Exam Total

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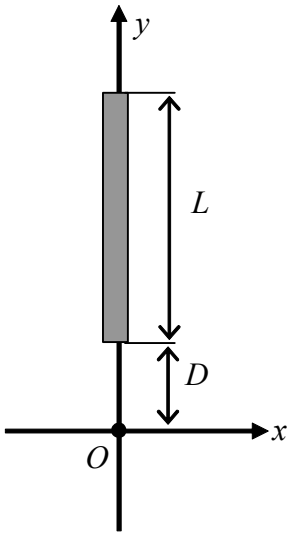
Physics 2135 Final Exam
May 11, 2022

Printed Name: _____

1. A rod of length *L* has a total charge of –*Q* uniformly distributed along its length. The rod is located on the *y*-axis with its bottom end a distance *D* from the origin (point *O*).



(30) a. Determine the ***magnitude and direction*** of the electric field at the origin (point *O*). Express your answer in unit vector notation.

$\vec{E} =$

(10) b. A point charge with charge -3*Q* is placed at the origin. Determine the ***magnitude and direction*** of the electric force on that charge. Express your answer in unit vector notation.

$\vec{F} =$

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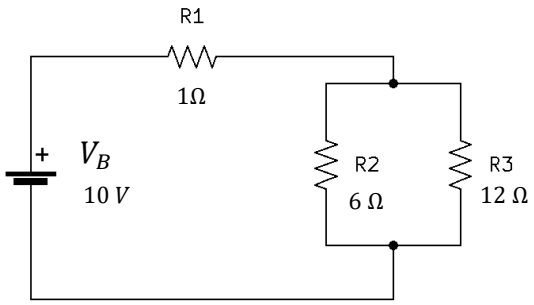
2. Consider the given circuit with $R_1 = 1\ \Omega, R_2 = 6\ \Omega, R_3 = 12\ \Omega$ and $V_B = 10\ V$.



(10) a. Determine the total equivalent resistance of the circuit R_T.

$R_T =$

(10) b. Determine I_1 the current through R_1.

$I_1 =$

(10) c. Determine the potential V_3 across R_3.

$V_3 =$

(10) d. Determine the power P_1 dissipated in R_1.

$P_1 =$

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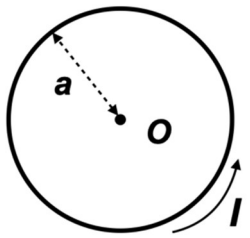
3. A current *I* runs around a circle with radius of *a*. You want to find a magnetic field at the center *O*.



(6) (a) Give the proper OSE for this purpose.

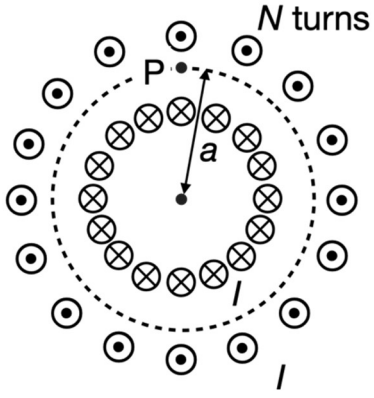
(3) (b) Circle the direction of the magnetic field at the center *O*.

(i) ⊙ (ii) ↺ (iii) ⊗ (iv) ↻

(6) (c) Find the magnitude of the magnetic field at the center *O*.

$B =$

4. Consider an ideal toroidal solenoid with *N* turns, each carrying a current *I* directed as shown in the figure. You want to find a magnetic field at the position P whose distance from the center is *a*, applying Ampere's law.



(6) (a) Give the proper OSE for this purpose.

(3) (b) Circle the direction of the magnetic field at P.

(i) ⊙ (ii) → (iii) ⊗ (iv) ←

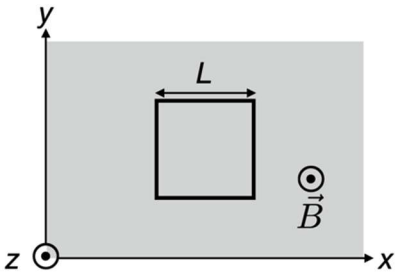
(6) (c) Find the magnitude of the magnetic field at the position P.

$B =$

5. A conducting square single loop with sides of length *L* is placed at the time $t = 0$ in a region of uniform magnetic field $\vec{B} = B_0 e^{-t/\tau}\hat{k}$ where B_0 and τ are positive constants.

(10) Find the magnitude of the induced emf ε in the loop.

$\mathcal{E} =$



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6. A light bulb is located 12cm in front of a concave spherical mirror of radius 6cm.

(5) a. Determine the type of image produced. [Circle the correct answer.]

Real *Virtual*

(5) b. Determine the orientation of the image produced. [Circle the correct answer.]

Upright *Inverted*

(15) c. Determine the location of the image produced.

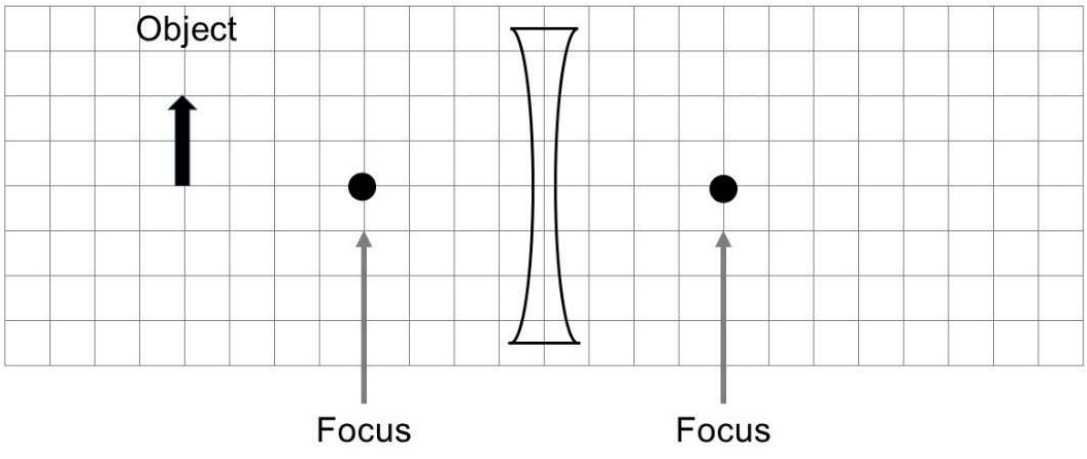
$s' =$

(5) d. Determine the magnification.

$m =$

7. An object is placed in front of a diverging lens, as illustrated.

(10) Determine the location of the image using a ray diagram. [You must show at least two correct rays and the location of the image to earn full credit.]



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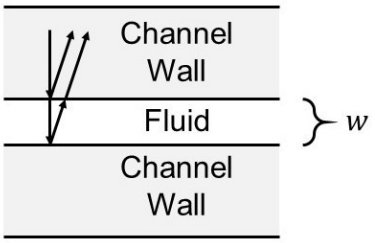
8. Light shines on a channel of unknown fluid normal to the surface, as illustrated. It is found that light of wavelength λ is maximally reflected. The width of the channel is w.



(20) Determine n_{fluid} the index of refraction of the fluid. [Only consider reflections off the two channel/fluid interfaces and assume the channel is the smallest thickness resulting in maximal reflection.]

$n_{fluid} =$

9. A laser shines upon a pair of slits producing an interference pattern on a screen beyond the pair of slits. The second dark fringe is located at a distance y_{2D} from the central maximum. [Assume the angles involved are small.]

(20) Determine y_{2B} the location of the second order bright fringe.

$y_{2B} =$

/40