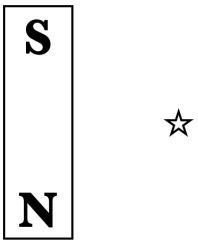
PHYS 2140 Name:_____

Wednesday, November 19 Exam 3a 19 questions, 100 points

1. The figure shows a bar magnet with its N pole at the bottom, and a location marked by a star.



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[4] (a) _____ The magnetic dipole moment $\vec{\mu}$ of this bar magnet points

A) ↑ **B)** → **C)** ↓ **D)** ←

[4] (b) _____ In what direction does the magnetic field point at the star?

A) ↑ **B)** → **C)** ↓ **D)** ←

2. For each of the following, what is the direction of the force on the charge?

A) ↑ **B)** → **C)** ↓ **D)** ←

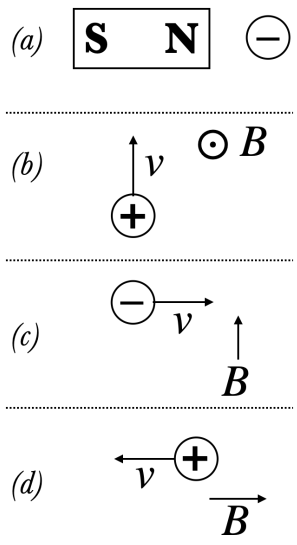
E) ⊗ (into page) **F)** ⊙ (out of page) **G)** zero

[2] (a) _____ negative, placed to the left of the N pole of a bar magnet.

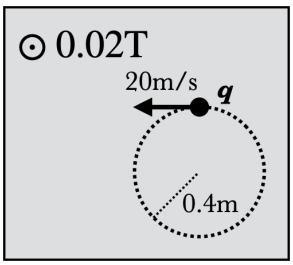
[2] (b) _____ positive, moves upward in a $\vec{B}$ field that points outward.

[2] (c) _____ negative, moves to the right in a $\vec{B}$ field that points upward.

[2] (d) _____ positive, moves to the left in a $\vec{B}$ field that points to the right.



3. A charge q with mass 0.03 kg is moving in a circle due to a magnetic field 0.02 T that points out of the page. The radius of the circle is 0.4 m and the charge is moving at 20 m/s.



[2] (a) _____ The sign of the charge is

A) positive **B)** negative

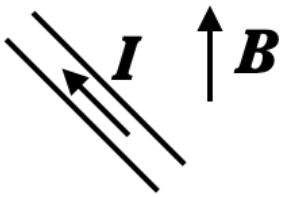
[2] (b) _____ The magnitude of the charge is

A) 12 C **B)** 27 C **C)** 61 C **D)** 75 C

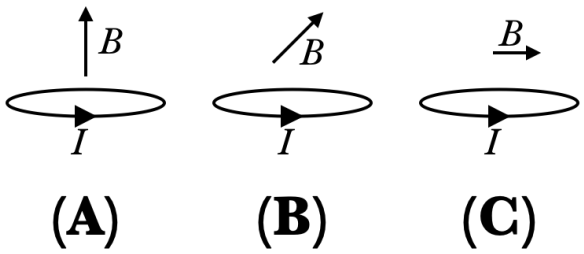
[4] 4. _____ A wire carries current I up and to the left through a magnetic field that points upward. What is the direction of the force felt by the wire?

A) ↖ **B)** ↗ **C)** ↙ **D)** ↘

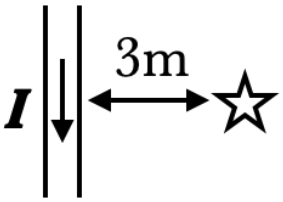
E) ⊙ (out of page) **F)** ⊗ (into page)



[4] 5. _____ These three loops carry the same current I, and they have are placed in three uniform magnetic fields with the same magnitude but which differ in direction. Which loop feels the **largest** torque due to the magnetic field?



6. A very long wire carries a current $I = 0.35\,\text{A}$ downward, which creates a magnetic field at the star, 3 meters to the right of the wire.



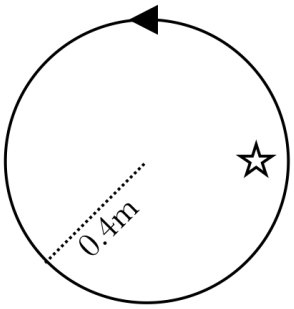
4 (a) _____ What direction does this magnetic field (at the star) point?

A) $\uparrow$ **B)** $\rightarrow$ **C)** $\downarrow$ **D)** $\leftarrow$
E) $\otimes$ (into page) **F)** $\odot$ (out of page)

4 (b) _____ The magnitude of the magnetic field is

A) $2.3 \times 10^{-8}\,\text{T}$ **B)** $3.5 \times 10^{-8}\,\text{T}$
C) $4.7 \times 10^{-8}\,\text{T}$ **D)** $1.5 \times 10^{-7}\,\text{T}$

7. The figure shows a counterclockwise current $I = 0.5\,\text{A}$ flowing through a circular loop with radius $r = 0.4\,\text{m}$.



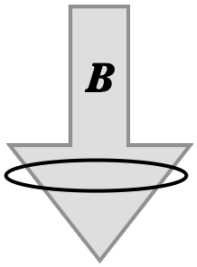
4 (a) _____ The magnetic field at the star points

A) $\uparrow$ **B)** $\rightarrow$ **C)** $\downarrow$ **D)** $\leftarrow$
E) $\otimes$ (into page) **F)** $\odot$ (out of page)

4 (b) _____ The magnetic dipole moment $\vec{\mu}$ of this loop is

A) $0.25\,\text{Am}^2\,\odot$ **B)** $0.25\,\text{Am}^2\,\otimes$
C) $0.63\,\text{Am}^2\,\odot$ **D)** $0.63\,\text{Am}^2\,\otimes$
E) $1.26\,\text{Am}^2\,\odot$ **F)** $1.26\,\text{Am}^2\,\otimes$

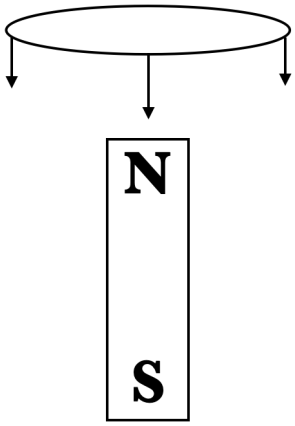
8. The figure shows a loop of wire in a downward-pointing magnetic field $\vec{B}$ which is increasing in magnitude. (The loop is not moving.)



2 (a) _____ The *original* or *external* flux through this loop points
A) up ↑ **B)** down ↓

2 (b) _____ The *induced* flux created by this loop points
A) up ↑ **B)** down ↓

9. A loop of wire is being lowered onto the N pole of a bar magnet as shown.

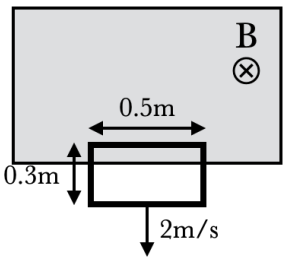


1 (a) _____ What is the direction of the original flux through this loop?
A) up ↑ **B)** down ↓

1 (b) _____ The original flux is
A) increasing **B)** decreasing **C)** constant

2 (c) _____ The induced flux through the loop points
A) up ↑ **B)** down ↓

10. The figure shows a rectangular loop of current which is falling out of a region with uniform magnetic field $B = 0.7\,\text{T}$. The loop is moving with a constant speed of $2\,\text{m/s}$.



2 (a) _____ The external flux through this loop is

A) increasing **B)** decreasing **C)** constant

2 (b) _____ The current induced in this loop runs

A) clockwise ↻ **B)** counterclockwise ↺

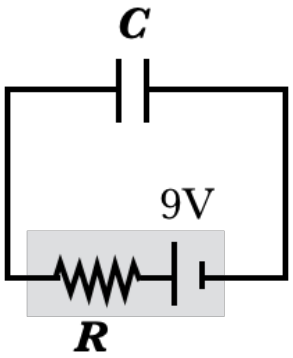
2 XC (c) _____ What is the induced emf $\mathcal{E}$ in this loop? *Show work for partial credit! You might want to let x be the distance from the top of the loop to the bottom edge of the field.*

A) $0.105\,\text{V}$ **B)** $0.210\,\text{V}$ **C)** $0.420\,\text{V}$ **D)** $0.700\,\text{V}$

2 11. _____ Two pucks of the same mass and same frictional coefficients are pushed across a flat surface made of copper (which is a weak diamagnet). One puck is a strong magnet, and the other puck is not. Which puck will come to a stop first? (Explain.)

A) the magnet **B)** the non-magnet **C)** both the same

12. A $C = 500\,\mu\text{F}$ capacitor is connected to a battery with an emf of $\mathcal{E} = 9\,\text{V}$ and an internal resistance of $R = 0.2\,\Omega$, and the capacitor charges.



4 (a) _____ What is the time constant of this charging process?

A) $1.0 \times 10^{-4}\,\text{s}$ **B)** $4.5 \times 10^{-3}\,\text{s}$ **C)** $45\,\text{s}$
D) $100\,\text{s}$ **E)** $1 \times 10^{4}\,\text{s}$

4 (b) _____ What is the final charge on the positive plate of the capacitor?

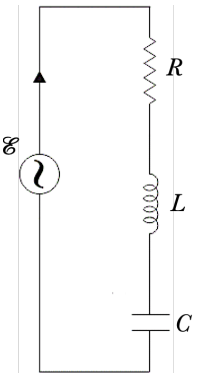
A) $0\,\text{C}$ **B)** $5.6 \times 10^{-5}\,\text{C}$ **C)** $1 \times 10^{-4}\,\text{C}$
D) $4.5 \times 10^{-3}\,\text{C}$ **E)** $45\,\text{C}$ **F)** $1.8 \times 10^{4}\,\text{C}$

4 (c) _____ What is the eventual current through the battery?

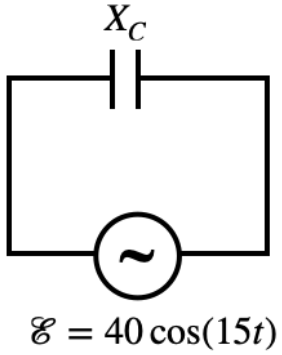
A) $0\,\text{A}$ **B)** $5.6 \times 10^{-5}\,\text{A}$ **C)** $1 \times 10^{-4}\,\text{A}$
D) $4.5 \times 10^{-3}\,\text{A}$ **E)** $45\,\text{A}$ **F)** $1.8 \times 10^{4}\,\text{A}$

4 13. _____ An RLC circuit has resistance $800\,\Omega$, capacitance $700\,\mu\text{F}$, and and inductance $0.2\,\text{H}$. What angular frequency ω must the power supply provide to get the maximum peak current through this circuit? (For partial credit, what is it called when this happens?)

A) $1.79\,\text{rad/s}$ **B)** $84.5\,\text{rad/s}$ **C)** $2390\,\text{rad/s}$ **D)** $7140\,\text{rad/s}$



14. An AC current with peak voltage 40 V and angular frequency $\omega = 15\,\text{rad/s}$ is connected to a capacitor. The capacitor has a reactance of $50\,\Omega$.



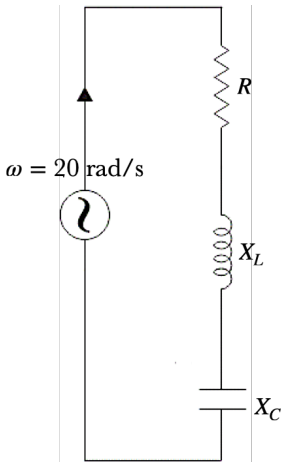
4 (a) _____ What is the capacitance of the capacitor?

A) $1.3 \times 10^{-3}\,\text{F}$ **B)** $0.3\,\text{F}$ **C)** $3.3\,\text{F}$ **D)** $64\,\text{F}$ **E)** $750\,\text{F}$

4 (b) _____ What is the peak current I_0 that flows through this current?

A) $0.0005\,\text{A}$ **B)** $0.8\,\text{A}$ **C)** $1.25\,\text{A}$ **D)** $28\,\text{A}$ **E)** $2000\,\text{A}$

15. An RLC circuit connected to a power supply with an angular frequency $\omega = 20\,\text{Hz}$ has a resistance $80\,\Omega$, a capacitance reactance of $X_C = 40\,\Omega$, and an inductive reactance of $X_L = 100\,\Omega$.



4 (a) _____ What is the inductance L of the circuit?

A) $5 \times 10^{-4}\,\text{H}$ **B)** $1.25 \times 10^{-3}\,\text{H}$ **C)** $0.2\,\text{H}$ **D)** $5\,\text{H}$ **E)** $2000\,\text{H}$

4 (b) _____ What is the impedance of this circuit?

A) $20\,\Omega$ **B)** $100\,\Omega$ **C)** $134\,\Omega$ **D)** $161\,\Omega$ **E)** $220\,\Omega$

[4] 16. _____ Europe's alternating current has an rms voltage of 240 V. The peak voltage $\mathcal{E}_0$ of this alternating current is

A) 120 V **B)** 170 V **C)** 240 V **D)** 339 V

[2] 17. _____ The symbol Z represents

A) impedance **B)** reactance **C)** resistance

[2] 18. _____ In the formula $X_C = \dfrac{1}{\omega C}$, the C stands for

A) capacitance **B)** charge **C)** current

[2] 19. _____ What is the equation $d\vec{B} = \dfrac{\mu_0}{4\pi} I \dfrac{d\vec{s} \times \vec{d}}{d^3}$ called?

A) Ampere's Law **B)** Biot-Savart Law **C)** Gauss' Law **D)** Maxwell's Law