

**A) Questions about lab! 3 questions, 5 points each...total 15 points.**

1). (5 pts) As in lab, you set up the optical bench with a lens so as to form an image on the screen. You then place an opaque card so that the top half of the lens is covered. How does the new image compare with the image before you inserted the card?

- a) The top half of the new image is missing
- b) The bottom half of the new image is missing
- c) The same image is visible as before, but it is fainter.
- d) The new image is formed at a different image distance than before.
- e) The image disappears.

2). (5 pts) As in lab, you have a lamp, a thin converging lens, and a screen set up on an optical bench. You first place the lamp so as to produce a sharp, real image on the screen with the image distance not equal to the object distance. You then keep the distance of the lamp from the screen fixed and move the lens along the optical bench. As you move the lens, for how many **ADDITIONAL** positions of the lens is there a sharp real image produced on the screen?

- a) 0 (i.e. the original position is the **ONLY** one that gives a sharp, real image)
- b) 1
- c) 2
- d) 3

3). Consider two identical simple mass-spring systems. In the first one the spring is extended by 3cm from its equilibrium position. In the second one, the spring is extended by 6cm from its equilibrium position. The magnitude of the restoring force on the second spring

- a) is double that on the first spring
- b) is half that on the first spring
- c) is the same as that on the first spring
- d) depends on the mass
- e) is four times that on the first spring.

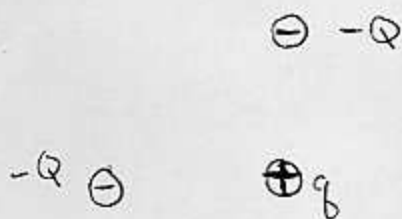
Name \_\_\_\_\_ Recitation Instructor \_\_\_\_\_

**B) Multiple Choice questions..40 questions, 5 points each...total 200 points.**

1) An object with a small amount of excess positive charge is placed near but not touching an *isolated* conductor, which is (initially) electrically neutral. What happens?

- a) positive charge is transferred from the object to the conductor
- b) negative charge is transferred from the conductor to neutralize the object
- c) the conductor remains electrically neutral overall but the negative charges in it go closer to the object and the positives go further away, and so the conductor is attracted to the object.
- d) the conductor develops an overall negative charge and is attracted to the object.
- e) None of the above occurs.

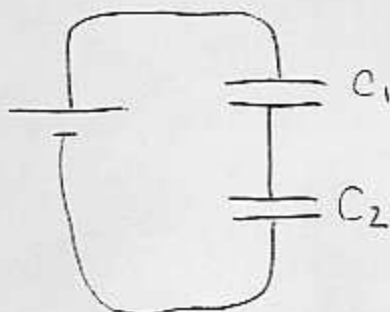
2) A particle with positive charge  $q$  is placed near two negative charges,  $-Q$  and  $-Q$ , as shown below. What is the direction of the resultant force on  $q$ ?



- a) down and to the right
- b) up and to the right
- c) down and to the left
- d) up and to the left

3) Two capacitors,  $C_1$  and  $C_2$ , are connected in series as shown below. If  $C_1$  is 2.6F and  $C_2$  is 4.8F, what is the equivalent capacitance of the two capacitors?

- a) .593 F
- b) 2.2F
- c) 7.4F
- d) 12.48F
- e) 1.69F



4) Which of the following statements is TRUE about electric field lines?

- a) They are very close together inside conductors.
- b) Their direction is perpendicular to the electric field.
- c) They start on positive charges (or at infinity) and end on negative charges (or at infinity).
- d) Although they typically do not cross each other, there are circumstances in which they do cross.
- e) The length of a line indicates the magnitude of the electric potential at that point in space.

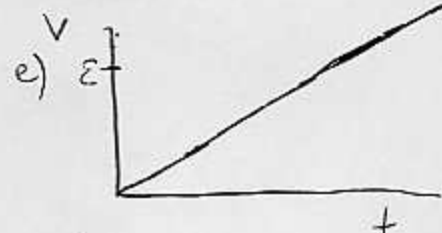
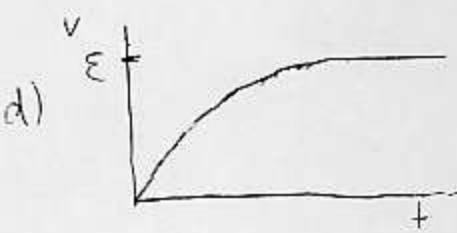
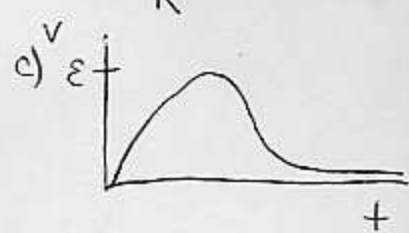
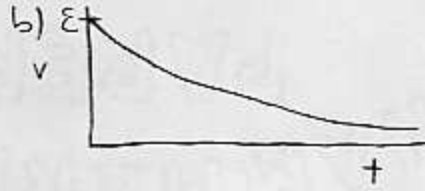
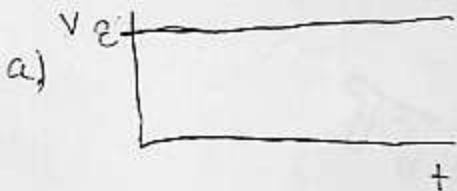
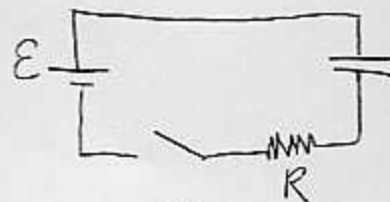
5) If the magnetic field at a distance 2m from a long straight wire carrying current  $I$  is 2.2mT, then the field at a distance of 1m from the same wire is:

- a) 4.4mT
- b) 8.8mT
- c) 2.2mT
- d) 1.1mT
- e) 0.55mT

6) How much work must you do against an electric field to move a +3 Coulomb point charge at constant velocity from a location where the electric potential is 7V to a location where it is 27V

- a) 21J
- b) 20V
- c) -20V
- d) 60J
- e) 81J

7) An initially uncharged capacitor is connected to a battery and resistor as shown in the diagram. At time  $t=0$  the switch  $S$  is closed. Which of the following graphs best describes the subsequent behavior of the voltage drop across the capacitor as a function of time?



8) A negatively charged particle is released with zero initial velocity, near a positively charged particle which is held at a fixed position. The negatively charged particle will begin to move from a \_\_\_\_\_ electric potential, and its potential energy \_\_\_\_\_.

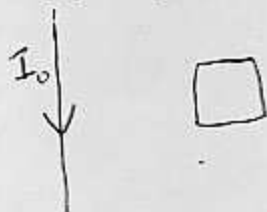
- a) lower to a higher; decreases
- b) lower to a higher; increases
- c) higher to lower; decreases
- d) lower to higher; decreases
- e) lower to higher; stays the same.

9) In class I dropped a bar magnet and an aluminum rod (having the same size and shape) down a hollow brass tube. To fall through the tube, the bar magnet took:

(Hint: When we talked about magnetism we talked about “rapping” something else from the 80’s.)

- a) The same time as the aluminum rod because the gravitational acceleration is the same for both.
- b) Less time than the aluminum rod because of Faraday’s law and Lenz law.
- c) More time than the aluminum rod because of Faraday’s law and Lenz law.

10) A straight wire carries a current  $I_0$ . Nearby, as shown in the figure, there is a rectangular copper loop.



At the center of the loop, the direction of the magnetic field  $B_0$  produced by the current  $I_0$  is:

- a) into the page.
- b) out of the page
- c) along +x
- d) along -x
- e) along +y

11) If the current  $I_0$  in the previous question DECREASES with time, then currents will be induced in the copper loop in which direction?

- a) upward
- b) downward
- c) clockwise
- d) counter-clockwise
- e) out of the page

12) A light ray travelling in air strikes a pond of water (index of refraction equal to 1.3) with an angle of incidence equal to zero. On entering the water, the direction of the light ray:

- a) changes and its frequency decreases
- b) changes and its wavelength decreases
- c) changes and its wavelength increases
- d) remains the same but its frequency decreases
- e) remains the same but its wavelength increases
- f) remains the same but its wavelength decreases

13) A vertical spring with spring constant  $k=150 \text{ N/m}$  stretches by 0.1 meters when a mass  $M$  is hung from it. What is the mass of  $M$ ?

- a)  $1.5 \times 10^2 \text{ kg}$
- b) 30kg
- c) 15kg
- d) 1.5kg
- e) ~~none of these~~

14) Standing 2.6m in front of a mirror, you hold a camera. To take a photograph of your image in the mirror, at what distance should the camera lens be focused?

- a) depends on the size of the mirror
- b) 1.3m
- c) 2.6m
- d) 5.2m
- e) 7.8m

15) A single optical device (i.e. a mirror or a lens) produces an <sup>real</sup> image of a real object. The image appears on a piece of paper placed at the location of the image. Which of the following optical devices, used ~~along~~ <sup>alone</sup>, could produce such an image?

- a) a plane mirror
- b) a concave mirror
- c) a thin concave glass lens
- d) none of the above
- e) all of the above (except d!)

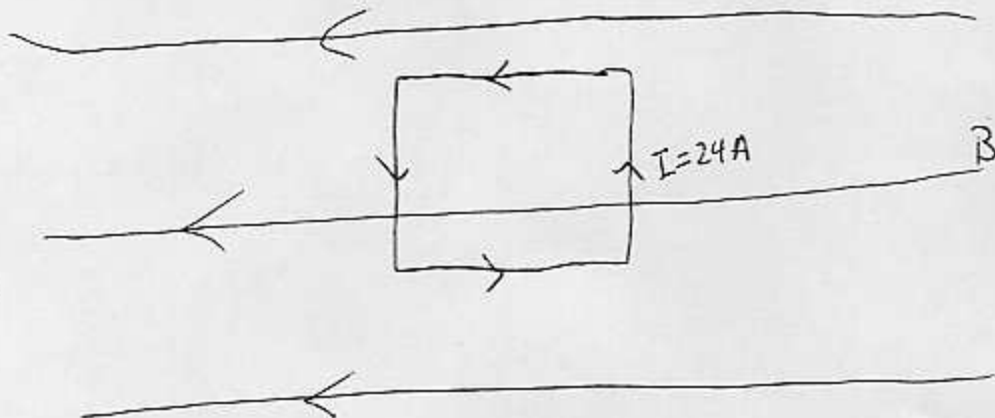
16) A constant magnetic field exerts NO magnetic force on a proton

- a) which is at rest
- b) which is traveling parallel to the magnetic field lines
- c) which is traveling perpendicular to magnetic field lines
- d) both answers a and c above
- e) both answers a and b above

17) A proton enters a region of uniform electric field, initially traveling parallel to the field lines, and in the same direction. After entering the region, the proton will:

- a) travel in a circle
- b) continue with the same speed and direction
- c) speed up but go in the same direction
- d) slow down but go in the same direction

18) A square loop of wire 50cm on a side is positioned in a magnetic field of magnitude  $B=1.2\text{T}$ , pointing to the left, as shown in the figure. A current of  $24\text{A}$  is sent through the wire loop. What is the magnitude of the TORQUE on this loop?



- a) 0 Nm
- b) 0.3 Nm
- c) 3 Nm
- d) 7.2Nm
- e) 14 Nm

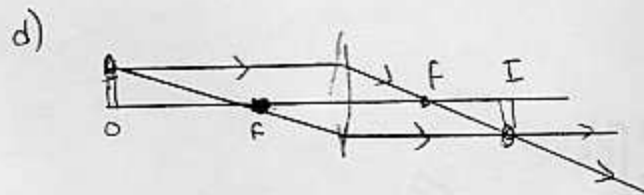
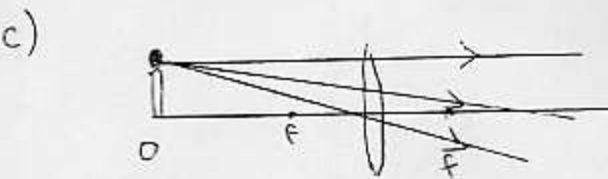
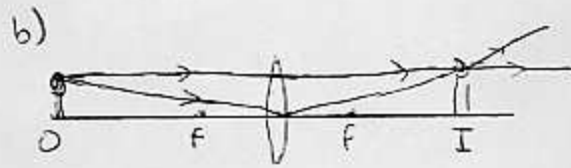
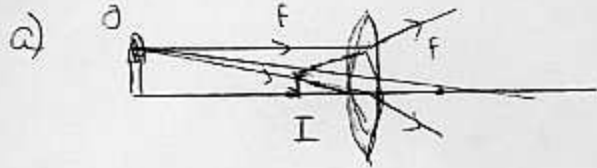
19) If the magnetic field in the previous questions now points OUT OF THE PAGE (but is still  $1.2\text{T}$ ), what is now the magnitude of the torque on the loop?

- a) 0 Nm
- b) 0.3 Nm
- c) 3 Nm
- d) 7.2Nm
- e) 14 Nm

20) A convex spherical mirror has a focal length of  $-7\text{m}$ . If the object is  $0.5\text{m}$  in front of this mirror, where is the image?

- a) 0.29m behind the mirror
- b) 0.57m in front of the mirror
- c) 0.57m behind the mirror
- d) 1.75m in front of the mirror
- e) 1.75m behind the mirror

21) Which of the following ray tracing diagrams is correct for a thin convex lens?  
(O=object, I=image, F=focal point)



22) If you increase the length of the string in a simple pendulum, the frequency of the oscillation will:

- a) increase
- b) decrease
- c) not change

23) When a leaf is placed 0.4m in front of a thin lens, its image is 0.2 m in front of the lens. The lens is \_\_\_\_\_ and its focal length is \_\_\_\_\_.

- a) concave; -0.4m
- b) concave; -2.5m
- c) convex; -0.4m
- d) convex; 0.13m
- e) none of the above

24) The magnification of the lens in the previous question is:

- a) +0.5
- b) -0.5
- c) 2.0
- d) -2.0

25) Magnetic fields are necessary for the operation of which of the following devices?

- a) electric speakers
- b) electric motors
- c) electric generators
- d) electric transformers
- e) all of the above

26) What is the speed of light in glass if the index of refraction is 1.48? (Note:  
 $c=3 \times 10^8 \text{ m/s}$ )

- a)  $3 \times 10^8 \text{ m/s}$
- b)  $2.03 \times 10^8 \text{ m/s}$
- c)  $1.48 \times 10^8 \text{ m/s}$
- d)  $4.44 \times 10^8 \text{ m/s}$
- e)  $1.02 \times 10^8 \text{ m/s}$

27) How long must a simple pendulum be if it is to complete two full cycles in one second?

- a) 24.8cm
- b) 53.1cm
- c) 12.42cm
- d) 6.21cm
- e) 35.0cm

28) A fisherman notices that wave crests pass the bow of his anchored boat every 3.0 s. He measures the distances between the two crests to be 14m. How fast are the waves traveling?

- a) 9.33m/s
- b) 4.67m/s
- c) 2.33m/s
- d) 42m/s
- e) 21m/s

29) Which of the following sign conventions is FALSE concerning mirrors??

- a) The image distance is positive if it is on the side opposite the reflecting side of the mirror.
- b) The focal length is negative for convex mirrors.
- c) The object distance is positive if it is on the reflecting side of the mirror.
- d) Magnification is positive for an upright image.

30) An object is placed 18.0cm from the center of a concave mirror having radius of curvature of 24cm. Find the image distance from the mirror.

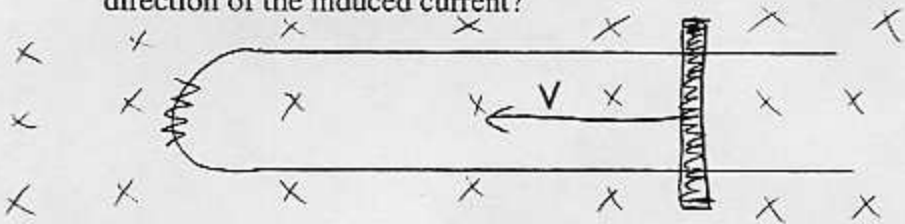
- a) 0.0278cm
- b) -.0139cm
- c) 36.0cm
- d) 7.2cm
- e) -72.0cm



31) If we are told that an erect image of an object is seen in a particular mirror, which of the following statements **cannot be true**?

- a) It is a convex mirror
- b) The image distance is positive.
- c) It is a concave mirror.
- d) It is a flat mirror
- e) The image size is reduced

32) In the diagram below, a sliding metal rod is moving to the right and makes a complete electric circuit. If the area of the loop is decreasing at a rate of  $2\text{m}^2/\text{s}$  and the magnetic field is  $0.1\text{T}$ , what is the magnitude of the induced EMF and direction of the induced current?



- a)  $0.2\text{V}$ ; clockwise current
- b)  $0.2\text{V}$ ; counterclockwise current
- c)  $20\text{V}$ ; clockwise current
- d)  $.05\text{V}$ ; counterclockwise current
- e) no EMF because the magnetic field is constant.

33) A transformer is used to “step down” line voltage ( $120\text{V}$ ) to  $25\text{V}$  in order to power a radio. If the current in the secondary (going to the radio) is  $0.2\text{A}$ , what is the current in the primary?

- a)  $0.96\text{A}$
- b)  $0.042\text{A}$
- c)  $4.8\text{A}$
- d)  $0.0083\text{A}$
- e)  $24\text{A}$

34) What is the amplitude of a mass undergoing simple harmonic motion if the total energy of the system is  $10\text{J}$  and the force constant is  $100\text{N/m}$

- a)  $0.2\text{m}$
- b)  $0.32\text{m}$
- c)  $0.45\text{m}$
- d)  $0.1\text{m}$
- e)  $10\text{m}$

35) The frequency  $f$  of visible radiation with a wavelength of  $6.33 \times 10^{-7} \text{ m}$  is:

- a) 4600kHz
- b)  $4.7 \times 10^6 \text{ Hz}$
- c)  $4.7 \times 10^{11} \text{ Hz}$
- d)  $4.7 \times 10^{14} \text{ Hz}$
- e)  $4.7 \times 10^{16} \text{ Hz}$

36) Which one of the following statements is TRUE concerning a (flat) PLANE MIRROR?

- a) It never produces an image..real or virtual
- b) It has a finite focal length
- c) It produces upright virtual images with  $d_i = -d_o$
- d) It produces upright real images with  $d_i = d_o$ .
- e) It produces inverted virtual images with  $d_i = -d_o$ .

37) Starlight shines on a concave spherical mirror of radius  $r$ . Which one of the following statements is TRUE?

- a) The light is focused onto a point a distance  $r$  away from the mirror.
- b) The light rays diverge as they reflect off the mirror.
- c) The light rays are focused at a point which is a distance  $f = r/2$  from the mirror.
- d) The light rays reflect off the mirror in parallel.

38) An object 30cm in front of a lens has a virtual image 10cm in front of the lens (on the same side as the object). What type of lens is this and what is its focal length?

- a) converging,  $f = 15 \text{ cm}$
- b) diverging,  $f = -15 \text{ cm}$
- c) converging,  $f = 7.5 \text{ cm}$
- d) diverging,  $f = -7.5 \text{ cm}$
- e) none of the above

39) Electromagnetic radiation with wavelength of 5m is best described as a:

- a) radio wave
- b) infrared wave
- c) visible wave
- d) ultraviolet wave
- e) x-ray

40) What is the resistance of a light bulb if applying 12V to it produces a current of 0.34A?

- a)  $4.1 \Omega$
- b)  $2.8 \times 10^{-2} \Omega$
- c)  $35 \Omega$
- d)  $1,200 \Omega$
- e)  $17.5 \Omega$