Answers

1A.1

(a) $\mathbf{E} = \dfrac{q}{4\pi\varepsilon_0 r^2}\hat{\mathbf{r}}$

(b) $\mathbf{E} = \mathbf{0}$

(c) $\mathbf{E} = \dfrac{\lambda}{2\pi\varepsilon_0 r}\hat{\mathbf{r}}$

(d) $\mathbf{E} = \dfrac{\sigma}{2\varepsilon_0}\hat{\mathbf{r}}$

1A.2

(a) $V_{ba} = \dfrac{q}{4\pi\varepsilon_0}\left(\dfrac{1}{r_b} - \dfrac{1}{r_a}\right)$

(b) $V_{ba} = \dfrac{q}{4\pi\varepsilon_0}\left(\dfrac{1}{r_b} - \dfrac{1}{r_a}\right)$ if $r_a > a, \quad r_b > a$

$V_{ba} = \dfrac{q}{4\pi\varepsilon_0}\left(\dfrac{1}{a} - \dfrac{1}{r_a}\right)$ if $r_a > a, \quad r_b < a$

$V_{ba} = 0$ if $r_a < a, \quad r_b < a$

(c) $V_{ba} = \dfrac{\lambda}{2\pi\varepsilon_0}\ln\left(\dfrac{r_a}{r_b}\right)$

(d) $V_{ba} = \dfrac{\sigma}{2\varepsilon_0}\left(r_a - r_b\right)$

1A.3

$\dfrac{C}{l} = \dfrac{2\pi\varepsilon_0\varepsilon_r}{\ln\left(d_2/d_1\right)}$

1A.4

$\mathbf{F} = \dfrac{-eQ}{4\pi\varepsilon_0 d^2}\hat{\mathbf{r}}$, $\hat{\mathbf{r}}$ = unit vector pointing to electron

1A.5

1A.6

27.3 μA

1A.7

(b) 63.7 Ω (c) 0.796 V

1A.9

$C = \dfrac{4\pi\varepsilon_0 R_1 R_2}{R_1 - R_2}$, $R_1 > R_2$

1B.1

(a) 6.28×10^{-5} T (b) 6.28×10^{-5} T (c) 0.628 T

1B.3

$B = \mu_0 \dfrac{i}{R}\left(\dfrac{1}{2\pi} + \dfrac{1}{4}\right) = 5.2\times10^{-4}$ T

1B.4

1.39×10^{-2} T

1B.5

(a) *G* yes, *G'* no (b) *G* no, *G'* yes (c) *G* yes, *G'* yes

1B.6

(b) $e = \frac{1}{2}\omega B r_0^2$ V

1B.7

960 N

1B.8

$2\times10^{-4}\ln 2$ Wb/km

1B.9

4.33×10^{-2} N

1B.10

(a) $\lambda = \dfrac{2bN}{\alpha}\sin\dfrac{\alpha a}{2}\hat{B}\sin\alpha X$ (b) $e = -2bN\sin\dfrac{\alpha a}{2}\hat{B}v\cos\alpha X$

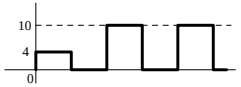
(c) $a = \pi/\alpha$ or an odd multiple

(d) $e = -2bN\sin\dfrac{\alpha a}{2}\left(\dfrac{\omega}{\alpha} - v\right)\hat{B}\cos(\omega t - \alpha X)$, $e = 0$

4A.2

(i) $v_o = \dfrac{R_L}{R_L + R_S/2}(V - e_{fd})$ (ii) $v_o = \dfrac{R_L}{R_L + R_S}(V - e_{fd})$

4A.3



4A.4

(a)

(i) 3 V, 1.3 mA (ii) $-5\dfrac{15}{47}$ V, $\dfrac{2}{47}$ mA

(b)

(i) 2.3 V, 1.23 mA (ii) $-5\dfrac{187}{235}$ V, $\dfrac{3}{235}$ mA

4B.1

(a) 1.33 T, 1200 A (b) 1.66 T, 1400 A

4B.2

(a) 5.03×10^5 H^{-1}, 0.5 T (b) 1.52×10^5 H^{-1}, 0.39 T

4B.3

(a) 1.25 A DC ($\rightarrow$) (b) $L_{12} = L_{21} = 1.\dot{7}$ H,

4B.4

(a) $B_m = 1.25$ T

4B.5

(a) $x_{\max} = 1.81$ mm

5B.1

(a) 1.4 T, 0.5 A 56 H; 0.55 T, 39 H

(b) -780 V

(c) 6.284 kV, 0.25 A, 1 T

5B.4

(a) 1.61 H (b) 0.236 H, T = 13.7 ms

5B.6

Battery is better by a factor of 1000.

6A.1

(i) 35 mA, 3.75 kΩ (ii) 162.5 V, 293.8 V

6B.1

1.212, 115 V / 26.4 A, 95 V / 31.6 A

6B.2

6.91

6B.3

(b) $L_{21} \approx 0.5$ H, $L_{31} \approx 0.25$ H (c) $\hat{v}_1 = 10\pi$ V, $\hat{i}_1 \approx 0.2$ A

6B.4

(b) $i_S = 0$ (c) $\hat{v}_1 + \hat{v}_3 = 15$ V, $\hat{v}_2 = 15$ V, $\hat{v}_4 = \hat{v}_1$, $\hat{v}_5 = \hat{v}_2$, $\hat{v}_6 = \hat{v}_3$

8B.1

(a) 2.685 mm (b) No

8B.2

(b) 4.189 mm, 5730 N (c) 578.3 kg (d) 202.5 mA (e) 11.72 ms^{-2} up

8B.3

(a) 0.255 A **Hint**: Flux is a maximum when plunger is fully in.

8B.4

(a) $x \leq 3.53$ mm (b) 8.9 J (c) 1.9 J

8B.5

885 μJ

8B.7

(b) $F = 55$ N

A.6

10A.1

1 MΩ , 1 kΩ , 80

10A.2

20 kΩ , 3 mS

10A.3

$R_o \geq 99R_L$, $A_{is}i_i = \dfrac{A_{vo}v_i}{R_o}$

10A.4

63.8, 90, 63.1, 1 Hz to 1 MHz

10A.5

26.7, 24.3

10B.2

$L_x = R_2R_3C_1$ and $R_x = \dfrac{R_2R_3}{R_1}$

10B.3

$L_x = \dfrac{R_2R_3C_1}{1+\omega^2R_1^2C_1^2}$ and $R_x = \dfrac{\omega^2R_1C_1^2R_2R_3}{1+\omega^2R_1^2C_1^2}$

12B.1

(b) 0.185 mm

12B.2

(a) 0.25 T, 199 kAm^{-1} (b) $\sqrt{20}$ A , 100 V (c) $1/\pi$ H