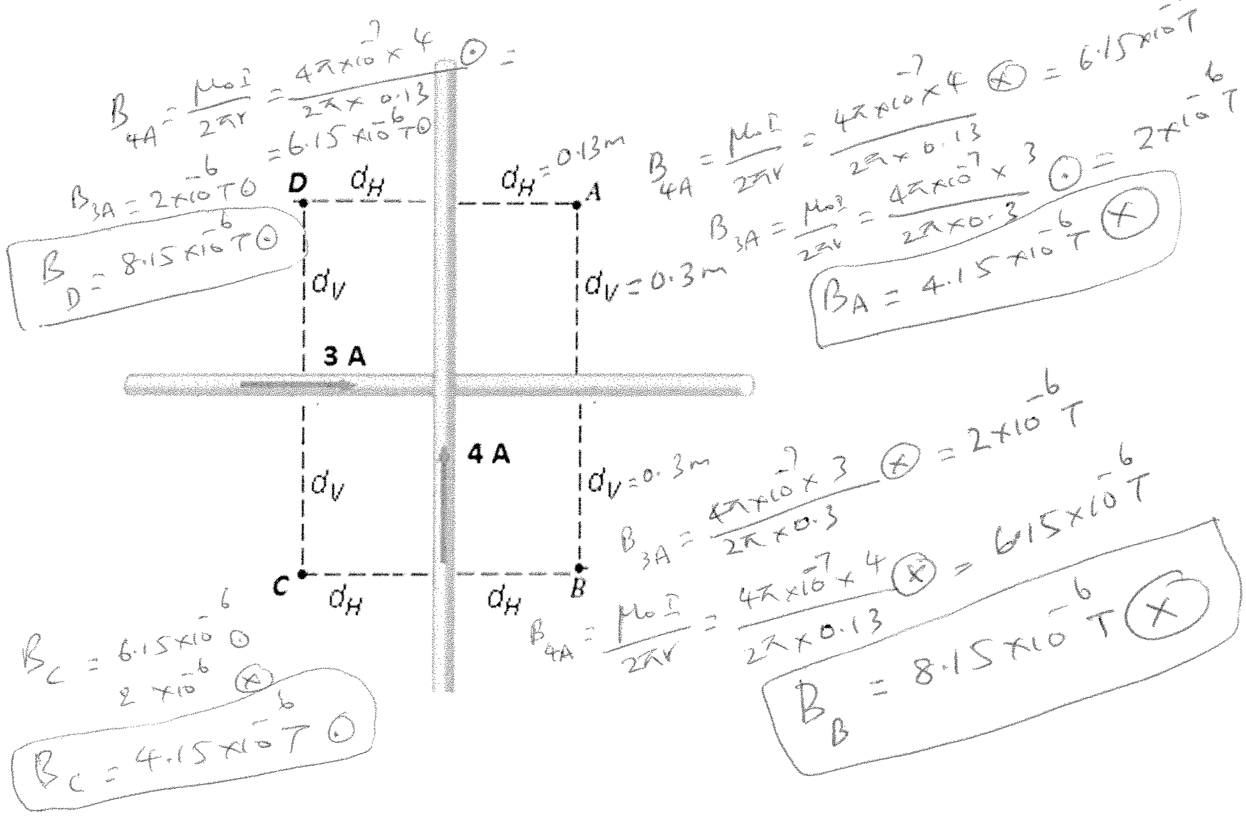
b 19. The reactance/resistance of which of the following increases linearly as a function of frequency?
a. Capacitor b. Inductor c. Resistor

e 20. The resonance curves for an RLC circuit are shown for various resistances. Using the plot, determine the angular frequency, ω of the resonance?
a. 10 rad/s b. 10^4 rad/s c. 10^5 rad/s
d. 10^6 rad/s e. 10^7 rad/s f. 10^8 rad/s



B. The magnetic field (B) due to a long straight wire, carrying a current (I), at a distance (r) is given by: $B = \frac{\mu_0 I}{2\pi r}$ ($\mu_0 = 4\pi x 10^{-7}$ T.m/A)

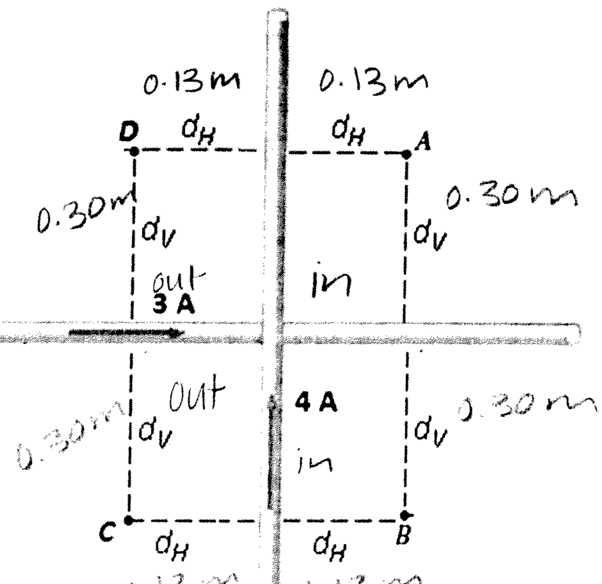
The drawing below shows two perpendicular, long, straight wires, both of which lie in the plane of the paper. The current in each of the wires are shown in the diagram. In the drawing $d_H = 0.13$ m and $d_V = 0.30$ m. Find the magnitude and direction of the net magnetic fields at points *A*, B, C, and D.



Version-2

B. The magnetic field (B) due to a long straight wire, carrying a current (I), at a distance (r) is given by: $B = \frac{\mu_0 I}{2\pi r}$ ($\mu_0 = 4\pi \times 10^{-7}$ T.m/A)

The drawing below shows two perpendicular, long, straight wires, both of which lie in the plane of the paper. The current in each of the wires are shown in the diagram. In the drawing $d_H = 0.13$ m and $d_V = 0.30$ m. Find the magnitude and direction of the net magnetic fields at points *A*, B, C, and D.



$B_{3D\ out} = \frac{(4\pi \times 10^{-7})(3)}{2\pi(0.30)} = 2 \times 10^{-6}$ +

$B_{4D\ out} = \frac{(4\pi \times 10^{-7})(4)}{2\pi(0.13)} = 6.153846151 \times 10^{-6}$

D = 8.15×10^{-6} T out

$B_{3A\ out} = \frac{(4\pi \times 10^{-7})(3)}{2\pi(0.30)} = 2 \times 10^{-6}$ −

$B_{4A\ in} = \frac{(4\pi \times 10^{-7})(4)}{2\pi(0.13)} = 6.15 \times 10^{-6}$

A = 4.15×10^{-6} T in

$B_{3C\ in} = \frac{(4\pi \times 10^{-7})(3)}{2\pi(0.30)} = 2 \times 10^{-6}$ −

$B_{4C\ out} = \frac{(4\pi \times 10^{-7})(4)}{2\pi(0.13)} = 6.15 \times 10^{-6}$

C = 4.15×10^{-6} T out

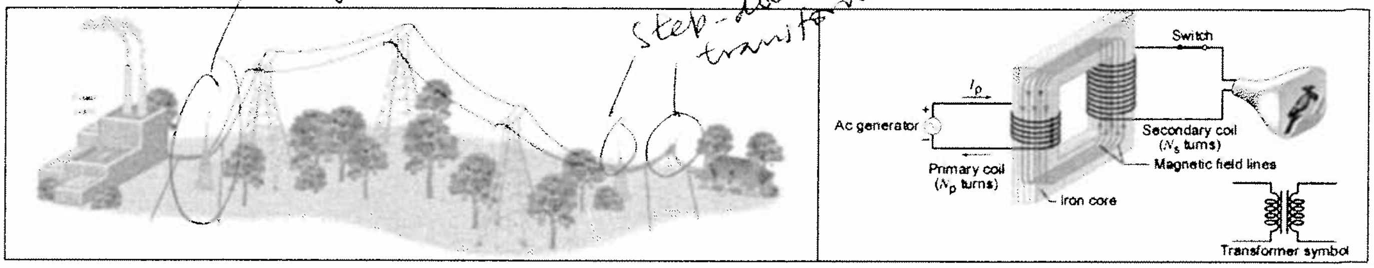
$B_{3B\ in} = \frac{(4\pi \times 10^{-7})(3)}{2\pi(0.30)} = 2 \times 10^{-6}$ +

$B_{4B} = \frac{(4\pi \times 10^{-7})(4)}{2\pi(0.13)} = 6.15 \times 10^{-6}$

B = 8.15×10^{-6} T in

step-up transformer

step-down transformer



C. Equations for transformers and power transmission are shown below:

$$\frac{V_s}{V_P} = \frac{N_s}{N_P} \qquad P = I_S V_S = I_P V_P \qquad P_{loss} = I^2 R$$

4 1. Identify a step-down and a step-up transformer in the diagram above.

3 2. Power plant shown in the figure is a Coal-burning plant.
a. Nuclear b. Hydroelectric c. Coal-burning d. Solar

3. A generating station is producing 1.8×10^6 W of power that is to be sent to a small town located 17 km away. Each of the two wires that comprise the transmission line has a resistance per kilometer of length of 4.0×10^{-2} Ω/km.
(a) Calculate the total resistance of the two wires.
(b) Find the power lost in heating the wires if the power is transmitted at 1200 V.
(c) A 100:1 step-up transformer is used to raise the voltage before the power is transmitted. How much power is now lost in heating the wires?
(d) A 1000:1 step-up transformer is used to raise the voltage before the power is transmitted. How much power is now lost in heating the wires?

(a) $4 \times 10^{-2} \times 17 \times 2 = 1.36\,\Omega$

(b) $P = IV;\ 1.8 \times 10^6 = 1200 I \rightarrow I = 1500\,A$

$P_{loss} = I^2 R = (1500)^2 \times 1.36 = 3060000\,W = 3.06 \times 10^6\,W$

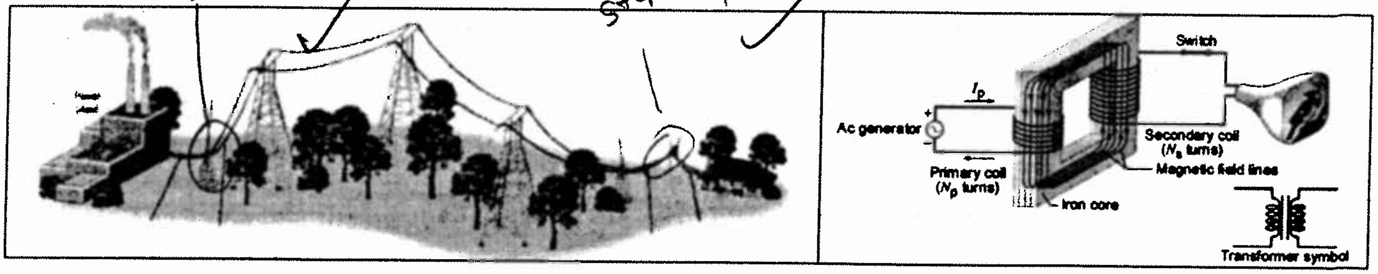
(c) $V = 1200 \times 100 = 120000\,V \rightarrow I = P/V = \frac{1.8 \times 10^6}{120000} = 15\,A$

$P_{loss} = I^2 R = 15^2 \times 1.36 = 306\,W$

(d) $V = 1200 \times 1000;\ I = \frac{P}{V} = \frac{1.8 \times 10^6}{1200 \times 1000} = 1.5\,A$

$P_{loss} = I^2 R = 1.5^2 \times 1.36 = 3.06\,W$

1) step up transformer step down transformer Version 2



C. Equations for transformers and power transmission are shown below:

$$\frac{V_s}{V_P} = \frac{N_s}{N_P} \qquad I_S V_S = I_P V_P \qquad P_{loss} = I^2 R$$

1. Identify a step-down and a step-up transformer in the diagram above.

2. Power plant shown in the figure is a __Coal burning__ plant.
a. Nuclear b. Hydroelectric (c.) Coal-burning d. Solar

3. A generating station is producing 1.8×10^6 W of power that is to be sent to a small town located 17 km away. Each of the two wires that comprise the transmission line has a resistance per kilometer of length of 4.0×10^{-2} Ω/km.
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a) $R = 4.0 \times 10^{-2}$ Ω/km × 17 km
0.68 Ω per wire
× 2
= 1.36 Ω total resistance

b) $P_{loss} = I^2 R$ $P = IV$
$P_{loss} = (1500)^2 (1.36\,\Omega)$ $1.8 \times 10^6 = I(1200\,V)$
$P_{loss} = 3060000$ W $I = 1500$ A

c) 1200 V × 100 = 120000 V $P = IV$
$1.8 \times 10^6 = I(120000)$
$P_{loss} = (15)^2 (1.36\,\Omega)$ $I = 15$ A
$P_{loss} = 306$ W

d) 1200 × 1000 = 1,200,000 6 $P = IV$
$1.8 \times 10^6 = I(1200000)$
$P_{loss} = (1.5)^2 (1.36)$ $I = 1.5$ A
$P_{loss} = 3.06$ W