General Physics II - Spring 2019
Final Exam Solution B

Show your work. Answers alone get no credit.

{4} **1**

$$\frac{dQ}{dt} = kA\frac{dT}{dx} = (0.03)(0.016)\frac{40-5}{0.006}\text{W} = 2.8\text{W}$$

{4} **2**

$$P = \frac{dQ}{dt} \approx \sigma A T^4 \longrightarrow A = \frac{P}{\sigma T^4} = 9.3\times10^{-3}\text{m}^2$$

{4} **3**

$$\langle K\rangle = \frac{3}{2}kT \longrightarrow T = \frac{2\langle K\rangle}{3k} = 900\text{K}$$

{4} **4** The force is down.

$$F = ILB_\perp = ILB\cos(31^\circ) = 900\text{N}$$

{4} **5**

(a) $p = \frac{h}{\lambda} = 1.33\times10^{-27}\text{kg}\cdot\text{m/s}$.
(b) $E = hf = \frac{hc}{\lambda} = 4.0\times10^{-19}\text{J}$.
(c) $P = E\frac{dN}{dt} \longrightarrow \frac{dN}{dt} = \frac{P}{E} = 1.0\times10^{15}1/\text{s}$.

{4} **6**

(a) $p = \frac{h}{\lambda} = 1.33\times10^{-27}\text{kg}\cdot\text{m/s}$.
(b) $f = \frac{E}{h} = \frac{p^2}{2mh} = 1.46\times10^{9}1/\text{s}$.

{4} **7**

$$\lambda = \frac{hc}{\Delta E} = \frac{hc}{[2\text{eV}, 8\text{eV}, 10\text{eV}]} = [620, 155, 124]\text{nm}$$

{8} **8** $E = \frac{dV}{dx} = 2\frac{\text{V}}{\text{cm}}$

$$\Delta K + \Delta U = 0 \longrightarrow K_A - K_B + q(V_A - V_B) = 0$$

$$\longrightarrow K_A = 11\text{J} - (-3.0\text{C})(4\text{V} - 6\text{V}) = 5\text{J}$$

{4} **9**

$$\begin{aligned} 10\text{V} - (1\Omega)I_1 - (3\Omega)I_3 &= 0\\ (1\Omega)I_1 - (2\Omega)I_2 + 5V &= 0\\ (3\Omega)I_3 - 5V - (4\Omega)I_4 &= 0\\ I_0 - I_1 - I + 2 &= 0\\ I_3 + I_4 - I_0 &= 0 \end{aligned}$$

{8} **10**

(a) $Q = CV = C\frac{d\Phi}{dt} = C\frac{dB}{dt}A = C2\alpha tA = (1.5\text{mA})t$
(b) $I = \frac{dQ}{dt} = 2C\alpha A = 1.5\text{mA}$

{4} **11** Increasing $\odot_e$ so $\otimes_i$ so current is clockwise.

{4} **12**

{4} **13** $n_1\sin\theta_1 = n_2\sin\theta_2 \rightarrow$

$$1.33\sin\theta_1 = 1.0\sin10^\circ \longrightarrow \theta_1 = 7.5021^\circ$$

while

$$\frac{x}{152\text{m}} = \tan\theta_1 \longrightarrow x = 152\text{m}\tan\theta_1 = 20.0\text{m}$$

{4} **14** $\Delta x\Delta p \geq \frac{\hbar}{2} \longrightarrow \Delta v = \frac{\hbar}{2m\Delta x} = 5.8\times10^3\frac{\text{m}}{\text{s}}$

{4} **15** In the following graphs are snapshots of a wave at different times. The distances are in meters.

(a) $\lambda = 45\text{m}$
(b) $T = 3\text{s}$
(c) $v = \frac{\lambda}{T} = 15\frac{\text{m}}{\text{s}}$
(d) $\psi = 5\cos(2\pi\frac{x}{\lambda} - 2\pi\frac{t}{T})$.

{4} **16** $N = N_a + N_b + 2\sqrt{N_a}\sqrt{N_b}\cos\Delta\phi \longrightarrow$
$2500 = 1600 + 900 + 2\cdot40\cdot30\cos\Delta\phi \longrightarrow \cos\Delta\phi = 0$
So $\Delta\phi = \frac{\pi}{2}$ is one option. But $\Delta\phi = 2\pi\frac{\Delta x}{\lambda}$ so $\lambda = 4\Delta x = 4\text{cm}$.

{8} **17**

$$\begin{aligned} F_1 &= 9000\frac{2.5\cdot0.4}{5^2} = 360\text{N}\\ F_{1x} &= 360\frac{-4}{5} = -288\text{N}\\ F_{1y} &= 360\frac{3}{5} = 216\text{N}\\ F_{2x} &= 9000\frac{0.6\cdot0.4}{3^2} = 240\text{N} \end{aligned}$$

$$\begin{aligned} F_x &= -288 + 240 = -48\text{N}\\ F_y &= 216 + 0 = 216\text{N}\\ F &= \sqrt{48^2 + 216^2} = 221\text{N} \end{aligned}$$

{4} **18**

{4} **19** You have a sample of radioactive material. You set up a detector to count the emission of radiation. You measure the emission rate and find that you get 1000 emissions per second. You measure the emission rate 32.2 day later and find the emission rate is 800 per second. What is the half life of the radioactive material?
$N = N_0 2^{-t/T_{1/2}} \longrightarrow \log_2(800/1000) = -t/T_{1/2}$

$$\longrightarrow T_{1/2} = \frac{32.2\text{d}}{-\log_2(0.8)} = 100\text{d}$$

{8} **20** $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \longrightarrow d_i = \frac{1}{\frac{1}{f} - \frac{1}{d_o}} = -2.0\text{cm}$