Homework solutions :

Chapter 1 : 13.5 Pts total

4. (a) $[v] = [v_0] = \frac{L}{T}$

$[a] = \frac{L}{T^2}$

$[x] = L$

$\rightarrow [ax] = \frac{L^2}{T^2}$

$\rightarrow$ The dimension of ax is different from the dimensions of $[v]$ and $[v_0]$

$\rightarrow$ The equation

$$v = v_0 + ax$$

is not dimensionally correct. 1 Pt

$\rightarrow$ The equation is incorrect.

(b) $[2m] = L$

$[y] = L$

$[k] = \frac{1}{L}$

$[x] = L$

$\rightarrow [kx] = 1$ (dimensionless)

$\rightarrow \cos(kx)$ is well defined.

$[\cos(kx)] = 1$ (dimensionless)

$\rightarrow [2m \cos(kx)] = L$

$\rightarrow$ The dimension of $2m \cos(kx)$ is the same as the dimension of y

$\rightarrow$ The equation is dimensionally correct. 1 Pt

$\rightarrow$ The equation might be correct.

5. $G = F \dfrac{r^2}{Mm}$

$\rightarrow [G] = \left[F \dfrac{r^2}{Mm}\right] = \dfrac{ML \cdot L^2}{T^2 \cdot M^2} = \dfrac{L^3}{T^2 M}$

$\rightarrow$ The SI units of G are $\underline{\dfrac{m^3}{s^2\,kg}}$. 1 Pt

8. $3.456\,m + 4.3\,m = 7.756\,m \approx \underline{7.8\,m}$ (since 4.3 m has only one digit beyond the decimal point.

1 Pt

12. (a) $\ell = 2\pi \cdot 3.5\,cm = 21.99\,cm \approx \underline{22\,cm}$. 0.5 Pt

(b) $A = \pi \cdot (4.65\,cm)^2 = 67.929\,cm^2 \approx \underline{67.9\,cm^2}$. 0.5 Pt

17. $325\,mg = \underline{3.25 \cdot 10^{-1}}\,g$ 0.5 Pt

18. $\dfrac{1}{32}\,\dfrac{in}{day} = \dfrac{2.54\,cm}{32 \cdot 24 \cdot 3600\,s} = 9.187 \cdot 10^{-9}\,\dfrac{m}{s} \approx \underline{9.2\,\dfrac{nm}{s}}$ 1 Pt

$\rightarrow$ The proteins are assembled at a rate of about 100 layers per second!

28. You can count for about 16 hours per day

$\rightarrow$ You can count $16 \cdot 3600 = 57{,}600$ \$1 bills per day.

$\rightarrow$ Counting \$$1 \cdot 10^9$ takes $1.7 \cdot 10^4$ days

$\rightarrow$ Counting \$$1 \cdot 10^9$ takes about 50 years $= \underline{5 \cdot 10 \text{ years}}$ 1 Pt

$\rightarrow$ Don't accept if you are older than 25 years!

34. There are about $250 \cdot 10^6$ consumers in the US. Assume each of them is drinking one can of soft drink every day, then this is

$365 \cdot 250 \cdot 10^6$ cans per year

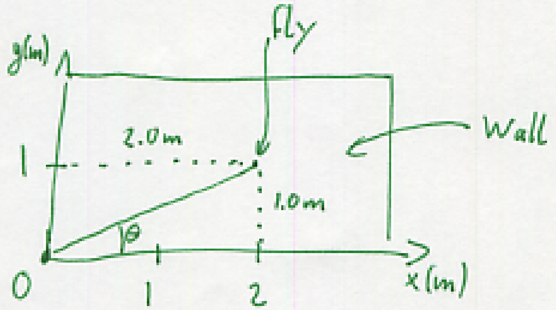
i.e. $9 \cdot 10^{10} \approx 10^{11}$ cans per year.

If each can weighs 20 g, this is

$1.8 \cdot 10^9$ kg, i.e. $1.8 \cdot 10^6$ tons $\approx$ $\underline{10^6 \text{ tons}}$ (1 Pt)

(Anything between 10^5 and 10^7 tons is ok.
Anything between 10^{10} and 10^{12} cans per year is ok)

36.



$d^2 = (2.0\,m)^2 + (1.0\,m)^2 = 5.0\,m^2$

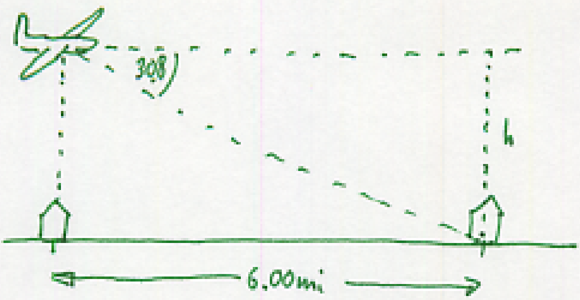
$\underline{d = 2.2\ m}$. (1 Pt)

37. $\tan\theta = \frac{1.0\,m}{2.0\,m} = \frac{1}{2}$

$\rightsquigarrow \theta = 26.6° \approx 27°$

$\rightsquigarrow$ Polar coordinates: $\underline{(2.2\,m;\ 27°)}$ (1 Pt)

51.



$$\tan 30.0° = \frac{h}{6.00\,\text{mi}}$$

$$h = 6.00\,\text{mi} \tan 30.0° = 3.46\,\text{mi}$$

→ The airplane is at an altitude of 3.46 miles (1 Pt)

55. (a) There are $365 \cdot 24 \cdot 3600\,\text{s} = 31536000\,\text{s} \approx 3.16 \cdot 10^7$ per year (0.5 Pt)

(b) A micrometeorite has the volume of about

$$(10^{-6}\,\text{m})^3 = 10^{-18}\,\text{m}^3$$

A box of 1 m each side has a base area of $1\,\text{m}^2$ and a volume of $1\,\text{m}^3$.

There fit 10^{18} micrometeorites in the box.

→ It takes 10^{18} s to fill the box.

→ It takes $3 \cdot 10^{10}$ years $\approx$ 10^{10} years to fill the box.

(1.5 Pt)

Homework solutions:

Chapter 2: 9.5 Pts total

2. (a) $\frac{20\,ft}{year} = \frac{20\,m}{3.281 \cdot 365 \cdot 24 \cdot 3600\,s} = 1.93 \cdot 10^{-7}\,\frac{m}{s} \approx$ 2 [illegible] $\cdot 10^{-7}\,\frac{m}{s}$ 0.5 Pt

$100\,\frac{ft}{year} \approx$ 1 [illegible] $\cdot 10^{-6}\,\frac{m}{s}$ 0.5 Pt

(b) $v = \frac{\Delta x}{\Delta t}$

$\curvearrowright \Delta t = \frac{\Delta x}{v} = \frac{3000\,mi}{10\,mm/year} = \frac{3000 \cdot 1609\,m}{10 \cdot 10^{-3}\,m}\,yr = 483 \cdot 10^{6}\,yr \approx 4.8 \cdot 10^{8}\,yr.$

1 Pt

6. (a) $\overline{v_{0,2}} = \frac{10.0\,m}{2.0\,s} = 5.00\,\frac{m}{s}$ 0.5 Pt

(b) $\overline{v_{0,4}} = \frac{5.00\,m}{4.00\,s} = 1.25\,\frac{m}{s}$ 0.5 Pt

(c) $\overline{v_{2,4}} = \frac{5.00\,m - 10.00\,m}{4.00\,s - 2.00\,s} = -2.50\,\frac{m}{s}$ 0.5 Pt

(d) $\overline{v_{4,7}} = \frac{-5.00\,m - 5.00\,m}{7.00\,s - 4.00\,s} = -3.33\,\frac{m}{s}$ 0.5 Pt

(e) $\overline{v_{0,8}} = \frac{0\,m - 0\,m}{8.00\,s} = 0.00\,\frac{m}{s}$ 0.5 Pt

9. (a) forward motion only: Graphs a, e, f 0.5 Pt

(b) backward motion only: Graphs c 0.5 Pt

(c) constant velocity: Graphs d, f 0.5 Pt

(d) greatest constant velocity: Graph f 0.5 Pt

(e) no movement: Graph d 0.5 Pt

12. Tortoise: $x_T = v_T\, t$

Hare: $x_H = v_H \cdot (t - 2.0\,min) = 20 \cdot v_T \cdot (t - 2.0\,min)$

$x_T = x_H + 20\,cm$

$\curvearrowright v_T \cdot t = 20 \cdot v_T\,(t - 2.0\,min) + 20\,cm.$

$19 \cdot v_T\, t = 20 \cdot v_T \cdot 2.0\,min - 20\,cm$

(a) $t = \frac{20 \cdot 0.10\,\frac{m}{s} \cdot 2.0 \cdot 60\,s - 0.20\,m}{19 \cdot 0.10\,\frac{m}{s}} = 126\,s \approx 1.3 \cdot 10^{2}\,s$ 2 Pt

(b) $\Delta x_T = 1.3 \cdot 10^{2}\,s \cdot 0.10\,\frac{m}{s} = 13\,m.$ 0.5 Pt