Physics II (PHY205)

Final Exam

Term 171

Tuesday 9/1/2018

Name:	
Student ID #:	
Section # or time:	

Instructions:

1. Write your name and ID# before starting with the questions.
2. You are NOT allowed to have your mobile phone/books/notes in the exam.
3. Check that you have **9 pages** in total. The exam has three parts.
4. You may use a calculator but you may not borrow one.

Physical Constants

Elementary charge	$e = 1.6 \times 10^{-19}$ C
Electron mass	$m_e = 9.11 \times 10^{-31}$ kg
Proton mass	$m_p = 1.67 \times 10^{-27}$ kg
Coulomb constant	$k = 9 \times 10^9$ N.m^2/C^2
Permittivity of free space	$\varepsilon_0 = \frac{1}{4\pi k} = 8.85 \times 10^{-12}$ C^2/N.m^2
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ T.m/A
Acceleration of gravity	$g = 9.8$ m/s^2
Speed of light in vacuum	$c = 3 \times 10^8$ m/s

Mark

Q1. Four unequal resistors are connected in a parallel circuit. Which one of the following statements is correct?
   a) The equivalent resistance is equal to the average of the four resistances
   b) The equivalent resistance is larger than the smallest resistance
   c) The equivalent resistance is equal to the smallest resistance
   d) The equivalent resistance is less than the smallest resistance

Q2. When the current through a resistor is increased by a factor of 4, the power dissipated by it
   a) increases by a factor of 8
   b) decreases by a factor of 8
   c) increases by a factor of 16
   d) decreases by a factor of 16

Q3. A rectangular coil lies flat on a horizontal surface. A bar magnet is held above the center of the coil with its north pole pointing down. If the magnet is dropped from this position, what is the direction of the induced current in the coil?
   a) Clockwise
   b) Counterclockwise
   c) There will be no current
   d) Not enough information in provided

Q4. Images formed by concave lenses are:
   a) Always real, inverted, reduced
   b) Always virtual, upright, reduced
   c) Always virtual, upright, enlarged
   d) Always real, upright, enlarged

Q5. An object is placed 20 cm from a converging lens having a focal length of 10 cm. What are the image properties?
   a) Real, inverted, reduced
   b) Virtual, upright, enlarged
   c) Real, inverted, same size
   d) Real, inverted, magnified

Q6. What is the capacitance of a capacitor having a plate area of 3.75 cm² and plate separation of 0.004 mm filled with a rubber having a dielectric constant of $\kappa = 6.7$?
   a) 0.12 nF   b) 11 nF   c) 0.8 nF   d) 5.6 nF

Q7. A circular coil of 600 turns has a radius of 15 cm. The coil is rotating about an axis perpendicular to a magnetic field of 0.02 T. If the maximum induced emf in the coil is 1.6 V, what is the angular frequency ω of the coil?
   a) 1.9 rad/s   b) 1.4 rad/s   c) 0.6 rad/s   d) 0.9 rad/s

Q8. An AC generator is connected to 15 Ω resitance. If the generator produces a maximum voltage of 24 Volts, what is the rms current in the circuit?
   a) 1.13 A   b) 1.6 A   c) 2.26 A   d) 3.84 A

Q1. Two charges, $+6.0$ nC and -6.0 nC, are placed on the x-axis at $(1, 0)$ m and at $(-1, 0)$ m, respectively. What is the net electric field at the point $(0,1)$ m on the y-axis?
a) $38.2\ \hat{y}$ N/C
b) $38.2\ \hat{x}$ N/C
c) $-38.2\ \hat{x}$ N/C
d) Zero

Q2. The figure shows the equipotential surfaces of a given system. How much work is done by the electric field on a proton when it is moved from point $(4, 0)$ cm to point $(12, 0)$ cm?
a) 1.28×10^{-18} J
b) -1.28×10^{-18} J
c) 3.2×10^{-18} J
d) -3.2×10^{-18} J
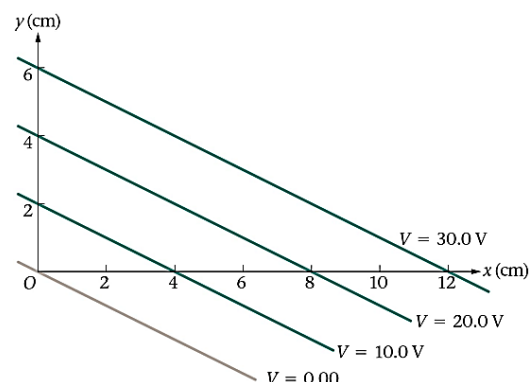
Q3. Three long wires each carry a current of $I = 3$ A are placed as shown. What is the magnitude of the magnetic force acting on an electron moving at 4×10^{6} m/s in in the negative x-direction and passing at the point shown in the figure (2 cm from all wires)?
a) 1.92×10^{-17} N
b) 5.76×10^{-17} N
c) 3.84×10^{-17} N
d) None of the above
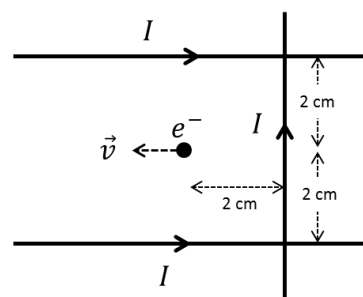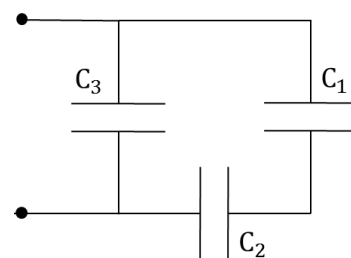

Q4. An RC circuit contains a 6 μF capacitor and its time constant is 12 seconds. If the uncharged capacitor is connected to a 3 V battery, determine the charge on the capacitor after 15 seconds.
a) $12.84\ \mu C$
b) $5.16\ \mu C$
c) $2.14\ \mu C$
d) $4.28\ \mu C$

Q5. In the figure, $C_1 = 6\ \mu F$, $C_2 = 3\ \mu F$, and $C_3 = 3\ \mu F$. If the charge on C_1 is $12\ \mu C$, what is the charge on C_3?
a) $12\ \mu C$
b) $18\ \mu C$
c) $9\ \mu C$
d) $24\ \mu C$

Q6. An object is placed 25 cm from a concave lens of focal length 10 cm. What is the magnification?
a) -0.09 b) -0.14 c) 0.14 d) 0.29

Solve the following problems in the provided space and show all your steps indicating proper units

Q1. Four charges $q_1 = q_2 = q_3 = -5$ nC, and $q_4 = +5$ nC are placed on the corners of a square of side length of 8 m, as shown.
   a) Determine the magnitude and direction of the net force on q_4.
   b) Find the electric potential at the center of the square.
   c) How much work is required to bring a fifth charge $q = -2$ nC from infinity to the center of the square?
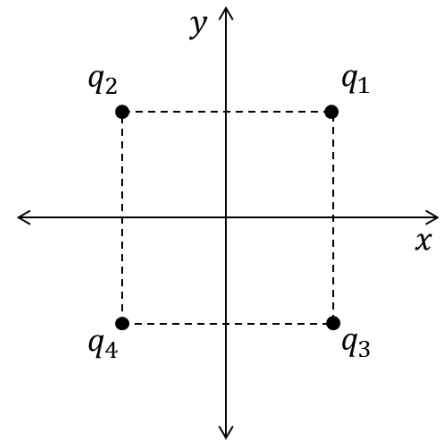
Q2. In the circuit shown, given that $I_2 = \frac{2}{15}$ A:
   a) Determine the unknown currents I_1 and I_3
   b) Calculate the potential difference between the points a and b: $\Delta V_{ab} = V_a - V_b$
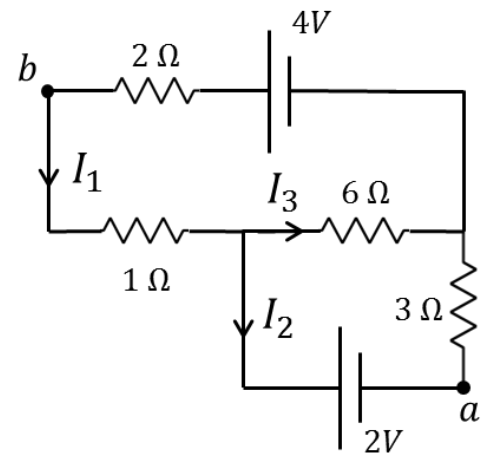
Q3. A 20 cm long conducting rod is placed on a U-shaped wire that has a bulb with a resistance of 15 Ω. A constant magnetic field is applied perpendicular to the plane of the loop in the direction shown in the figure. The rod falls under its own weight and reaches a constant speed of 6 m/s, inducing a current of 0.5 A in the bulb.
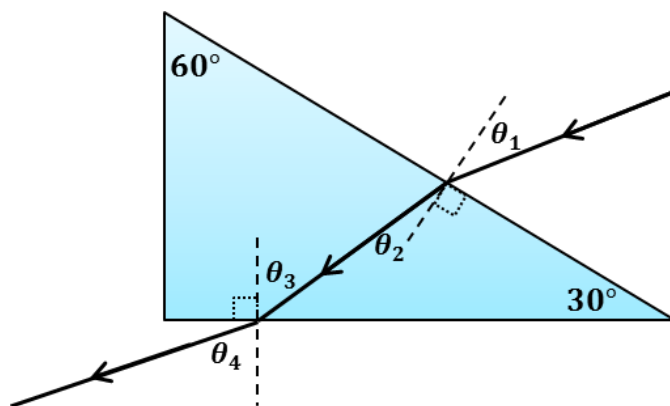
a) What is the magnitude of the magnetic field B?
b) What is the direction of the induced current in the bulb? Explain.
c) What is the dissipated power in the bulb
d) What is the mass of the rod
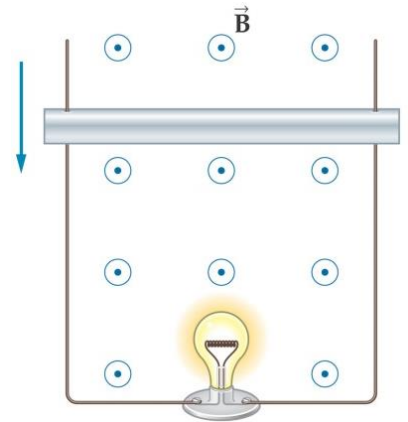
Q4. An object is placed 10 cm in front of a concave mirror that has a radius of curvature of 40 cm.
   a) Draw a ray diagram to find the image
   b) Calculate image location and magnification and determine its properties
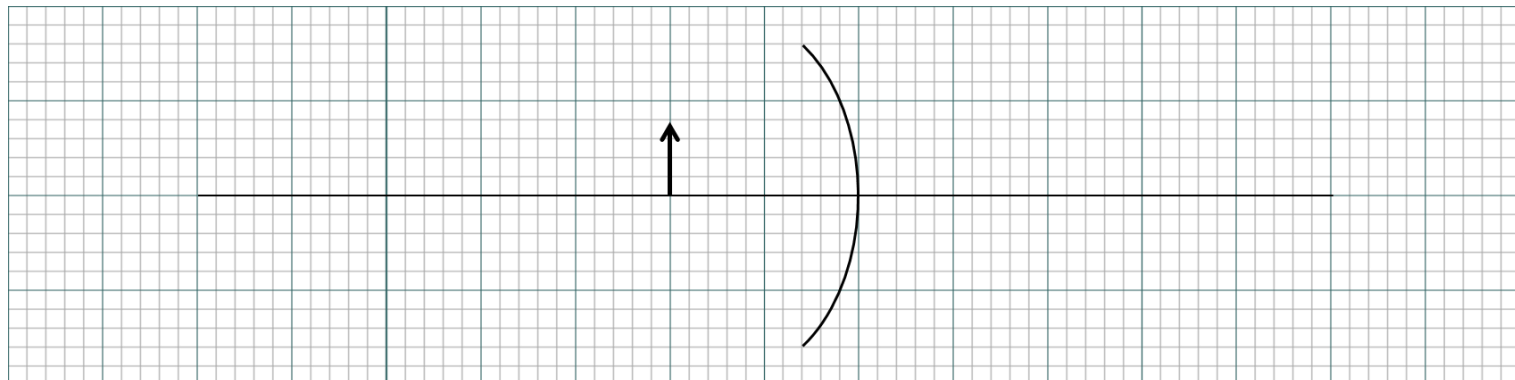
Q5. A light ray travelling in air is incident on a 30°-60°-90° glass prism, as shown, such that its angle of incidence on the prism is $\theta_1 = 21°$. The light ray travels inside the prism and leaves from its lower side. Assuming the index of refraction of air is $n = 1$ and of glass is $n = 1.3$ determine:
a) The angle θ_4 at which the light ray leaves the prism to air.
b) The speed of light in the prism.
c) The critical angle for light travelling from glass to air.

Scratch sheet

Name: