P34.2 (a) Since the light from this star travels at 3.00×10^8 m/s

the last bit of light will hit the Earth in $\dfrac{6.44 \times 10^{18}\ \text{m}}{3.00 \times 10^8\ \text{m/s}} = 2.15 \times 10^{10}\ \text{s} = 680\ \text{years}$.

Therefore, it will disappear from the sky in the year $2\,004 + 680 = \boxed{2.68 \times 10^3\ \text{C.E.}}$.
The star is 680 light-years away.

(b) $$\Delta t = \frac{\Delta x}{v} = \frac{1.496 \times 10^{11}\ \text{m}}{3 \times 10^8\ \text{m/s}} = \boxed{499\ \text{s}} = 8.31\ \text{min}$$

(c) $$\Delta t = \frac{\Delta x}{v} = \frac{2\left(3.84 \times 10^8\ \text{m}\right)}{3 \times 10^8\ \text{m/s}} = \boxed{2.56\ \text{s}}$$

(d) $$\Delta t = \frac{\Delta x}{v} = \frac{2\pi\left(6.37 \times 10^6\ \text{m}\right)}{3 \times 10^8\ \text{m/s}} = \boxed{0.133\ \text{s}}$$

(e) $$\Delta t = \frac{\Delta x}{v} = \frac{10 \times 10^3\ \text{m}}{3 \times 10^8\ \text{m/s}} = \boxed{3.33 \times 10^{-5}\ \text{s}}$$

P34.3 $$v = \frac{1}{\sqrt{\kappa \mu_0 \epsilon_0}} = \frac{1}{\sqrt{1.78}} c = 0.750c = \boxed{2.25 \times 10^8\ \text{m/s}}$$

P34.5 (a) $f\lambda = c$

or $f(50.0\ \text{m}) = 3.00 \times 10^8$ m/s

so $\boxed{f = 6.00 \times 10^6\ \text{Hz} = 6.00\ \text{MHz}}$.

(b) $\dfrac{E}{B} = c$

or $\dfrac{22.0}{B_{max}} = 3.00 \times 10^8$

so $\mathbf{B}_{max} = \boxed{-73.3\hat{\mathbf{k}}\ \text{nT}}$.

(c) $k = \dfrac{2\pi}{\lambda} = \dfrac{2\pi}{50.0} = 0.126\ \text{m}^{-1}$

and $\omega = 2\pi f = 2\pi\left(6.00 \times 10^6\ \text{s}^{-1}\right) = 3.77 \times 10^7$ rad/s

$$\mathbf{B} = \mathbf{B}_{max} \cos(kx - \omega t) = \boxed{-73.3\cos\left(0.126x - 3.77 \times 10^7 t\right)\hat{\mathbf{k}}\ \text{nT}}.$$

P34.11 $S = I = \dfrac{U}{At} = \dfrac{Uc}{V} = uc$ $$\frac{\text{Energy}}{\text{Unit Volume}} = u = \frac{I}{c} = \frac{1\,000\ \text{W/m}^2}{3.00 \times 10^8\ \text{m/s}} = \boxed{3.33\ \mu\text{J/m}^3}$$

P34.15 Power output = (power input)(efficiency).

Thus, $$\text{Power input} = \frac{\text{Power out}}{\text{eff}} = \frac{1.00\times10^{6}\ \text{W}}{0.300} = 3.33\times10^{6}\ \text{W}$$

and $$A = \frac{\mathscr{P}}{I} = \frac{3.33\times10^{6}\ \text{W}}{1.00\times10^{3}\ \text{W/m}^2} = \boxed{3.33\times10^{3}\ \text{m}^2}.$$

P34.26 The pressure P upon the mirror is $$P = \frac{2S_{av}}{c}$$

where A is the cross-sectional area of the beam and $$S_{av} = \frac{\mathscr{P}}{A}.$$

The force on the mirror is then $$F = PA = \frac{2}{c}\left(\frac{\mathscr{P}}{A}\right)A = \frac{2\mathscr{P}}{c}.$$

Therefore, $$F = \frac{2\left(100\times10^{-3}\right)}{\left(3\times10^{8}\right)} = \boxed{6.67\times10^{-10}\ \text{N}}.$$

P34.59 Think of light going up and being absorbed by the bead which presents a face area πr_b^2.

The light pressure is $P = \frac{S}{c} = \frac{I}{c}$.

(a) $$F_\ell = \frac{I\pi r_b^2}{c} = mg = \rho\frac{4}{3}\pi r_b^3 g \quad \text{and} \quad I = \frac{4\rho gc}{3}\left(\frac{3m}{4\pi\rho}\right)^{1/3} = \boxed{8.32\times10^{7}\ \text{W/m}^2}$$

(b) $$\mathscr{P} = IA = \left(8.32\times10^{7}\ \text{W/m}^2\right)\pi\left(2.00\times10^{-3}\ \text{m}\right)^2 = \boxed{1.05\ \text{kW}}$$