note: boxed #'s are #'s in red given in the problem set.

Problem set #1

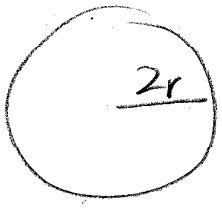
1) Given: Dr. increases radius by a factor of [2]

Question: By what factor does cross-sectional area of artery change?

Solution:

Before

After



Area $= \pi r^2$

where r = radius of circle

$A = \pi (r)^2$

$= \pi r^2$

$A = \pi (2r)^2$

$= 4\pi r^2$

Answer: increases by factor of (4)

2) Given: $P = \frac{V^2}{R}$ P = power V = voltage R = resistance

Resistance of bulb B is [10%] greater than resistance of A

↳ in eqtn form → $R_B = (1.1) R_A$ (Eqtn. 1)

Question: what is ratio $\frac{P_B}{P_A}$ of power drawn by bulb B to power drawn by bulb A if line voltages are same? ($V_A = V_B$)

Solution: $\frac{P_B}{P_A} = \frac{V_B^2/R_B}{V_A^2/R_A}$

$\Rightarrow$ if $V_B = V_A$

$= \left(\frac{V_B^2}{R_B}\right)\left(\frac{R_A}{V_A^2}\right) = \frac{R_A}{R_B}$

$\Rightarrow$ Plug in Eqtn. 1 $(R_B = (1.1)R_A$

$= \frac{R_A}{(1.1)R_A} = \frac{1}{1.1} = .909$

3) Question: write answers to prob. w. appropriate # of sig. figs.

Solution: refer to rules of sig. figs. on pg. 7 of text.

a) 6.55×10^{-5}
$+ 4.4 \times 10^{-7}$

6.55×10^{-5}
$+ .044 \times 10^{-5}$
$6.594 \times 10^{-5} \rightarrow 6.59 \times 10^{-5}$
(2 sig figs)

b) 702.56
+ 1855.862
2558.422 → 2558.42
2 sig figs.

c) 6.0
× 4.0
24.00 → 24

d) .08/π (1 sig fig)
= .0254
= .03

e) .080/π (2 sig figs)
= .02546
= .025

4) Given: blue whale → mass = $\boxed{2.2\times10^5\ kg}$

Avg. density = $.85\ \frac{g}{cm^3}$ = $\frac{mass}{vol.}$

Question: what was vol. in m^3?

Solution:

conversns: $2.2\times10^5\ kg \times \frac{1000\ gram}{1\ kg} = 2.2\times10^8\ g$

$1\ cm^3 \times \frac{1\ m^3}{1\times10^{-6}\ cm^3} = 1\times10^{-6}\ m^3$

set up a ratio:

$\frac{.85\ g}{1\times10^{-6}\ m^3} = \frac{2.2\times10^8\ g}{vol} \rightarrow vol =$ answer: $\boxed{259\ m^3}$

5) Given: freq. is measured & used to calc. total mass m

spring constant k is measured in $\frac{kg}{s^2}$

$f = .50\ \frac{1}{s}$ for a $\boxed{62\ kg}$.

mass of chair $\boxed{10.0\ kg}$

Question: what is chair's freq for a $\boxed{75\ kg}$ astronaut?

Solution:

* use dimension analysis * include mass of chair!

$k = \frac{kg}{s^2} = \frac{mass}{(freq)^2} = \frac{(62+10)\ kg}{(.50)^2 s^2} \overset{\checkmark\ m_{chair}}{=} 288\ \frac{kg}{s^2}$

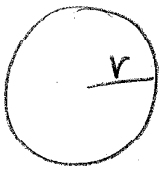
$freq = \sqrt{\frac{mass}{k}} = \sqrt{\frac{75kg+10kg}{288\ kg/s^2}} =$ $\boxed{.54\ \frac{1}{s}}$ answer

6) Given: radius of circular garden plot is increased by 35%

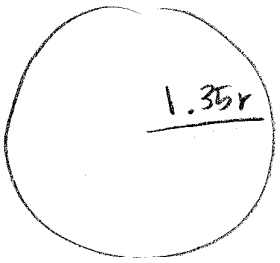
Question: By what percentage does area of garden increase?

solution:

Before



After



$A = \pi r^2$

r = radius

$A = \pi (r)^2$

$= \pi r^2$

$A = \pi (1.35r)^2$

$= 1.8225 \pi r^2$

Answer: increases by 82.3 %

7) Given: marathon race is $\approx$ 25 miles long

Question: What is length of race in km?

solution:

unit conversion

$$25 \text{ miles} \times \frac{1609 \text{ m}}{1 \text{ mile}} \times \frac{.001 \text{ km}}{1 \text{ m}} = 40.2 \text{ km}$$

Answer

8) Given: Furlong = 220 yards Fortnight = 14 days (5)

Question: How fast is $\frac{1 \text{ Furlong}}{1 \text{ fortnight}}$? a) in $\frac{\mu m}{s}$ b) in $\frac{km}{day}$

Solution:

a) unit conversion

$$\frac{1 \text{ furl}}{1 \text{ fort}} = \frac{220 \text{ yards}}{14 \text{ days}}$$

$$\frac{220 \text{ yards}}{14 \text{ days}} \times \frac{.9144 m}{1 \text{ yd}} \times \frac{10^{-6} \mu m}{1 m} \times \frac{1 \text{ day}}{86400 s}$$

$$= \boxed{166 \frac{\mu m}{s}}$$

answer

b) unit conversion

$$\frac{220 \text{ yds}}{14 \text{ days}} \times \frac{.9144 m}{1 \text{ yrd}} \times \frac{.001 km}{1 m} = \boxed{.0144 \frac{km}{day}}$$

answer

9) given: $W = Fd$ W = work, F = mag. of force, d = distance ($1 N = 1 kg \cdot \frac{m}{s^2}$)

Question: find SI unit of work
i) in base units only &
ii) using Newton

solution:

i) $W = Fd = \boxed{[N \cdot m]}$ ← answer →

ii) $= [N \cdot m] = \left[1 kg \cdot \frac{m}{s^2}(m)\right] = \boxed{\left[kg \cdot \frac{m^2}{s^2}\right]}$

10] Given: patient's temp = 97.0°F @ 8:05 am
& 101.0°F @ 12:05 pm

Question: If ΔT with respect to elapsed time was linear throughout day, what would patient's temp be @ 3:35 pm?

Solution: $y = mx + b$ (line eqtn)

Find change in temp from given values:

$m = \frac{\Delta y}{\Delta x}$ ← with respect to time

T = temp = y
t = time = x

$$\frac{(T_f - T_i)}{(t_f - t_i)} = \frac{\Delta T}{\Delta t} = \frac{4°F}{4\ hrs} = m \text{ (slope)} = 1$$

know linear (slope is 1) throughout day

So @ 3:35, 3.5 hrs have passed since 12:05 pm.

$T = m(t) + b$ $\quad b = 0$

$T = (1)(3.5)$ $\quad m = 1$

$= 3.5°F$ $\quad t = 3.5\ hrs$

$T = 101.0°F + 3.5°F = 104.5°F$

answer