Physics 30 – Lesson 5
Introduction to Light

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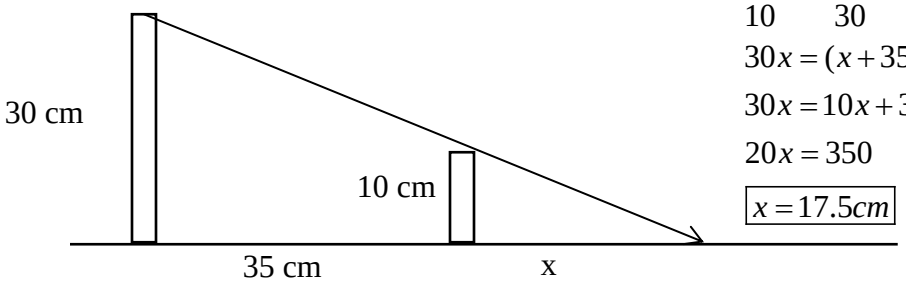
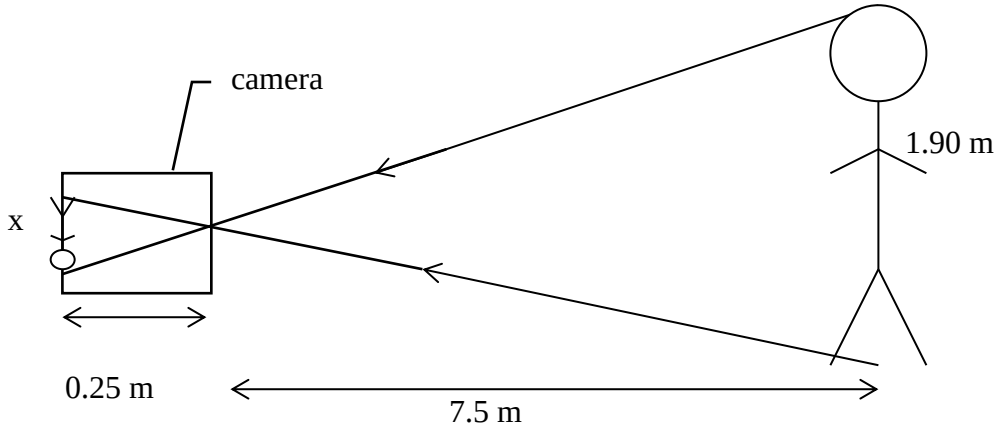
Practice problems

1)



$$\frac{x}{10} = \frac{x+35}{30}$$
$$30x = (x+35)10$$
$$30x = 10x + 350$$
$$20x = 350$$
$$\boxed{x = 17.5cm}$$

2)



$$\frac{x}{0.25} = \frac{1.90}{7.5}$$
$$x = \frac{(0.25)1.90}{7.5}$$
$$\boxed{x = 0.063m}$$

3)

$$v = \frac{\text{distance difference}}{\text{time difference}}$$
$$v = \frac{2 \times 1.5 \times 10^{11} m}{1320 s}$$
$$\boxed{v = 2.27 \times 10^{8}\ {}^{m}/_{s}}$$

4)

a. Calculate the time for one revolution – T

$$T = \frac{1}{f}$$
$$T = \frac{1}{707.1\ {}^{cycles}/_{s}}$$
$$T = 1.414 \times 10^{-3} s$$

b. Calculate the time for the light to go to and return from the reflecting mirror – 1/8th T

$$\Delta t = \tfrac{1}{6} T = \tfrac{1}{6}(1.414 \times 10^{-3} s)$$
$$\Delta t = 2.357 \times 10^{-4} s$$

$$v = \frac{\Delta d}{\Delta t}$$
$$v = \frac{2 \times 35.0 \times 10^{3} m}{2.357 \times 10^{-4} s}$$
$$\boxed{v = 2.97 \times 10^{8}\ {}^{m}/_{s}}$$

Assignment

1) $t = \frac{d}{v}$

/3 $t = \frac{2(8.7\times10^{9}m)}{3.00\times10^{8}\,{}^{m}/_{s}}$

$\boxed{t = 58s}$

2) $d = vt$

/4 $d = 3.0\times10^{8}\,\frac{m}{s}\left(\frac{3\cancel{y}}{}\times\frac{365\cancel{d}}{\cancel{y}}\times\frac{24\cancel{h}}{\cancel{d}}\times\frac{3600s}{\cancel{h}}\right)$

$\boxed{d = 2.84\times10^{16}m}$

$\boxed{d = 3ly}$

3) 10 years after it exploded

/1

4) a) $d = vt$

$d = 3.0\times10^{8}\,{}^{m}/_{s}(4.3\times365\times24\times3600s)$

$d = 4.07\times10^{16}m$

/7 $\boxed{d = 4.07\times10^{13}km}$

b) 4.3 years

c) $t = \frac{d}{v}$

$t = \frac{4.07\times10^{16}m}{10000\,{}^{m}/_{s}} = 4.07\times10^{12}s$

$\boxed{t \cong 1.3\times10^{5}\,years}$

d) $t = \frac{d}{v}$

$t = \frac{4.07\times10^{16}m}{3.00\times10^{5}\,{}^{m}/_{s}}$

$t = 1.36\times10^{11}s$

$\boxed{t \cong 4300\,years}$

5) /3

$$\Delta t = \frac{\Delta d}{v}$$

$$\Delta t = \frac{1.49\times10^{11} m}{3.00\times10^{8}\ {}^{m}/_{s}}$$

$$\boxed{\Delta t = 497 s}$$

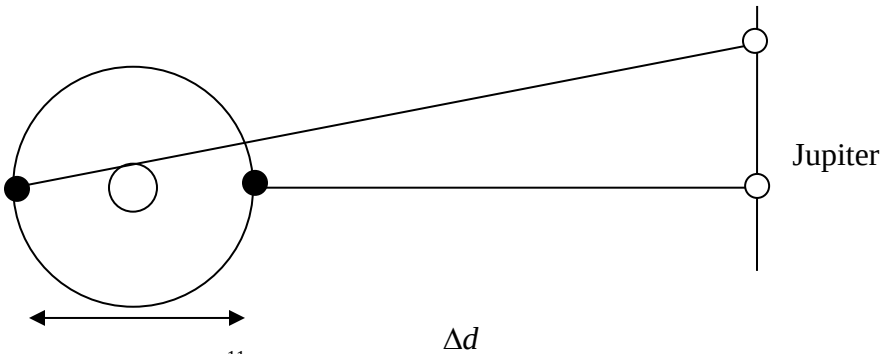
6) /3

$$\Delta t = \frac{\Delta d}{v}$$

$$\Delta t = \frac{4700 m}{3.00\times10^{8}\ {}^{m}/_{s}}$$

$$\boxed{\Delta t = 1.57\times10^{-5} s}$$

7) /4



$$\Delta d = 2\times1.49\times10^{11} m$$

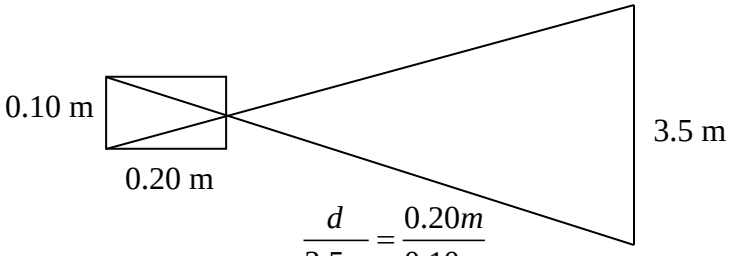
$$\Delta t = 1000 s$$

$$v = \frac{\Delta d}{\Delta t}$$

$$v = \frac{2\times1.49\times10^{11} m}{1000 s}$$

$$\boxed{v = 2.98\times10^{8}\ {}^{m}/_{s}}$$

8) /3



$$\frac{d}{3.5m} = \frac{0.20m}{0.10m}$$

$$\boxed{d = 7.0m}$$

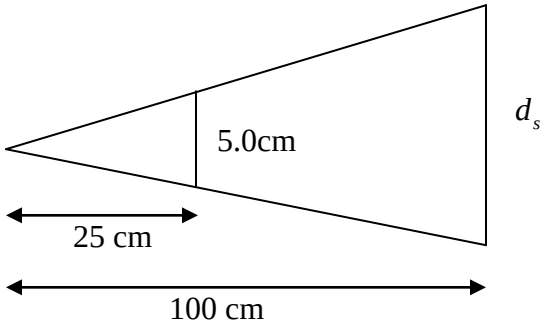
9) /2

$$\frac{h}{0.030} = \frac{300}{0.050}$$

$$\boxed{h = 180m}$$

10)

/3



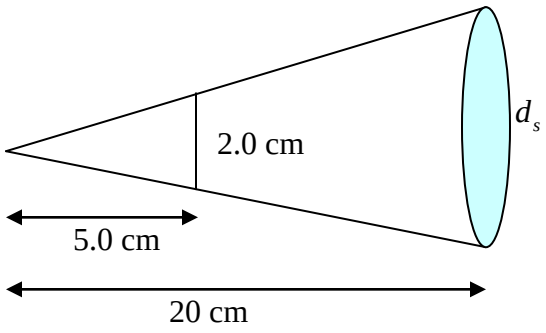
Similar Triangles

$$\frac{d_s}{100cm} = \frac{5.0cm}{25cm}$$

$$\boxed{d_s = 20cm}$$

11)

/6



Ratios

$$\frac{d_s}{20cm} = \frac{2.0cm}{5.0cm}$$

$$d_s = 8.0cm$$

$$Radius\ r_s = \tfrac{1}{2} d_s = 4.0cm$$

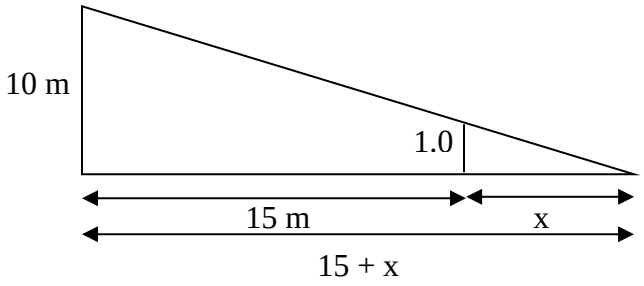
$$A = \pi r^2$$

$$A = \pi (4.0cm)^2$$

$$\boxed{A = 50.2cm^2}$$

12)

/4



Ratios

$$\frac{15 + x}{10} = \frac{x}{1.0}$$

$$15 + x = 10x$$

$$15 = 9x$$

$$\boxed{x = 1.7m}$$

13)

/4

$$d = 2 \times 450km = 9 \times 10^5 m$$

$$T = \frac{1}{f} = \frac{1}{54.15Hz} = 1.8467 \times 10^{-2} s$$

$$t_{\frac{1}{6}} = \tfrac{1}{6} T = \tfrac{1}{6}\left(1.8467 \times 10^{-2} s\right) = 3.07787 \times 10^{-3} s$$

$$v = \frac{d}{t}$$

$$v = \frac{9 \times 10^5 m}{3.07787 \times 10^{-3} s}$$

$$\boxed{v = 2.92 \times 10^8 m/s}$$

14) $\Delta d = 51.52km \times 2$

$\Delta d = 103.04km$

/6 $\Delta d = 103040m$

$$\Delta t = \frac{\Delta d}{v}$$

$$\Delta t = \frac{103040m}{3.0\times10^{8}\ {}^{m}\!/_{s}}$$

$$\Delta t = 3.43\times10^{-4}s$$

$$\Delta t_{\frac{1}{8}} = 3.43\times10^{-4}s$$

$$T = 8\times3.43\times10^{-4}s$$

$$T = 0.00275s$$

$$f = \frac{1}{T}$$

$$f = \frac{1}{0.00275s}$$

$$\boxed{f = 364Hz}$$

15) $d = 2\times35km = 7.0\times10^{4}m$

/6 $$t_{\frac{1}{5}} = \frac{d}{v} = \frac{7.0\times10^{4}m}{3.0\times10^{8}\ {}^{m}\!/_{s}} = 2.33\times10^{-4}s$$

$$T = 5\times2.33\times10^{-4} = 1.17\times10^{-3}s$$

$$f = \frac{1}{1.17\times10^{-3}s}$$

$$\boxed{f = 857Hz}$$

16) $$T = \frac{1}{f} = \frac{1}{125Hz} = 8.00\times10^{-3}s$$

/6 $$\Delta t_{\frac{1}{12}} = \tfrac{1}{12}T = \tfrac{1}{12}8.00\times10^{-3}s = 6.6667\times10^{-4}s$$

$$d = \frac{v\Delta t_{\frac{1}{12}}}{2}$$

$$d = \frac{3.0\times10^{8}\ {}^{m}\!/_{s}(6.6667\times10^{-4}s)}{2}$$

$$d = 1.0\times10^{5}m$$

$$\boxed{d = 100km}$$