Physics 160: Hw #2

Mastering Physics: 6 problems

Written: 2.75

Sig. Fig Conceptual Question

Part A: A: 2.567 km to two Sig Fig

B: 2.567 km to 3 Sig Fig

A: 2.567 km to 2sg Fig = 2.6 km

B: 2.567 km to 3sg Fig = 2.57 km

$\Rightarrow$ A > B

Part B: A: (2.567 km + 3.146 km) to 2sg Fig

B: (2.567 km to 2sg Fig) + (3.146 to 2sg Fig)

$\Rightarrow$ A $\Rightarrow$ Add First then Round

2.567 km + 3.146 km = 5.713 km = 5.7 km

B $\Rightarrow$ Round First then Add

2.6 km + 3.1 km = 5.7 km $\Rightarrow$ A = B

PART C: A: Area of 2.536m by 1.4m

B: Area of 2.536m by 1.41m

USE RULES ⇒ ROUND TO Fewest # of Sig Fig

A: $(2.536m)(1.4m) = 3.5504m^2 = 3.6m^2$

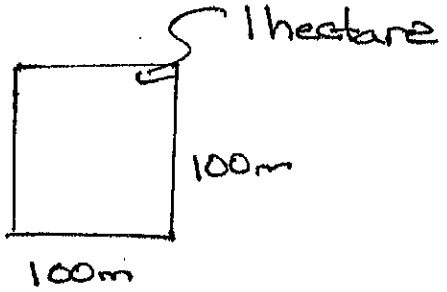
2 sig fig

B: $(2.536m)(1.41m) = 3.57576m^2 = 3.56m^2$

3 sig fig

⇒ A > B

1.6



$1 acre = 43600 ft^2$

Country lot of 12 acres. How many hectares?

$1 hectare = (100m)(100m) = 1 \times 10^4 m^2$

We need conversion from ft^2 to m^2

$1m = 3.281 ft \Rightarrow 1m^2 = 1m \times 1m = (3.281 ft) \times (3.281 ft)$

$\Rightarrow 1m^2 = (3.281)^2 ft^2 = 10.765 ft^2$

$$\therefore 12 acre \times \frac{43600 ft^2}{acre} \times \frac{1 m^2}{10.765 ft^2} \times \frac{1 hectare}{1 \times 10^4 m^2} = 4.86 hectares$$

1.11 Neptunium

$M_c = 60\,kg$ ← CRITICAL MASS

DENSITY, $\rho = 19.5\,g/cm^3$.

WHAT IS RADIUS OF (60 kg) SPHERE?

THINK OF THE DENSITY AS A CONVERSION FACTOR (THIS CAN SOMETIMES GET YOU INTO TROUBLE, BUT IT WORKS HERE)

$$\Rightarrow 19.5\,g = 1\,cm^3$$

$$\Rightarrow 60\,kg \times \frac{1000\,g}{kg} \times \frac{1\,cm^3}{19.5\,g} = 3076.923\,cm^3 \leftarrow \text{VOLUME OF SPHERE}$$

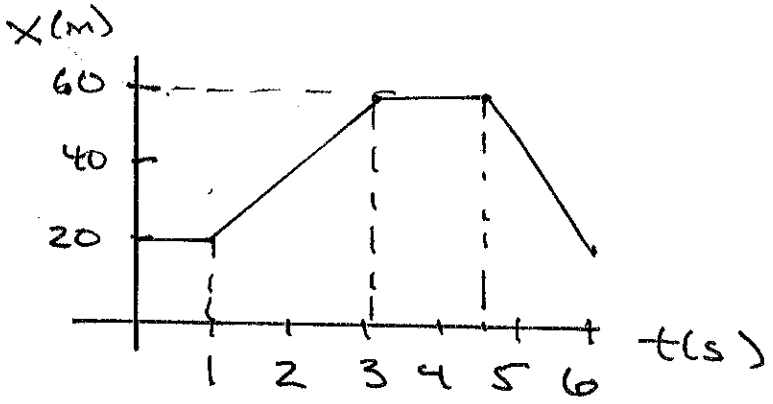
$V = \frac{4}{3}\pi r^3$ FOR A SPHERE $\Rightarrow r = \left[\frac{3(3076.923\,cm^3)}{4\pi}\right]^{1/3}$

$$\Rightarrow r = 9.022\,cm = 9\,cm$$

↑

1 Sig Fig IF BEING CAREFUL

Average Velocity From position vs. time graph



A: $V_{ave[0,1]} = ?$ Always going to use $V_{AV} = \frac{\Delta x}{\Delta t}$

For $0 \le t \le 1$, $x_2 = x_1 = 20m \Rightarrow \Delta x = 0 \Rightarrow V_{AV} = 0$

B: $1 \le t \le 3s$: $x_2 = 60m$, $x_1 = 20m \Rightarrow \Delta x = 40m$

$\Delta t = 3s - 1s = 2s \Rightarrow V_{AV} = \frac{40m}{2s} = 20m/s$

C: Careful! Now wants $0 \le t \le 3s$

$\Rightarrow x_2 = x|_{3s} = 60m$, $x_1 = x|_{0s} = 20m \Rightarrow \Delta x = 40m$

$\Delta t = 3s - 0 = 3s \Rightarrow V_{AV} = \frac{40m}{3s} = 13.3m/s$ to 3 sig figs

D: $3s < t < 6s$ $\quad X_2 = X|_{6s} = 20m$

$X_1 = X|_{3s} = 60m$

$\Rightarrow \Delta X = 20m - 60m = -40m$

$\Delta t = 6s - 3s = 3s$

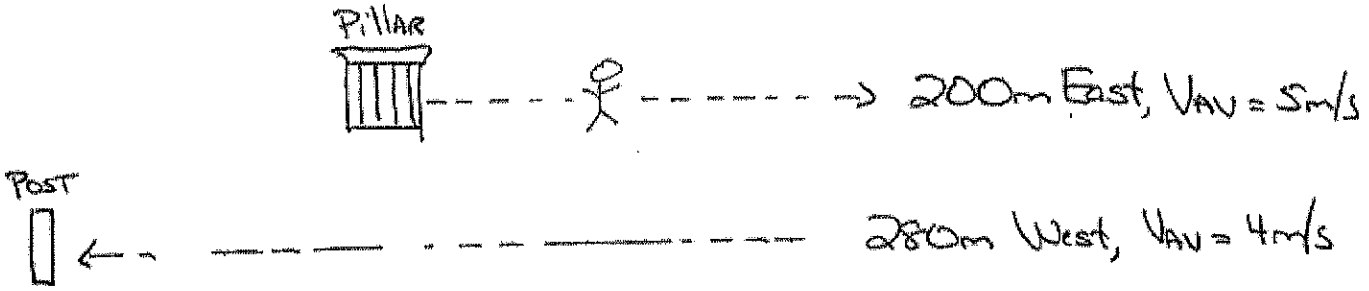
$\Rightarrow V_{AV} = \frac{-40m}{3s} = -13.3 m/s$

E: Whole Graph: $0 < t < 6s$

$\Rightarrow X_2 = X|_{6s} = 20m, \quad X_1 = X|_0 = 20m$

$\Rightarrow \Delta X = 0 \Rightarrow V_{AV} = 0$

2.4



a) WHAT IS AVERAGE SPEED? CAREFUL HERE: AVG SPEED = $\frac{\text{TOTAL DISTANCE}}{\text{ELAPSED TIME}}$

DISTANCE ALWAYS POSITIVE $\Rightarrow$ TOTAL DISTANCE = 200m + 280m = 480m

ELAPED TIME = ? $\quad$ SPEED = $\frac{\text{DISTANCE}}{\text{TIME}}$ $\Rightarrow$ TIME = $\frac{\text{DISTANCE}}{\text{SPEED}}$

TIME TO GO EAST: $t_E = \frac{200m}{5m/s} = 40s$, GO WEST: $t_W = \frac{280m}{4m/s} = 70s$

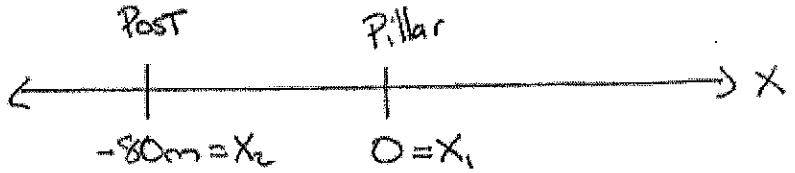
TOTAL TIME = $t_E + t_W = 110s$ $\Rightarrow$ **AVG. SPEED = $\frac{480m}{110s} = 4.4m/s$**

b) WHAT IS AVERAGE VELOCITY? $V_{AV} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{\Delta t}$

x_2 = FINAL POSITION FOR ENTIRE TRIP $\Rightarrow x_2$ = POST

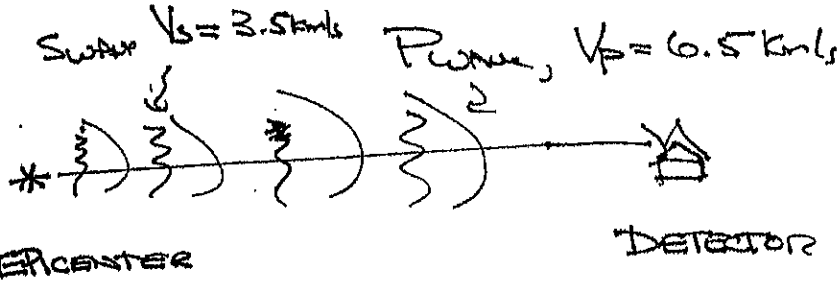
x_1 = INITIAL POSITION FOR ENTIRE TRIP $\Rightarrow x_1$ = PILLAR

Δt = ELAPED TIME FOR ENTIRE TRIP $\Rightarrow \Delta t = 110s$.



$V_{AV} = \frac{-80m}{110s} = -.7m/s$

2.59



P WAVE ARRIVES 33s BEFORE S WAVE

HOW FAR IS DETECTOR?

BOTH WAVES MOVE WITH CONSTANT SPEED ⇒

$V_p = \frac{d_p}{\Delta t_p}$ $\quad V_s = \frac{d_s}{\Delta t_s}$ $\quad (d_p = d_s = d = \text{DISTANCE FROM EPICENTER TO DETECTOR})$

↑ PRIMARY DISTANCE & ELAPSED TIME

↑ SECONDARY DISTANCE & ELAPSED TIME

PRIMARY ARRIVES FIRST ⇒ $\Delta t_s = \Delta t_p + 33s$

$\therefore \quad 6.5 km/s = \frac{d}{\Delta t_p}, \quad 3.5 km/s = \frac{d}{\Delta t_p + 33s}$

$d = (6.5 km/s)\,\Delta t_p \qquad d = (3.5 km/s)(\Delta t_p + 33s)$

$= (3.5 km/s)\,\Delta t_p + 115.5 km$

UNITS: $\frac{km}{s} \times s = km$

Equal distances $\Rightarrow$

$$(6.5\,km/s)\,\Delta t_p = (3.5\,km/s)\,\Delta t_p + 115.5\,km$$

$$\Rightarrow (6.5\,km/s)\,\Delta t_p - (3.5\,km/s)\,\Delta t_p = 115.5\,km$$

$$\Rightarrow (3\,km/s)\,\Delta t_p = 115.5\,km$$

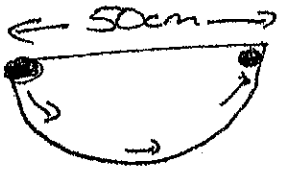
$$\Rightarrow \Delta t_p = \frac{115.5\,km}{3\,km/s} = 38.5\,s$$

Units: $km\left(\frac{s}{km}\right) = s$

$$d = (6.5\,km/s)\,\Delta t_p = (6.5\,km/s)(38.5\,s) = 250.25\,km$$

$$= \underline{250\,km}$$

2.75



Rolls from one side to the other in 10s

a) Find Average speed.

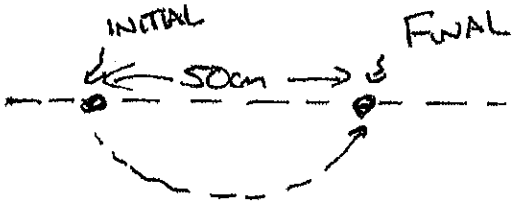
$SP_{AV} = \frac{d}{\Delta t}$ $\Delta t = 10s$. $d = \frac{1}{2}$ of Circle's Circumference

$\Rightarrow d = \frac{1}{2}(2\pi r) = \pi r$. $r = \frac{1}{2}(50cm) = 25cm$

r = radius

$\Rightarrow SP_{AV} = \frac{\pi(25cm)}{10s} = \pi(2.5cm/s) = \underline{7.85cm/s}$

b) Find Average Velocity. $V_{AV} = \frac{\Delta x}{\Delta t}$



NOTE: We can cheat and do this problem here because the Displacement is in a straight line!

$\Delta x = 50cm \Rightarrow V_{AV} = \frac{50cm}{10s} = 5cm/s$