Assignment #18 3/21/2001

$\boxed{22.1}$

#1 a) $t = 9$ (rate is greater than 15)

b) $t = 12$ (people come in most rapidly)

c) $t = 3$ (people come in faster than 15 and add to the line until 3 o'clock)

d) assume they treat 15 people per hour. Calculate how many people come in, in addition to 15 per hour

$\approx 8 \times 15 = \boxed{120}$

e) line longest with 120 people.

to treat everyone in line takes $\dfrac{120 \text{ people}}{\left(15 \frac{\text{people}}{\text{hr}}\right)} \approx \boxed{8 \text{hrs}}$

f) It is approximately 110 people. Line decreased a little between 3 and 4 o'clock.

g) total area under curve

$\approx (15 \text{ squares})\left(15 \frac{\text{people/hr}}{\text{square}}\right) \approx \boxed{225 \text{ people}}$

* these are just approximations!

#2 a) for upper bound, assume that the faster rate is held for the duration of each 2-second interval!

$\left(10 \frac{\text{in cm}^3}{\text{sec}}\right)(2\text{sec}) + \left(9 \frac{\text{in cm}^3}{\text{sec}}\right)(2\text{sec}) + (7)(2) + (4)(2) =$

$\boxed{60 \text{ cm}^3}$

b) assume lower rate is held for each 2-sec interval.

$\left(9 \frac{\text{in cm}^3}{\text{sec}}\right)(2\text{sec}) + (7)(2) + (4)(2) + 2(2) = \boxed{44 \text{ cm}^3}$

#3 a) similar to # 2

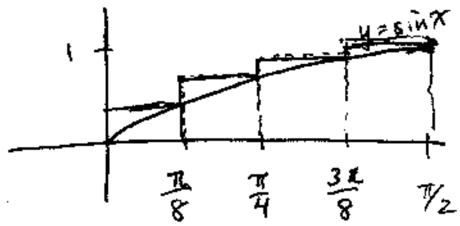
upper bound $= \left(12 \frac{\text{in grams}}{\text{min}}\right)(3\text{ min}) + (20)(4\text{ min}) + (23)(3) + (25)(3)$

$= \boxed{260 \text{ grams}}$

lower bound $= (10)(3) + (12)(4) + (20)(3) + (23)(3)$

$= \boxed{207 \text{ grams}}$

#4 a) upper bound:

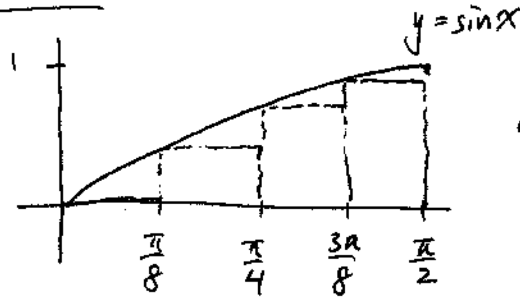


for upper bound, can approximate area under the curve by drawing the right-hand approximation rectangles. Then, add the areas of the rectangles. The base of each rectangle $= \frac{\pi}{8}$ height depends which rectangle

$$\text{upper bound} = \left(\frac{\pi}{8}\right)\left(\sin\frac{\pi}{8}\right) + \left(\frac{\pi}{8}\right)\left(\sin\frac{\pi}{4}\right) + \left(\frac{\pi}{8}\right)\left(\sin\frac{3\pi}{8}\right) + \left(\frac{\pi}{8}\right)\left(\sin\frac{\pi}{2}\right)$$

$$0.15 + 0.28 + 0.36 + \frac{\pi}{8} = \boxed{1.18}$$

lower bound

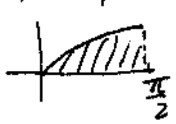


use left-hand approximation and add rectangles' areas

$$\text{lower bound} = \left(\frac{\pi}{8}\right)(0) + \left(\frac{\pi}{8}\right)\left(\sin\frac{\pi}{8}\right) + \left(\frac{\pi}{8}\right)\left(\sin\frac{\pi}{4}\right) + \left(\frac{\pi}{8}\right)\left(\sin\frac{3\pi}{8}\right)$$

$$= 0 + 0.15 + 0.28 + 0.36 = \boxed{0.79}$$

b) from part (a)



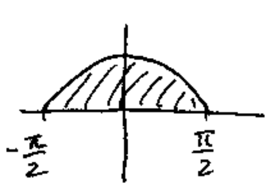
now, $0 \le x \le \pi$

area is double

upper bound $= 2(1.18) = 2.36$

lower bound $= 2(0.79) = 1.58$

c) $\cos x$, with $-\frac{\pi}{2} \le x \le \frac{\pi}{2}$



same area as $y = \sin x$ with $0 \le x \le \pi$

upper $= 2.36$

lower $= 1.58$

#8 a) $v(t) = t^2$

distance traveled = time × velocity

from $t=0$ to $t=1$

$$D_{Lower} = (1\,sec)(0\ ft/sec) = 0$$

$$D_{upper} = (1\,sec)(1\ ft/sec) = 1\ ft$$

from $t=1$ to $t=2$

$$D_{lower} = (1\,sec)(1\ ft/sec) = 1\ ft$$

$$D_{upper} = (1\,sec)(2^2\ ft/sec) = 4\ ft$$

from $t=2$ to $t=3$

$$D_{Lower} = (1\,sec)(4\ ft/sec) = 4\ ft$$

$$D_{upper} = (1\,sec)(3^2\ ft/sec) = 9\ ft$$

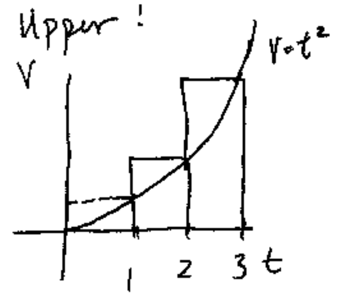
D_{Lower} from $t=0$ to $t=3$

$$= 0+1+4 = \boxed{5\ ft}$$

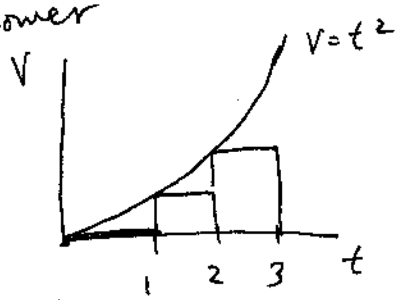
D_{upper} from $t=0$ to $t=3$

$$= 1+4+9 = \boxed{14\ ft}$$

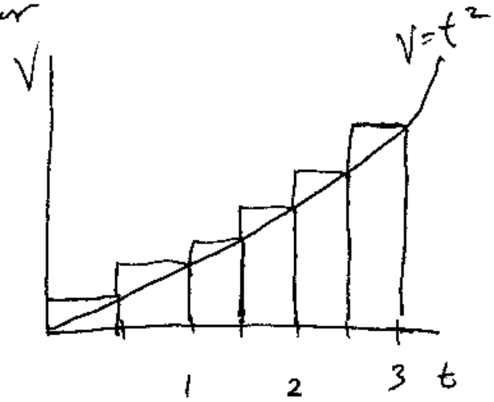
b) Upper!



Lower



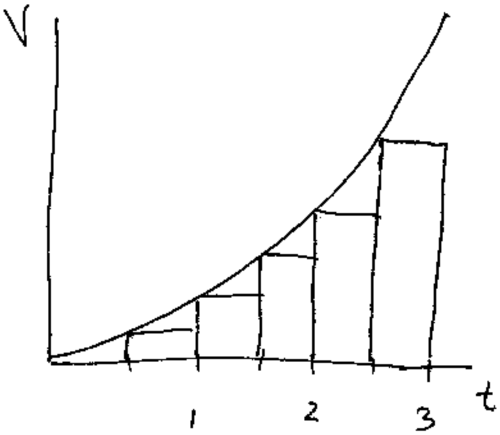
c) Upper



Add up rectangles:

$$\left(\tfrac{1}{2}\right)(0.5^2)+\left(\tfrac{1}{2}\right)(1^2)+\left(\tfrac{1}{2}\right)(1.5^2)$$
$$+\left(\tfrac{1}{2}\right)(2^2)+\left(\tfrac{1}{2}\right)(2.5^2)+\left(\tfrac{1}{2}\right)(3)^2$$
$$=\boxed{11.38}$$

Lower



Add up rectangles:

$$\left(\tfrac{1}{2}\right)(0)+\left(\tfrac{1}{2}\right)(0.5^2)+\left(\tfrac{1}{2}\right)(1^2)$$
$$+\left(\tfrac{1}{2}\right)(1.5^2)+\left(\tfrac{1}{2}\right)(2^2)+\left(\tfrac{1}{2}\right)(2.5^2)$$
$$=\boxed{6.88}$$