PHYS 2426 - Practice Final Problems

Useful information: $k = 9.0\times10^{9}$ N·m^2 / kg^2 $m_{electron} = 9.11\times10^{-31}$ kg $e = 1.60\times10^{-19}$ C
$c = 3.00\times10^{8}$ m/s $\mu_0 = 4\pi\times10^{-7}$ N/A^2 $\varepsilon_0 = 8.85\times10^{-12}$ C^2/N·m^2 $n_{water} = 1.333$

Problem 1 Three charges +Q, +Q and -Q are arranged at the vertices of an equilateral triangle with sides of length a. What is the magnitude of the force on one of the +Q charges.

(a) 0 (b) 0.914 kQ^2/a^2 (c) kQ^2/a^2 (d) 1.732 kQ^2/a^2 (e) 2 kQ^2/a^2

Problem 2 An insulating sphere with an 3 cm radius has a uniform charge of 12 μC. What is the magnitude of the electric field at a distance of 2 cm from the center?

(a) 0 (b) 2.4×10^{6} N/C (c) 8.0×10^{7} N/C (d) 1.2×10^{8} N/C (e) 2.7×10^{8} N/C

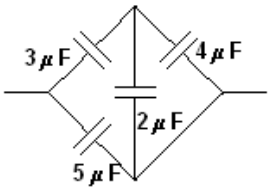
Problem 3 What is the magnitude of the electric field and the voltage at the center of a ring with a uniform charge Q and radius R, where the voltage at infinity is taken to be zero?

(a) E = 0, V = 0 (b) E = 0, V = kQ/R (c) E = kQ/R^2, V = 0 (d) E = kQ/R^2, V = kQ/R (e) not listed

Problem 4 What is the change in potential energy when a –7 μC charge is moved from the origin to (2m,0) in an electric field of **E** = (3 **i** – 4 **j**) V/m?

(a) 0 (b) –42 μJ (c) 42 μJ (d) –70 μJ (e) 70 μJ

Problem 5 What is the equivalent capacitance of the arrangement shown?



(a) 1.14 μF (b) 2.32 μF (c) 7 μF (d) 7.88 μF (e) 14 μF

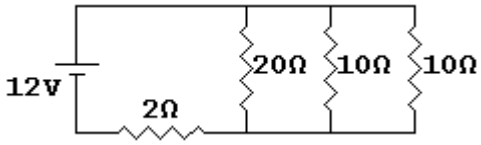
Problem 6 If a 12 V battery is connected between two parallel plates separated by 0.6 cm, what is the magnitude of the force on an electron placed between the plates?

(a) 2.00×10^{3} N (b) 2.00×10^{-16} N/C (c) 1.44×10^{-18} N (d) 1.60×10^{-16} N (e) 3.20×10^{-16} N

Problem 7 What length of a gold ($\rho = 2.44\times10^{-8}$ Ω·m) wire with a 3mm diameter will have a 5 mΩ resistance?

(a) 1.45 m (b) 5.79 m (c) 307 m (d) 615 m (e) 1930 m

Problem 8 How much current is flowing through the 20 Ω resistor?



(a) 0.8 A (b) 2.0 A (c) 1.6 A (d) 0.4 A (e) 1.2 A

Problem 9 What is the magnetic field at the midpoint of two long parallel wires 20 cm apart that carry currents of 5A and 8A in the same direction?

(a) 3 μT (b) 6 μT (c) 13 μT (d) 26 μT (e) 40 μT

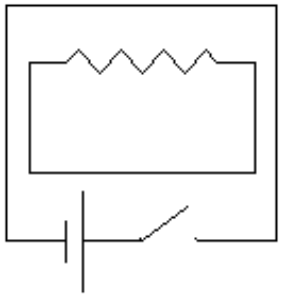
Problem 10 An electron with an initial velocity perpendicular to a uniform magnetic field will follow what path?

(a) straight line (b) parabola (c) helix (d) ellipse (e) circle

Problem 11 What is the direction of the force on a vertical wire with an upward current in a magnetic field directed to the west?

(a) north (b) south (c) east (d) west (e) upward

Problem 12 What is the direction of the induced current through the resistor when the switch is closed and then opened?



(a) left then left (b) left then right (c) right then left (d) right then right (e) no current

Problem 13 What is the average power dissipated when a 40 Ω resistor and a 50 μF capacitor are connected in series across a standard U.S. outlet?

(a) 0 W (b) 72.2 W (c) 130. W (d) 271. W (e) 360. W

Problem 14 The primary winding of a transformer has 50 turns and the secondary has 400. If the input voltage is 120 V (rms), what is the output (rms) voltage?

(a) 960 V (b) 480. V (c) 60 V (d) 15. V (e) 10. V

Problem 15 A 3.5 mW He-Ne laser (λ = 632.8 nm) produces a polarized beam of cross-sectional area 5×10^{-6} m^2. What is the peak electric field in the beam?

(a) 1450 V/m (b) 726 V/m (c) 700 V/m (d) 633 V/m (e) 514 V/m

Problem 16 At what angles (measured from the normal) would light from air incident on glass (n = 1.52) produce no refracted ray?

(a) angles greater than 33.3° (b) angles greater than 41.1° (c) angles greater than 48.9°
(d) angles greater than 56.7° (e) There will always be a refracted ray.

Problem 17 Which of the following best describes the image of a concave mirror when the object is at a distance less than the focal point distance from the mirror?

(a) virtual, erect and magnification greater than one
(b) real, inverted and magnification less than one
(c) virtual, erect and magnification less than one
(d) real, inverted and magnification greater than one
(e) cannot be determined from the information given

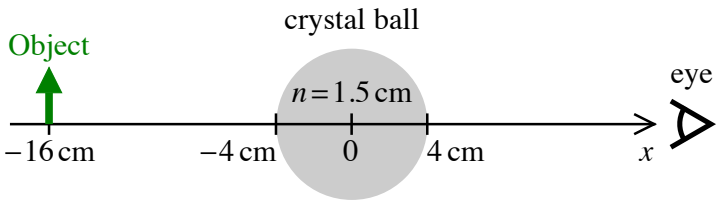
Problem 18 Light of wavelength 700 nm passes through two slits separated by 6.0×10^{-5} m. What is the distance from the center of the central maximum to the first dark fringe on a screen 1.2 m away?

(a) 7.0 mm (b) 14.0 mm (c) 21.0 mm (d) 28.0 mm (e) 35.0 mm

Problem 19 Unpolarized light of intensity 1000 W/m^2 passes through two polarizing filters: the first at 20° from vertical and the second at 50° from vertical. What is the light's intensity after the filters?

(a) 662 W/m^2 (b) 375W/m^2 (c) 365 W/m^2 (d) 207 W/m^2 (e) 0

Problem 20 A fortuneteller looks through her crystal (n = 1.50) ball with a 4 cm radius centered at x = 0. An object at x = -16 cm is viewed from some position down the positive x-axis. Where does she see the image? Give the x-coordinate of the image position. (8 points)



Problem 21 A slide projector is used to project a 35 mm wide slide to fill a 1.4 m wide screen. If the projector uses a converging lens with a 10 cm focal length, then relative to the lens where must the slide and screen be placed?

Problem 22 What is the minimum thickness of a soap bubble film (n = 1.46) on which light of wavelength 500 nm shines so that one observes constructive interference of the reflected light?

Problem 23 Light of wavelength 540 nm falls on a single slit of width 0.15 mm. On a screen a distance of 8 m away what is the width of the central bright fringe?

Problem 24 When light of wavelength λ passes through as a diffraction grating the highest order bright fringe that is seen is m=7. What does this imply about the slit spacing, d, in the grating?

Problem 25 Unpolarized light of intensity $1000 W/m^2$ passes through 2 polarizing filters. The first has an axis that is 40° from vertical and the second is 70° from vertical. What is the intensity of the light between the filters and after the second filter?