Dear AP physics 2 2019-2020 students,

This is the summer assignment for the course you have chosen to take. This assignment is not meant to be easy. Don't wait till the last few weeks of summer to begin this assignment. Your work will be collected on the first days of school and graded as a test grade. If you do not turn it in the first week of school it will be accepted late but with penalties. I will be happy to provide hints if you email me over the summer at jmurad@bergenfield.org.

You will need to research on your own the following topics: fluids, electric charge, coulomb force, electric circuits, electromagnetic induction, waves, sound, electromagnetic waves, atoms in order to complete this assignment.

Feel free to use online resources such as njctl.org, PhET simulations from Colorado University, CrackAP, Khan Academy on youtube.com, Flippingphysics.com, physicsclassroom.com or any other resources you find useful.

I look forward to our learning together in our upcoming school year.

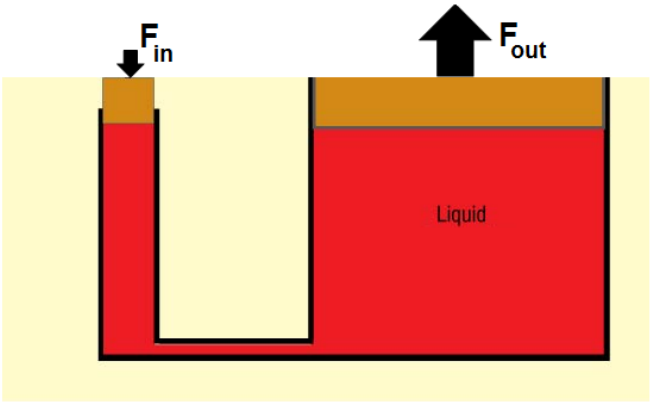
Sincerely,
Mr. Murad

AP Physics 2

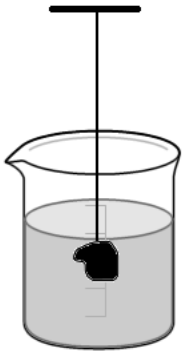
BHS Summer Assignment

1. There are two round tables in the physics classroom: one with the radius of 50 cm the other with a radius of 150 cm. What is the relationship between the two forces applied on the tabletops by the atmospheric pressure?
   (A) $F_1/F_2 = 1/3$ (B) $F_1/F_2 = 1/9$ (C) $F_1/F_2 = 3/1$ (D) $F_1/F_2 = 9/1$ (E) $F_1/F_2 = 1/6$

2. What is the difference between the pressure on the bottom of a pool and the pressure on the water surface?
   (A) ρgh (B) ρg/h (C) ρ/gh (D) gh/ ρ (E) zero



3. In a hydraulic lift the small piston has an area of 2 cm^2 and large piston has an area of 80 cm^2. What is the mechanical advantage of the hydraulic lift?
   (A) 40 (B) 4 (C) 2 (D) 1 (E) 20



4. Physics students use a spring scale to measure the weight of a piece of lead. The experiment was performed two times one in air the other in water. If the volume of lead is 50 cm^3, what is the difference between two readings on the scale?
   (A) 0.5 N (B) 5.0 N (C) 50 N (D) 500 N (E) 0 N

5. Three blocks of equal volume are completely submerged into water. The blocks made of different materials: aluminum, iron and lead. Which of the following is the correct statement about the buoyant force on each block? ($P_{aluminum}$ = 2700 kg/m^3, ρ_{iron} = 7800 kg/m^3, ρ_{lead} = 11300 kg/m^3)
   (A) $F_{aluminum} > F_{iron} > F_{lead}$

   (B) $F_{aluminum} < F_{iron} < F_{lead}$

   (C) $F_{aluminum} < F_{iron} > F_{lead}$

   (D) $F_{aluminum} = F_{iron} = F_{lead}$

   (E) $F_{aluminum} > F_{iron} < F_{lead}$

6. A plastic rod is rubbed with a piece of animal fur. The plastic rod acquires a negative charge during this process. Which of the following is true about the charge on the piece of fur?
   A. It acquires a positive charge but greater in magnitude than the rod

   B. It acquires a positive charge but less in magnitude than the rod

   C. It acquires a negative charge but greater in magnitude than the rod

   D. It acquires a negative charge but less in magnitude than the rod

   E. It acquires a positive charge with the same magnitude as the rod

7. A positively charged sphere A is brought close without touching to a neutral sphere B. Sphere B is briefly touched with a grounded wire. What is the charge on sphere B after the wire is removed?

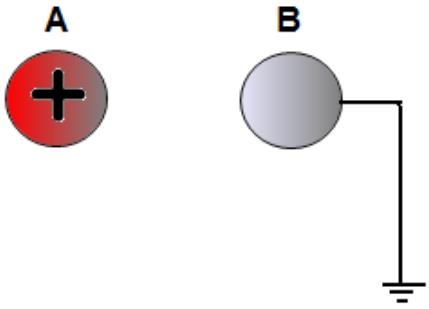
A. Positive

B. Negative

C. It stays neutral

D. It depends on the contact time

E. It depends on the material that sphere B is made of



8. A neutral electroscope is touched with a positively carged rod. After the rod is removed the electroscope is charged positively because of:

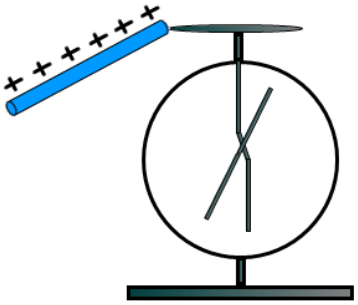
A. Induction

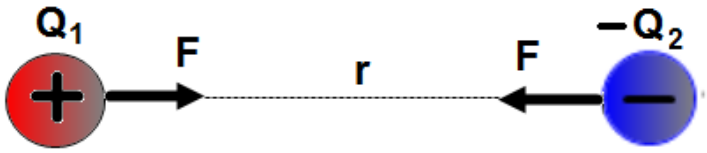
B. Conduction

C. Thermoemission

D. Photoemission

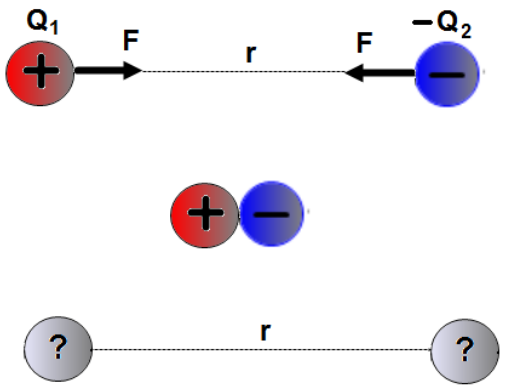
E. None from the above





9. Two charges Q_1 and $-Q_2$ are separated by a distance r. The charge attract each other with a force F. What is the new force between the charges if the distance is cut to one-fourth and the magnitude of each charge is doubled?

A. 16 F B. 64 F C. 48 F D.F / 48 E.F / 64



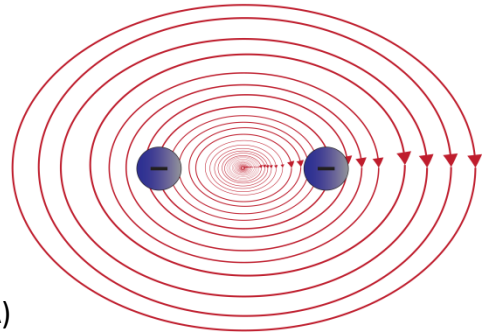
10. A positively charged sphere with a charge of +8Q is separatred from a negatively charged sphere -2Q by a distance r. There is an attractive force F exerted on each sphere. The spheres briefly touch each other and move to the original distance r. What is the new force on each sphere in terms of F?

A. 9F / 16 B. 16F / 9 C. 9F / 4

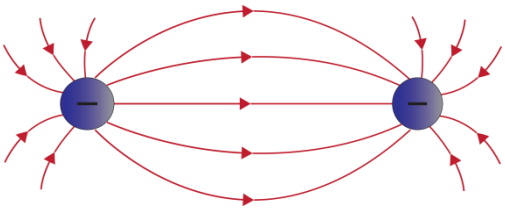
D.4F / 9 E. 2F / 3

11. Which of the following represents the electric field map due to a combination of two negative charges?

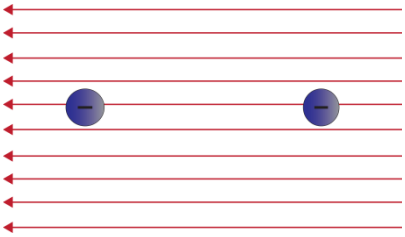
A)



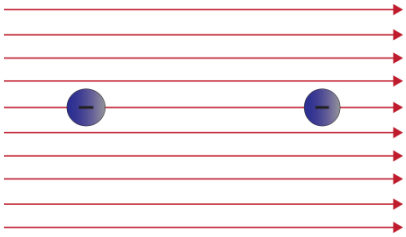
B)



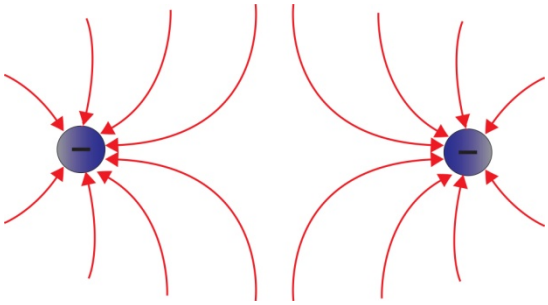
C)



D)



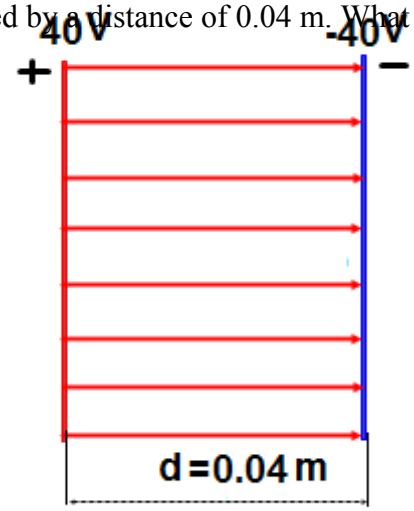
E)

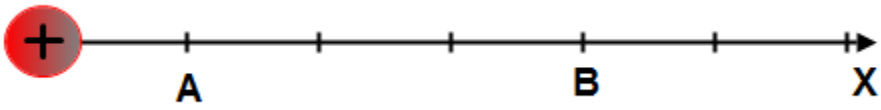


12. A uniform electric field is created by two parallel plates separated by a distance of 0.04 m. What is the magnitude of the electric field established between the plates?

A. 20 V/m B. 200 V/m C. 2,000 V/m

D. 20,000 V/m E. 0 V/m





13. The electric potential at point A is V. What is the electric potential at point B in terms of V?

A. 2 V B. 4 V C. V D. V E. V

14. A conducting sphere is negatively charged. Which of the following statements is true?

A. The charge is uniformly distributed throughout the entire volume

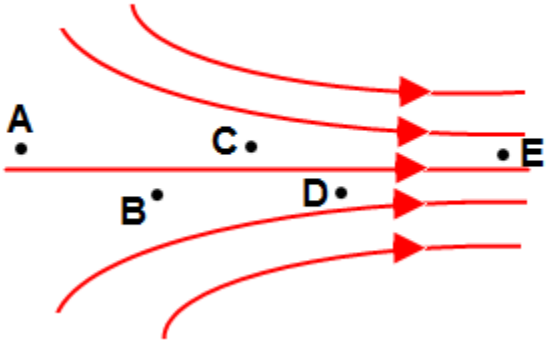
B. The charge is located at the center of the sphere

C. The charge is located at the bottom of the sphere because of gravity

D. The charge is uniformly distributed on the surface of the sphere

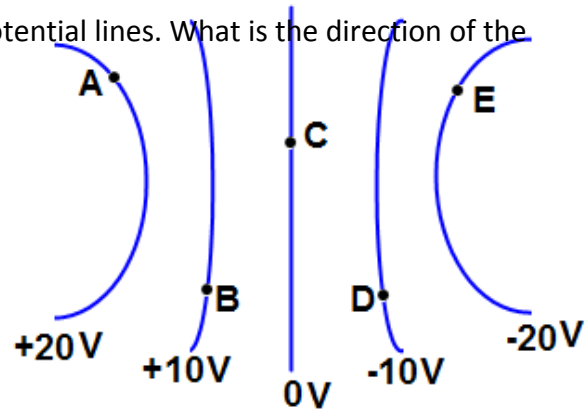
E. The negative charge is neutralized by the positive charge

15. A non-uniform electric field is represented by the diagram. At which of the following points the electric field is greatest in magnitude?



A. A B. B C.C D.D E.E

16. A non-uniform electric field is represented by equipotential lines. What is the direction of the electric field at point A?



A.

B.

C.

D.

E.

17. A wire of length L and cross-sectional area A has a resistivity ρ. Which of the following formulas can be used to calculate the resistance of the wire?

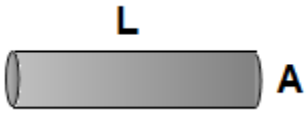
A.R =

B. R =

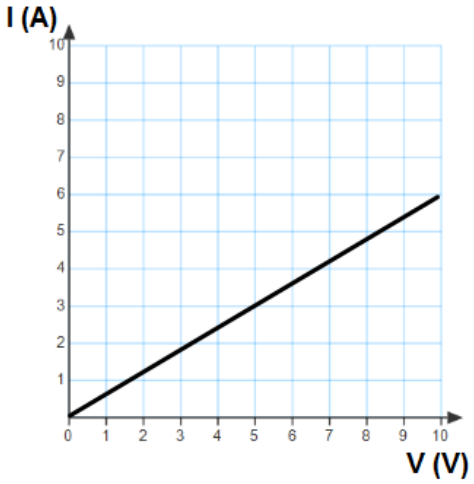
C. R =

D. R =

E. R =



The electric current as a function of voltage of a wire is presented by the graph to the right. Use this graph for questions 49 and 50.



18. What is the resistance of the wire?

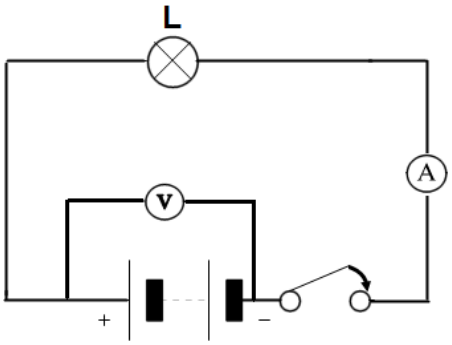
A. 1Ω B.0.8 Ω C.1.6 Ω

D. 0.4 Ω E. 0.2 Ω

19. The electric current as a function of voltage of a wire is presented by the graph. What is the power dissipated in the resistor when the applied voltage is 5 V?

A. 5 W B.10 W C.15 W D. 20 W E. 25 W

20. When the switch in the circuit presented by the diagram above is closed, the voltmeter reading is referred to:



A. Terminal voltage B. EMF C. Current

D. Resistance E. Power

21. A magnet bar is divided in two pieces. Which of the following statements is true?

A. The magnet bar is demagnetized

B. The magnetic field of each separated piece becomes stronger

C. The magnetic poles are separated

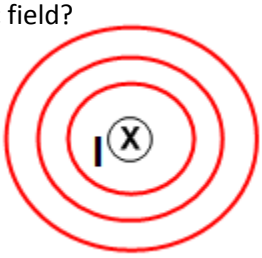
D. The two magnets are created

E. The electric field is created

22. An electric current flows into the page. What is the direction of the magnetic field?

A. To the bottom of the page

B. To the top of the page

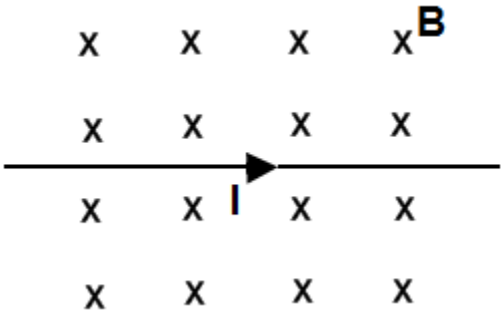


C. Clockwise

D. Counter-clockwise

E. To the right

23. A straight long wire carries an electric current to the right. The current is placed in a uniform magnetic field directed into the page. What is the direction of the magnetic force on the current?



A. Left

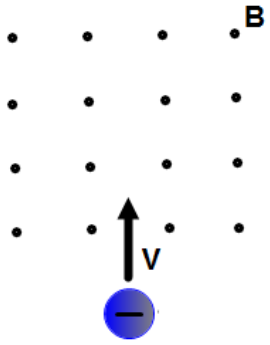
B. Right

C. To the bottom of the page

D. To the top of the page

E. Out of the page

24. A negative charge moving with a constant velocity v enters a region of a uniform magnetic field pointing out the page. What is the direction of the magnetic force on the charge?



A. Left

B. Right

C. To the bottom of the page

D. To the top of the page

E. There is no magnetic force on the current

25. A positive charge moves in parallel to a current carrying wire. What is the direction of the magnetic force on the charge?

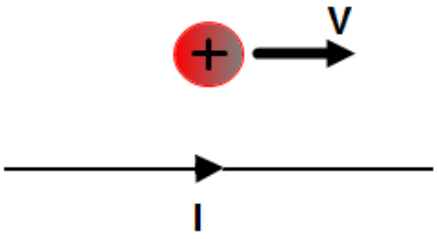
A. Left

B. Right

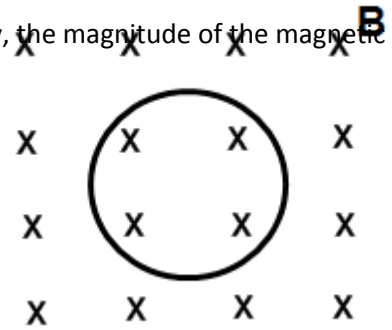
C. To the bottom of the page

D. To the top of the page

E. There is no magnetic force on the charge



26. A loop of wire is placed in a perpendicular magnetic field. Suddenly, the magnitude of the magnetic field begins to increase, what is the direction of the induced current?



A. Clockwise

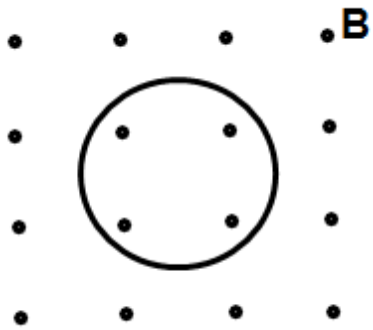
B. Counter-clockwise

C. Out of the page

D. Into the page

E. There is no induced current in the loop

27. A loop of wire is placed in a perpendicular magnetic field. Suddenly, the magnitude of the magnetic field begins to decrease, what is the direction of the induced current?



A. Clockwise

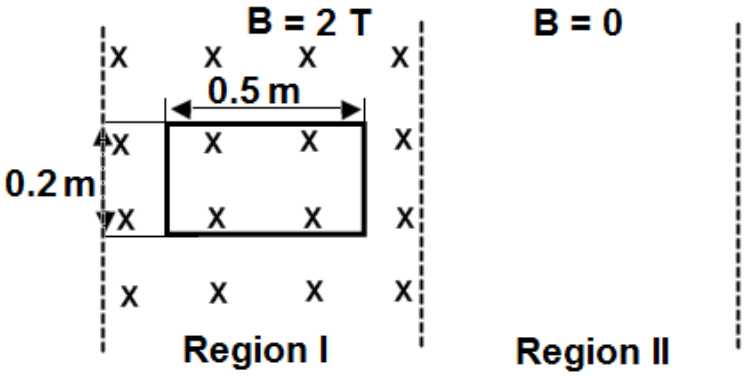
B. Counter-clockwise

C. Out of the page

D. Into the page

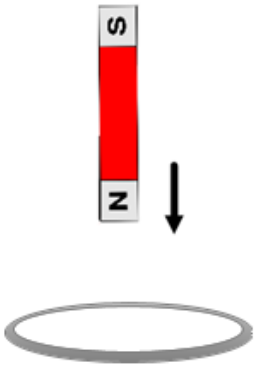
E. There is no induced current in the loop

28. A rectangular loop of wire with dimensions 0.2 m x 0.5 m is placed in a uniform magnetic field of magnitude 2 T. The magnetic field is perpendicular to the plane of the loop. The loop is moved from region I to region II in 0.05 s? What is the induced emf in the loop?



A. 1 V B. 2 V C. 3 V

D. 4 V E. 5 V



29. A magnet bar with the north pole faced downward is dropped above a horizontal circular coil. Which of the following statements about the induced current is true? (viewed from above)

A. The induced current flows in clockwise direction

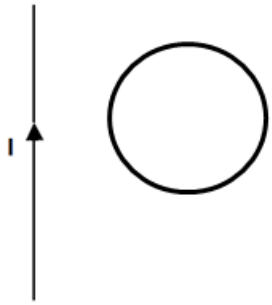
B. The induced current flows in counter-clockwise direction

C. The induced current flows first in clockwise and then in counter-clockwise direction

D. The induced current flows first in counter-clockwise and then in clockwise direction

E. There is no induced current in the coil

30. A current-carrying wire lies on a horizontal table. A circular coil is placed next to the loop. The current vanishes suddenly. What is the direction of the induced current in the coil?



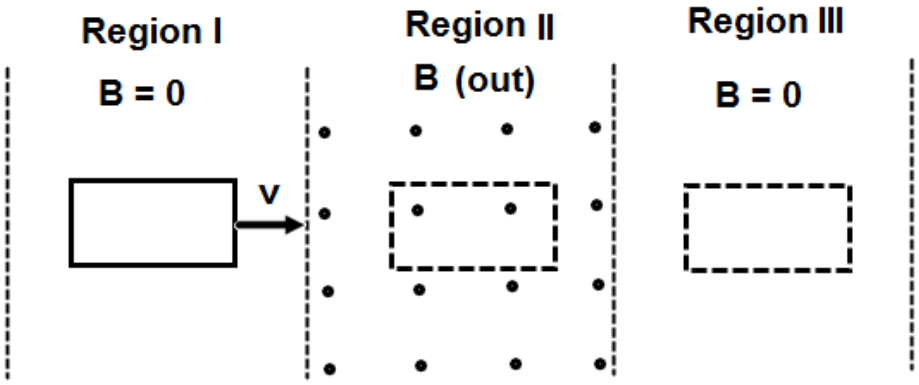
A. Clockwise

B. Counter-clockwise

C. There is no induced current in the coil

D. The induced current changes its direction from clockwise to counter-clockwise

E. The induced current changes its direction from counter-clockwise to clockwise



31. A rectangular loop of wire is moved at a constant speed from region I to region II and then to region III. Which of the following is true about the magnetic force direction acting on the loop when it crosses the boundary between the regions?

	Region I→ Region II	Region II→ Region III
A.	Left	Right
B.	Left	Left
C.	Right	Right
D.	Right	Left
E.	Zero	Zero

32. A beam of light has a wavelength of 600 nm in air. What is the frequency of light? ($c = 3 \cdot 10^8$ m/s)
(A) $5.0 \cdot 10^{14}$ Hz (B) $2.0 \cdot 10^{14}$ Hz (C) $3.0 \cdot 10^{14}$ Hz (D) $6.0 \cdot 10^{14}$ Hz (E) $2.0 \cdot 10^{14}$ Hz

33. A light beam traveling in air with a wavelength of 650 nm falls on a glass block. What is the speed of the light beam in glass? ($c = 3 \cdot 10^8$ m/s, n = 1.5)
(A) $3.0 \cdot 10^8$ m/s (B) $2.0 \cdot 10^8$ m/s (C) $1.5 \cdot 10^8$ m/s (D) $1.0 \cdot 10^8$ m/s (E) $0.5 \cdot 10^8$ m/s

34. A light beam traveling in air with a wavelength of 600 nm falls on a glass block. What is the frequency of the light beam in glass? ($c = 3 \cdot 10^8$ m/s, n = 1.5)
(A) $5.0 \cdot 10^{14}$ Hz (B) $2.5 \cdot 10^{14}$ Hz (C) $3.0 \cdot 10^{14}$ Hz (D) $6.0 \cdot 10^{14}$ Hz (E) $2.0 \cdot 10^{14}$ Hz

35. A blue beam of light falls on two narrow slits producing an interference pattern on a screen. If instead blue light a red beam of light was used in the same experiment, which new changes to the interference pattern we can observe?
(A) Interference fringes move close to the central maximum

(B) Interference fringes move away from the central maximum

(C) No change in interference

(D) Bright fringes are replaced with dark fringes

(E) The number of fringes increases

36. Which of the following theories can explain the bending of waves behind obstacles into "shadow region"?
    (A) Particle theory of light (B) Wave theory of light (C) Kinetic theory
    (D) Special theory of relativity (E) Classical mechanics

37. The wave theory of light is associated with:
    (A) I. Newton (B) A. Einstein (C) Max Plank (D) Christian Huygens (E) Robert Milliken

38. Which of the following photons has the greatest energy?
    (A) Infrared (B) Blue (C) X-Ray (D) γ- photon (E) UV – photon

39. In the Rutherford's Experiment "Scattering α – particles by a gold foil" the biggest part of α – particles could pass through the foil undeflected. Which of the following properties of the atom can be explained from this observation?
    (A) The positive charge is concentrated in the nucleus
    (B) The nucleus has electrons and protons
    (C) The atomic mass is concentrated in the nucleus
    (D) The α – particles couldn't be deflected by electrons
    (E) The size of the nucleus is much less than the size of the atom

40. Which of the following statement(s) can be associated with Bohr's theory of the atom?
    I. An electron orbiting the nucleus can change its energy continuously
    II. An electron orbiting the nucleus emits energy and falls on the nucleus
    III. An electron orbits the nucleus without radiating energy and can change its energy only by a certain portion when it jumps between the orbits
    IV. The angular momentum of an electron around the nucleus is equal an integer times $h/2\pi$

(A) I and II (B) II and IV (C) II and III (D) III and IV (E) I, II, III and IV

41. The atomic number is equivalent to which of the following?
    A. The number of neutrons in the atom B. The number of protons in the atom

C. The number of nucleons in the atom D. The number of –particles in the atom

E. None of the above

42. The atomic mass number is equivalent to which of the following?
A. The number of neutrons in the atom B. The number of protons in the atom

C. The number of nucleons in the atom D. The number of –particles in the atom

E. None of the above

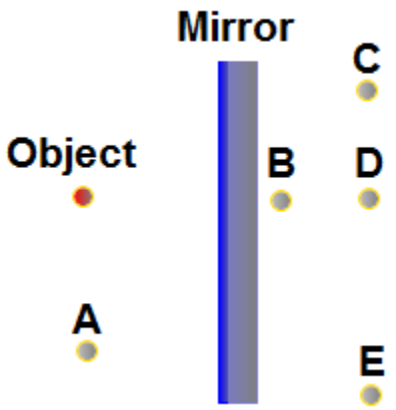
43. Which of the following is the α–particle?
A. B. C. D. E.

44. Which of the following is the –particle?
A. B. C. D. E.

45. Which of the following is the –particle?
A. B. C. D. E.

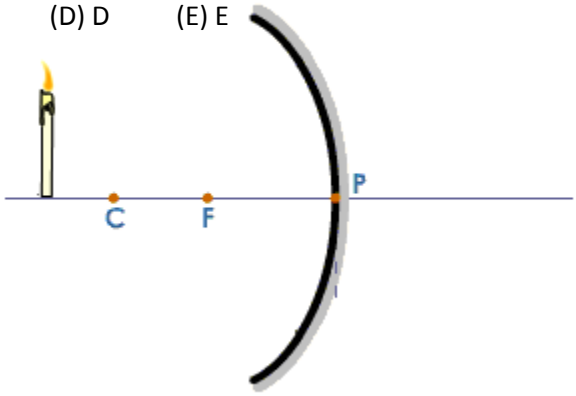
46. What is the missing element from the following equation →? +?
A. B. C. D. E.

47. A 100 g of a radioactive element has a half-life of 5 days. How many grams of radioactive material will remain after 15 days?
A. 100 g B. 50 g C. 25 g D. 12.5 g E. 0



48. A point object is placed in front of a plane mirror. Which is the correct location of the image produced by the mirror?

(A)A (B) B (C) C (D) D (E) E



49. A candle is placed in front of a concave mirror. The image produced by the mirror is:

(A) Real, inverted and magnified

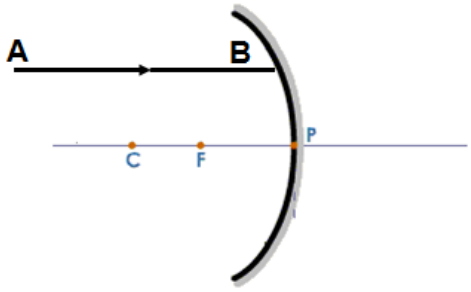
(B) Real, inverted and demagnified

(C) Virtual, upright and magnified

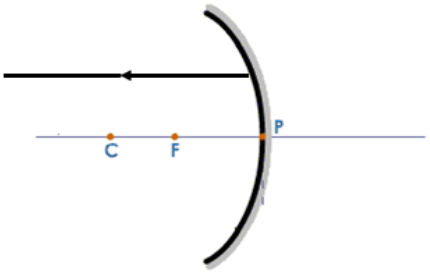
(D) Virtual, upright and demagnified

(E) Real, upright and magnified

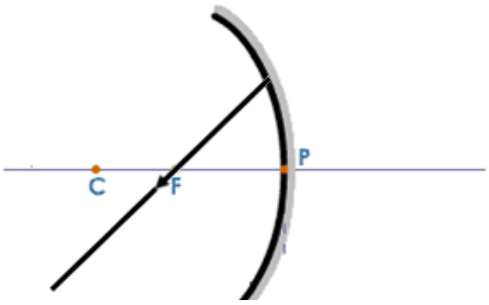
50. A very narrow light ray AB strikes the surface of a concave mirror as shown on the diagram. Which of the following diagrams represents the reflected ray?



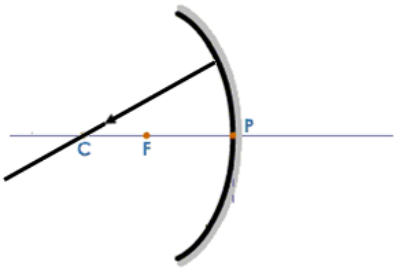
(A)



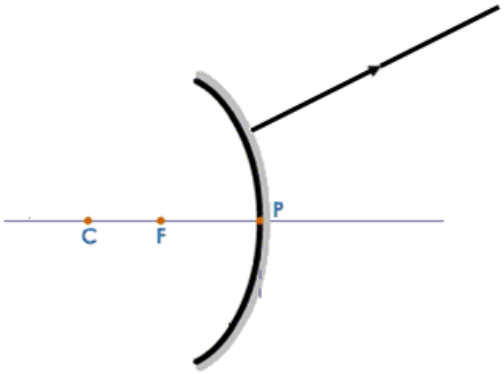
(B)



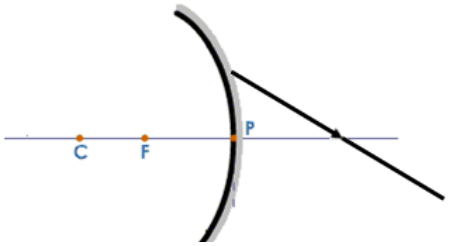
(C)



(D)

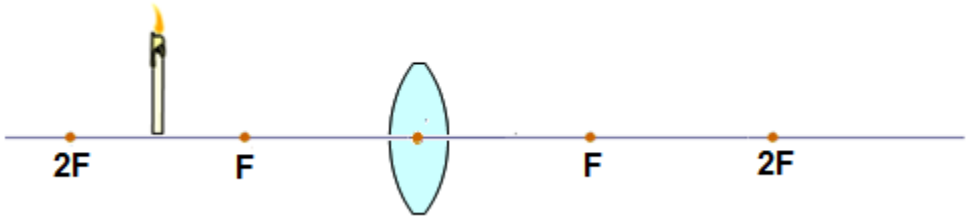


(E)



51. Which of the lens or lenses is the diverging lens?

(A) I and V (B) II, III and IV (C) II and III (D) III and IV (E) IV and V



52. An object is placed in front of a converging lens at a distance between F and 2F. The image produced by the lens is:

(A)Real, inverted and demagnified

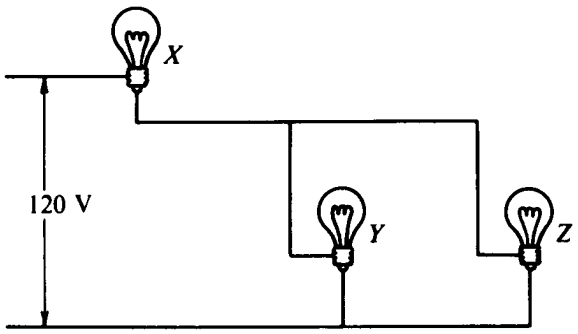
(B)Real, inverted and magnified

(C) Virtual, upright and magnified

(D) Virtual, upright and demagnified

(E) Virtual, inverted and magnified

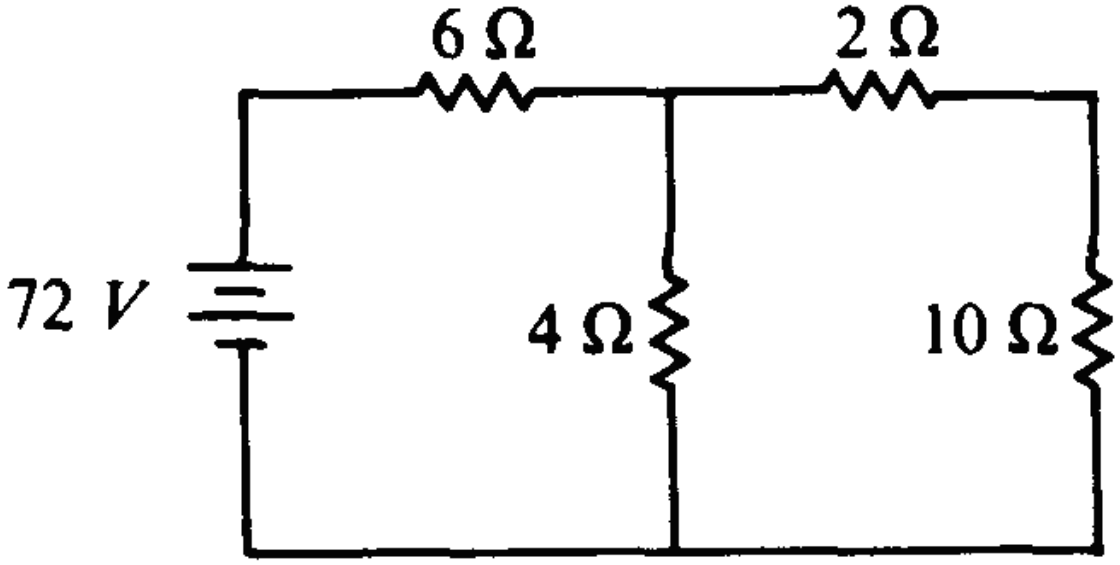
Free Response



1. In the circuit shown above, X, Y. and Z represent three light bulbs, each rated at 60 watts, 120 volts. Assume that the resistances of the bulbs are constant and do not depend on the current.

   a. What is the resistance of each bulb?
   b. What is the equivalent resistance of the three light bulbs when arranged as shown?
   c. What is the total power dissipation of this combination when connected to a 120volt source as shown?

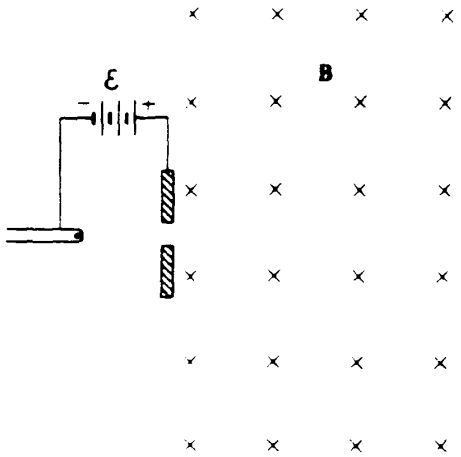
d. What is the current in bulb X ?
e. What is the potential difference across bulb X ?
f. What is the potential difference across bulb Z ?



2. The circuit shown above includes a 72 V battery and four resistors. Find the following:

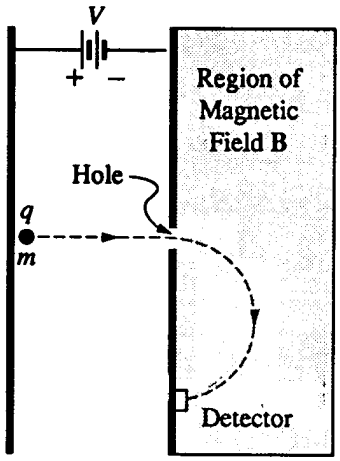
a. the total resistance of the circuit
b. the current in the battery
c. the current in the 10ohm resistor

d. the potential difference across the 10ohm resistor



3. An electron from a hot filament in a cathode ray tube is accelerated through a potential difference, ε. It then passes into a region of uniform magnetic field B, directed into the page as shown above. The mass of the electron is m and the charge has magnitude e.

    a. Find the potential difference ε necessary to give the electron a speed v as it enters the magnetic field.
    b. On the diagram above, sketch the path of the electron in the magnetic field.
    c. In terms of mass m, speed v, charge e, and field strength B, develop an expression for r, the radius of the circular path of the electron.
    d. An electric field E is now established in the same region as the magnetic field, so that the electron passes through the region undeflected.
        i. Determine the magnitude of E.
        ii. Indicate the direction of E on the diagram above.



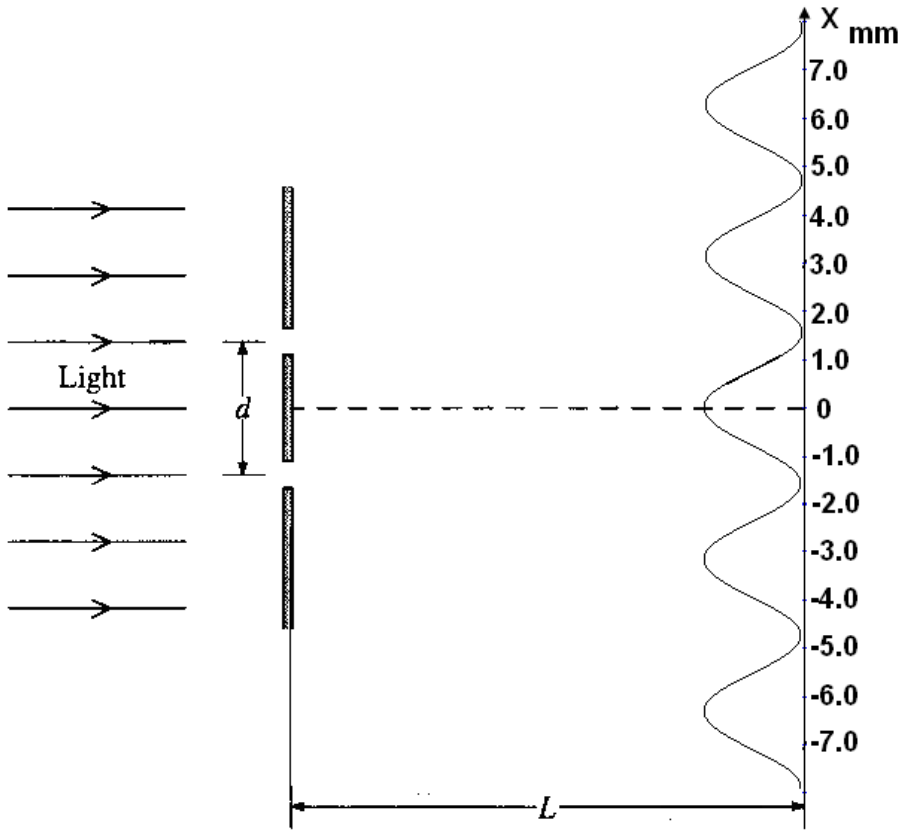
4. A particle of mass m and charge q is accelerated from rest in the plane of the page through a potential difference V between two parallel plates as shown above. The particle is injected through a hole in the righthand plate into a region of space containing a uniform magnetic field of magnitude B oriented perpendicular to the plane of the page. The particle curves in a semicircular path and strikes a detector. Neglect relativistic effects throughout this problem.

   a.

      i. State whether the sign of the charge on the particle is positive or negative.
      ii. State whether the direction of the magnetic field is into the page or out of the page.

   b. Determine each of the following in terms of m, q, V, and B.

      i. The speed of the charged particle as it enters the region of the magnetic field B.
      ii. The force exerted on the charged particle by the magnetic field B.
      iii. The distance from the point of injection to the detector.
      iv. The work done by the magnetic field on the charged particle during the semicircular trip.

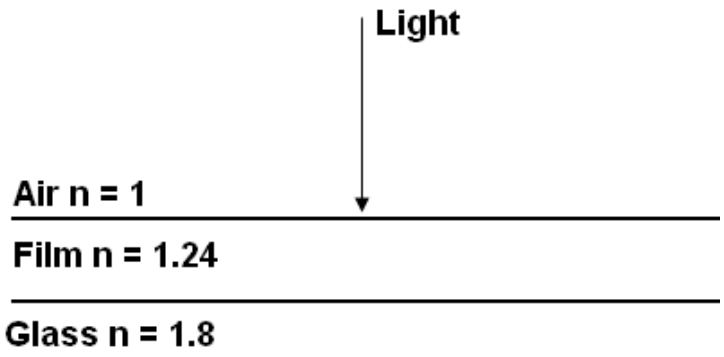


5. Monochromatic light strikes a double-slit apparatus as shown above. The separation between the slits is 0.3 mm. As result of diffraction an interference pattern is produced on the second screen 4.5 m away.

    a. What property of light does this experiment demonstrates?
    b. Find the wavelength of the incident light based on the interference pattern.

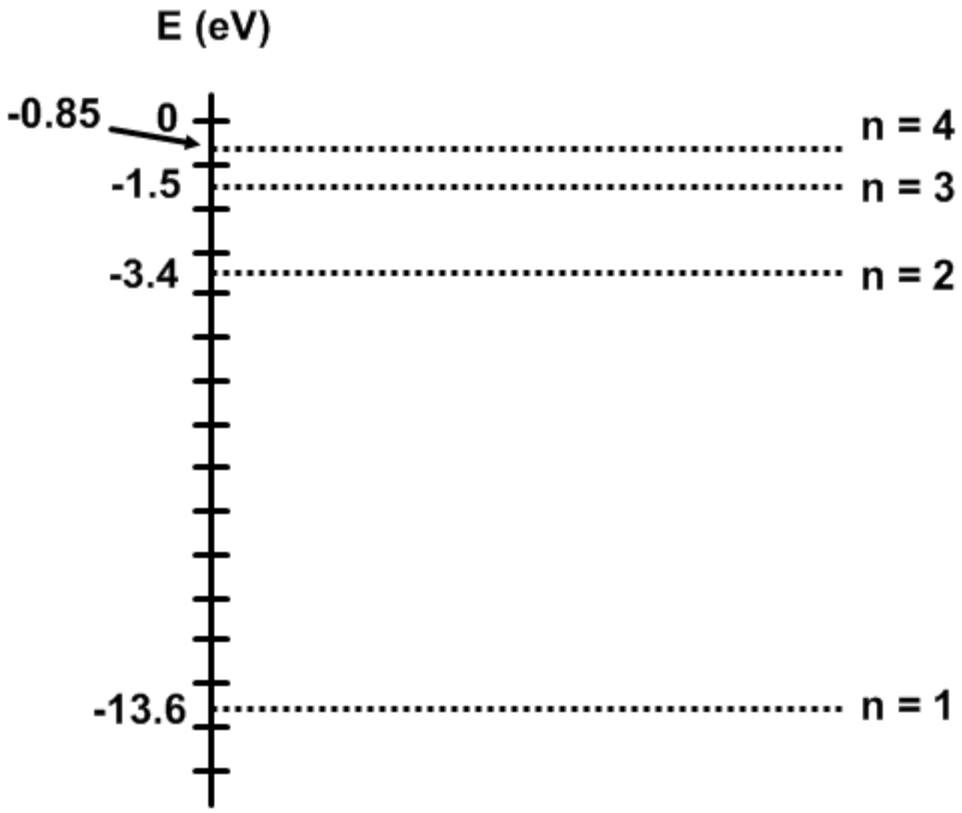
    The double-slit apparatus is submerged into water (n = 1.33)

    c. What is the frequency of the light in water?
    d. What is the wavelength of the light in water?
    e. What happens to the distance between two adjacent fringes in water?

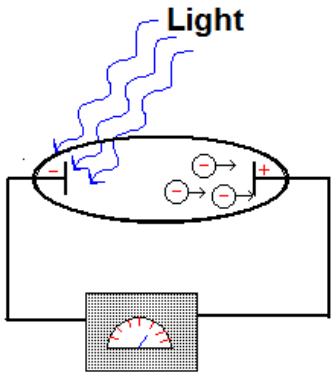


6. The glass surface is coated with a thin film and illuminated with monochromatic light of wavelength 570nm.

    a. What is the frequency of the incident light in vacuum?
    b. What is the frequency of light in the film?
    c. What is the speed of light in the film?
    d. What is the wavelength of light in the film?
    e. Calculate the minimum thickness of the film required to produce no reflected light.
    f. Calculate the minimum thickness of the film required to produce maximum intensity of the reflected light.



7. A free electron is captured by a proton. As a result, two photons are emitted. The energy of the first photon is 1.5 eV.
    a. What is the wavelength of this photon?
    b. What is the energy of the second photon?
    c. What is the wavelength of the second photon?
    d. On the diagram, show the arrows associated with the transitions.
    e. If instead only one photon was emitted, what would be its frequency?



8. An experiment is conducted to investigate the photo-electric effect with a metal plate. It was found when the wavelength of the incident light is less than 650 nm the plate starts emitting electrons.
    a. What is the threshold frequency of the plate?
    b. What is the work function of Barium?

    The wavelength of the incident light is changed to 350 nm.

    c. What is the kinetic energy of photo-electrons?
    d. What is the stopping voltage required?