

PHYS 2426
Engineering Physics II
Fall 2012

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Homework Answers

Chapter 21

5. $F = 2.81 \text{ N}$

7. $q_1/q_2 = -4.0$

10. a.) $Q/q = -2.83$

b.) $Q/q = -\frac{1}{2\sqrt{2}}$

13. a.) q_3 placed at $x =$
-14 cm along x-axis

b.) $y = 0$

30. a.) $x = 2.0 \text{ cm}$

b.) $F_{\text{net}} = 9.21 \times 10^{-24} \text{ N}$

32. $q_2 = 13e$

42. a.) $x \approx \left(\frac{q^2 L}{2\pi \epsilon_0 mg} \right)^{1/3}$

b.) $|q| = 2.4 \times 10^{-8} \text{ C}$

46. a.) $\vec{F}_1 = (3.52 \times 10^{-25} \text{ N}) \hat{i}$

b.) $F_{\text{net}} = 0$

54. $F = 9.0 \times 10^3 \text{ N}$
Don't assume the parts are equal

64. $Q = 1.2 \times 10^{-5} \text{ C}$

Chapter 22

4. $\vec{E}_{\text{net}} = -(6.39 \times 10^5 \frac{\text{N}}{\text{C}}) \hat{i}$

14. a.) $x \approx 2.72 \text{ L}$

18. $E_{\text{net}} = \frac{qd^3}{4\pi\epsilon_0 z^5}$

24. a.) Field vanishes at center

b.) $\propto \frac{1}{r^2}$

c.) $z = +\frac{R}{\sqrt{2}} = 0.707R$

d.) $E_{\text{max}} = 3.46 \times 10^7 \frac{\text{N}}{\text{C}}$

37. $\frac{E(a) - E(b)}{E(a)} = 0.283$

49. a.) $F = 0.245 \text{ N}$

b.) $\theta = -11.3^\circ$

clockwise from +x-axis

c.) $x = 108 \text{ m}$

d.) $y = -21.6 \text{ m}$

Chapter 23

$$6. q_{enc} = -4.3 \times 10^{-9} \text{ C}$$

$$10. q_{enc} = 2.13 \times 10^{-10} \text{ C}$$

$$27. \sigma = 3.8 \times 10^{-8} \text{ C/m}^2$$

$$33. \text{ a.) Left: } 0$$

$$\text{ b.) Right: } 0$$

$$\text{ c.) Between: } -7.91 \times 10^{-11} \frac{\text{N}}{\text{C}} \hat{x}$$

$$38. \sigma = 2.9 \times 10^{-6} \text{ C/m}^2$$

$$44. q = 2.2 \times 10^{-6} \text{ C}$$

$$51. A = 1.79 \times 10^{-11} \frac{\text{C}}{\text{m}^2}$$

Chapter 24

7. $V_B - V_A = -32.0 \text{ V}$

13. a.) $q_b = 3.3 \times 10^{-9} \text{ C}$

b.) $\sigma = 1.2 \times 10^{-8} \frac{\text{C}}{\text{m}^2}$

19. a.) $x = 6.0 \text{ cm}$ (+x axis)

b.) $x = 12.0 \text{ cm}$ (-x axis)

24. $V_D = -6.20 \text{ V}$

29. $V = 3.24 \times 10^{-2} \text{ V}$

31. $V \pm 47.1 \mu\text{V}$

36. a.) $E = 39 \frac{\text{V}}{\text{m}}$

b.) toward plate 1

43. $U_f = \frac{2q^2}{4\pi\epsilon_0 a} \left(\frac{1}{\sqrt{2}} - 2 \right)$

$W = -1.92 \times 10^{-13} \text{ J}$

47. $V = 22490 \text{ m/s}$

53. a.) $U = 0.225 \text{ J}$

b.) $a_B = 22.5 \text{ m/s}^2$

c.) Energy is conserved

d.) $V_A = 7.75 \text{ m/s}$

$V_B = -3.87 \text{ m/s}$

57. a.) $K_f = 3.0 \text{ J}$

b.) $y = -8.5 \text{ m}$

63. a.) $E = 1.2 \times 10^4 \frac{\text{N}}{\text{C}}$

b.) $V = 1.8 \times 10^3 \text{ V}$

c.) $x = 5.8 \times 10^{-2} \text{ m}$

Chapter 25

$$7. \frac{c}{A} = 6.79 \times 10^{-4} \frac{F}{m^2}$$

$$10. C_{eq} = 7.33 \mu F$$

$$12. q_{TOTAL} = 120 \mu C$$

$$\Delta q_{TOTAL} = 60 \mu C$$

$$22. q_1 = 20 \mu C$$

$$q_2 = 40 \mu C$$

$$q_3 = 40 \mu C$$

$$32. a.) 35 pF$$

$$b.) 2 nC$$

$$c.) U = 6.3 \mu J$$

$$d.) E = 6.0 \times 10^5 \frac{V}{m}$$

$$e.) u = 1.6 \frac{J}{m^3}$$

$$37. a.) V_f = 16.0 V$$

$$b.) U_i = 4.51 \times 10^{-11} J$$

$$c.) U_f = 1.20 \times 10^{-10} J$$

$$d.) W = 7.52 \times 10^{-11} J$$

$$44. a.) C = 0.73 nF$$

$$b.) V_{BD} = 28 kV$$

$$46. q_{TOT} = 1.06 \times 10^{-9} C$$

$$49. C = 1.73 \times 10^{-11} F$$

$$52. a.) C = 13.4 pF$$

$$b.) q = 1.15 nC$$

$$c.) E_1 = 1.13 \times 10^4 \frac{N}{C}$$

$$d.) E_2 = 4.33 \times 10^3 \frac{N}{C}$$

Chapter 26

7. $r = 1.9 \times 10^{-4} \text{ m}$

11. a.) $i = 1.33 \text{ A}$

b.) $i = 0.666 \text{ A}$

c.) J_a has max value near the surface.

21. $T = 1.8 \times 10^3 \text{ }^\circ\text{C}$

31. a.) $i = 6.0 \times 10^{-3} \text{ A}$

b.) $V = 1.59 \times 10^{-8} \text{ V}$

c.) $R_{\text{TOTAL}} = 2.12 \times 10^{-8} \Omega$

33. a.) $i = 3.83 \times 10^{-2} \text{ A}$

b.) $J = 109 \text{ A/m}^2$

c.) $v_d = 1.28 \times 10^{-2} \text{ m/s}$

d.) $E = 227 \text{ V/m}$

42. a.) UPWARD

b.) $W = 12 \text{ eV}$

c.) $E = 12 \text{ eV} = 1.9 \times 10^{-18} \text{ J}$

49. a.) \$4.46

b.) $R = 144 \Omega$

c.) $i = 0.833 \text{ A}$

62. $R = 13.3 \Omega$

68. $T = 57^\circ\text{C}$

73. $L = 3.0 \times 10^6 \frac{\text{J}}{\text{kg}}$

Chapter 27

8. $\Delta t = 14.4 \mu\text{s}$

10. a.) $q \Delta V = 12.0 \text{ eV}$

b.) $P = 9.9 \times 10^{-4} \text{ W}$

15. $R = 8.0 \Omega$

20. a.) $R_1 = 4.0 \Omega$

b.) $R_2 = 12 \Omega$

45. a.) $i = 0.666 \text{ A}$

b.) i_1 is downward

c.) $i_2 = 0.33 \text{ A}$

d.) i_2 UPWARD

e.) $i_2 = i_3 = 0.33 \text{ A}$

f.) i_3 is UPWARD

g.) $V_a - V_b = 3.3 \text{ V}$

49. a.) $i_1 = 1.14 \text{ A}$

$i_3 = 0.45 \text{ A}$

b.) $i_3 = 0.6818 \text{ A}$

$i_1 = 0.45 \text{ A}$

60. a.) $\frac{t_{1/3}}{\tau} = 0.41$

b.) $\frac{t_{2/3}}{\tau} = 1.1$

87. $i = 3.33 \text{ A}$

$V = 1.67 \text{ V}$

$\Delta q = -13 \mu\text{C}$

92. $i_2 = 2.00 \text{ A}$

95. 3

Chapter 28

8. $v_{\min} = 3.75 \times 10^3 \text{ m/s}$

11. $E = 6.8 \times 10^5 \frac{\text{V}}{\text{m}}$

17. a.) $v = 2.60 \times 10^6 \text{ m/s}$

b.) $T = 1.09 \times 10^{-7} \text{ s}$

c.) $K = 1.40 \times 10^5 \text{ eV}$

d.) $\Delta V = 7.0 \times 10^4 \text{ eV}$

20. $B = 6.7 \times 10^{-2} \text{ T}$

28. $K = 2.09 \times 10^{-22} \text{ J}$

42. a.) $F = -16 \text{ N } \hat{j}$

b.) $F = 0$

45. $\vec{F}_B = -2.50 \times 10^{-3} \text{ N } \hat{j} + 0.750 \times 10^{-3} \text{ N } \hat{k}$

49. $\vec{\tau} = -4.3 \times 10^{-3} \text{ N} \cdot \text{m } \hat{j}$

52. $i = 0.0036 \text{ A}$ (assumes $L = 8 \text{ cm}$); $I = 7.5 \times 10^{-4} \text{ A}$
ASSUMES x_{\max} OCCURS
AT t_{\max}

81. $\vec{F}_B = q(-200 \hat{k} - 140 \hat{j})$

$\vec{F} = (0.00080 \hat{j} - 0.001 \hat{k}) \text{ N}$

Chapter 29

7. a.) $B = 1.02 \times 10^{-7} \text{ T}$

b.) Direction out of page

10. a.) $B = 1.18 \times 10^{-7} \text{ T}$

b.) Into the page

29. $B_{\text{net}} = 8.0 \times 10^{-5} \text{ T}$
In the y-direction

43. a.) At $r=0$, $B=0$

b.) At $r=0.01 \text{ m}$, $B = 8.50 \times 10^{-4} \text{ T}$

c.) At $r=0.02 \text{ m}$, $B = 1.70 \times 10^{-3} \text{ T}$

d.) At $r=0.04 \text{ m}$, $B = 8.50 \times 10^{-4} \text{ T}$

44. a.) $\oint_1 \vec{B} \cdot d\vec{s} = -2.5 \times 10^{-6} \text{ T} \cdot \text{m}$

b.) $\oint_2 \vec{B} \cdot d\vec{s} = -1.6 \times 10^{-5} \text{ T} \cdot \text{m}$

50. $B = 0.00571 \text{ T}$

53. $i = 0.272 \text{ A}$

56. $B_p = 8.78 \times 10^{-6} \text{ T}$
In the +x-direction

69. a.) $i_b = 15 \text{ A}$

b.) Wire b must carry current into the page

85. $\vec{B}(x, y, z) = \frac{\mu_0 i \Delta s (z\hat{i} - x\hat{k})}{4\pi (x^2 + y^2 + z^2)^{3/2}}$

89. $B_{\text{center}} = \frac{2\sqrt{2}\mu_0 i}{\pi a}$

Chapter 30

5. The B-field is out of the page in the upper half of the circle and into the page in the lower half.

$$\therefore \phi_{\text{net}} = 0$$

→ no induced current

11. a.) $\mathcal{E} = N B a b 2\pi f \sin(2\pi f t)$

Since $\omega = 2\pi f$

$$\mathcal{E} = N B a b \omega \sin(\omega t)$$

b.) $N a b = 0.796 \text{ m}^2$

17. a.) $B(t=0) = 1.26 \times 10^{-4} \text{ T}$

b.) $B(t=0.500 \text{ s}) = 0$

c.) $B(t=1.0 \text{ s}) = -1.26 \times 10^{-4} \text{ T}$

23. a.) $\phi_B = \frac{\pi \mu_0 i r^2 R^2}{2x^3}$

b.) $\mathcal{E} = \frac{3\pi \mu_0 i r^2 R^2 v}{2x^4}$

c.) Counter clockwise when viewed from above

28. a.) $|\phi_B| = 1.4 \times 10^{-8} \text{ Wb}$

b.) $i_{\text{loop}} = 1.0 \times 10^{-5} \text{ A}$

33. a.) $\mathcal{E} = 2.40 \times 10^{-4} \text{ V}$

b.) $i_e = 6.00 \times 10^{-4} \text{ A}$

c.) $P = 1.44 \times 10^{-7} \text{ W}$

d.) $F_B = 2.87 \times 10^{-8} \text{ N}$
to the right

e.) $P = 1.44 \times 10^{-7} \text{ W}$

34. $V_t = \frac{MgR}{B L^2}$

50. $t_L = 12.3 \text{ s}$

54. a.) $i_1 = 3.33 \text{ A}$

b.) $i_1 = i_2 = 3.33 \text{ A}$

c.) $i_1 = 4.55 \text{ A}$

d.) $i_2 = 2.73 \text{ A}$

e.) $i_1 = 0$

f.) $i_2 = -1.82 \text{ A}$

65. a.) $\int_0^t P_{\text{battery}} dt = 18.7 \text{ J}$

b.) $U_B = 5.16 \text{ J}$

c.) $E_{\text{lost}} = 13.6 \text{ J}$

70. a.) $i_1 \approx 23 \text{ mA}$

b.) $i_2 = 70 \text{ mA}$

74. $M = 13 \text{ H}$

17. (d.) YES

(e.) $\mathcal{E} = 5.04 \times 10^{-8} \text{ V}$

Chapter 31

3. a.) $T = 6.00 \mu\text{s}$
b.) $f = 1.67 \times 10^5 \text{ Hz}$
c.) $\frac{1}{2}$ period or $3.0 \mu\text{s}$

12. a.) $q/Q = 0.500$
b.) $i/I = 0.866$

16.

26. $t = \frac{L}{R} \ln 2$

32. a.) $I = 5.22 \times 10^{-3} \text{ A}$
b.) $e_L = 0$
c.) $i = 4.51 \times 10^{-3} \text{ A}$

34. a.) $I = 3.91 \times 10^{-2} \text{ A}$
b.) $e = 0$
c.) $i = -3.38 \times 10^{-2} \text{ A}$

42. a.) $R = 40 \Omega$
b.) $L = 60 \text{ mH}$

44. a.) $X_C = 16.6 \Omega$
b.) $Z = 422 \Omega$
c.) $I = 0.521 \text{ A}$
d.) X_C inc as C dec
e.) $Z = 408 \Omega < 422 \Omega$
f.) $I \propto Z^{-1}$, it increases

50. a.)

b.) $R = \omega L$

c.) $\phi = +45^\circ$

d.) $\omega L = 2.00 \times 10^3 \frac{\text{mH}}{\text{s}}$

e.) $I = 53.0 \text{ mA}$

Chapter 32

$$6. \mu_0 i_d \left(\frac{\text{enc. } A}{\text{total } A} \right) = 52 \text{ nT} \cdot \text{m}$$

$$9. \text{ a.) } B = 5.01 \times 10^{-22} \text{ T}$$

$$\text{ b.) } B = 4.51 \times 10^{-22} \text{ T}$$

$$16. \frac{dE}{dt} = 7.2 \times 10^{12} \frac{\text{V}}{\text{m} \cdot \text{s}}$$

$$18. B = 8.40 \times 10^{-13} \text{ T}$$

$$26. \text{ a.) } i_{d, \text{enc}} = 1.33 \text{ A}$$

$$\text{ b.) } r = 0.300 \text{ cm}$$

$$\text{ c.) } r = 4.80 \text{ cm}$$

Chapter 33

10. $B_m = 1.07 \times 10^{-12} \text{ T}$

14. $\left(\frac{\partial B}{\partial t}\right)_{\max} = 3.44 \times 10^6 \frac{\text{T}}{\text{s}}$

21. $P_r = 5.9 \times 10^{-8} \text{ Pa}$

25. $u = \frac{I}{c} = \frac{(1+f)I_0}{c}$

39. a.) $E_m = 1.9 \text{ V/m}$

b.) $P_r = 1.7 \times 10^{-11} \text{ Pa}$

47. $n_2 = 1.48$

49. Angle between i
and $r = 180^\circ$

59. a.) $\phi = 48.9^\circ$

b.) $\phi = 29.0^\circ$

65. $\theta = 23.2^\circ$

67. a.) $n_3 = 1.69$

b.) $\theta = 28.1^\circ$

c.) $N \rightarrow$ transmission

Chapter 34

7. $p = 10.5 \text{ cm}$

10. a.) $r = 20 \text{ cm}$

b.) $i = +30 \text{ cm}$

c.) $m = -\frac{i}{p} = -2.0$

d.) Real

e.) Inverted

f.) Real image on the same side as the object.

14. a.) $r = -70 \text{ cm}$

b.) $i = -14 \text{ cm}$

c.) $m = +0.61$

d.) Virtual

e.) upright

f.) virtual image forms on side opposite of object

16. a.) $r = -28 \text{ cm}$

b.) $i = -7.7 \text{ cm}$

c.) $m = +0.45$

d.) virtual

e.) upright

f.) opposite

41. a.) $f = +40 \text{ cm}$

b.) $i = \infty$

43. $h_i = 5.0 \text{ mm}$

54. a.) $i = -3.8 \text{ cm}$

b.) $m = +0.38$

c.) virtual

d.) upright

e.) same side as obj

56. a.) $i = -8.7 \text{ cm}$

b.) $m = +0.72$

c.) virtual

d.) upright

e.) same side as obj

89. a.) $s = 13.0 \text{ cm}$

b.) $i = 17.0 \text{ cm}$

$p = 5.23 \text{ cm}$

c.) $m = -3.25$

d.) $m_o = 3.13$

e.) $M = m m_o = -10.2$

96. a.) $i_2 = -4.0 \text{ cm}$

b.) $m = -1.2$

c.) virtual

d.) Inverted

e.) same side as obj.

Chapter 35

8. a.) Pulse 2 travels thru the plastic in less time.

b.) $\Delta t = \frac{0.03L}{c}$
multiple by 0.03

18. a.) $\phi = 2.90$

b.) $\phi = 18.2 \text{ rad}$

c.) Greater than $\frac{5}{2}$
(3rd min) and less than 3 (3rd max)

19. $\Delta y = 2.25 \text{ mm}$

41. $L = 161 \text{ nm}$

45. $L = 478 \text{ nm}$

48. $L = 339 \text{ nm}$

70. a.) $|\Delta d| = 155 \text{ nm}$

b.) $d_o - d_f = 1.09 \mu\text{m}$

94. $\Delta t = 51.6 \text{ ns}$

Chapter 36

5. a.) $\lambda_a = 700 \text{ nm}$

b.) $m_a = 2; m_b = 4$

c.) $m_a = 3 \rightarrow m_b = 6$

9. $\Delta y = 1.77 \text{ mm}$

20. $D = 53 \text{ m}$

36. 13 bright fringes

46. $\lambda < 635 \text{ nm}$

50. $m = \pm 1; \lambda = 523 \text{ nm}$

$m = \pm 2; \lambda = 524 \text{ nm}$

59. With $\lambda_{\text{avg}} = 600 \text{ nm}$

and $m = 2$

$\Delta \lambda = 0.15 \text{ nm}$.