Rate In/ Rate Out

a.) $\int_0^{12} H(t)\,dt = 70.570$ or 70.571

1.

A tank contains 125 gallons of heating oil at time $t = 0$. During the time interval $0 \le t \le 12$ hours, heating oil is pumped into the tank at the rate

(in) $$H(t) = 2 + \frac{10}{(1 + \ln(t+1))} \text{ gallons per hour.}$$

During the same time interval, heating oil is removed from the tank at the rate

(out) $$R(t) = 12\sin\left(\frac{t^2}{47}\right) \text{ gallons per hour.}$$

(a) How many gallons of heating oil are pumped into the tank during the time interval $0 \le t \le 12$ hours?

(b) Is the level of heating oil in the tank rising or falling at time $t = 6$ hours? Give a reason for your answer.

(c) How many gallons of heating oil are in the tank at time $t = 12$ hours?

(d) At what time t, for $0 \le t \le 12$, is the volume of heating oil in the tank the least? Show the analysis that leads to your conclusion.

*See printout.

b) $H(6) = 5.394$ in

$R(6) = 8.318$ out

Since $R(6) > H(6)$ the oil level is falling

$H(6) - R(6) = -2.924 < 0$

Oil level is falling

t	
0	125
11.318	$125+\int_0^{11.318}(H(t)-R(t))\,dt$ $=120.738$
12	122.026

$\boxed{t=11.318}$

compare gallons and write the time that is minimized

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*See printout.

c.) initial + net change

$$125 + \int_0^{12} (H(t) - R(t))\,dt$$

122.026

5.

Water is pumped into an underground tank at a constant rate of 8 gallons per minute. Water leaks out of the tank at the rate of $\sqrt{t+1}$ gallons per minute, for $0 \le t \le 120$ minutes. At time $t = 0$, the tank contains 30 gallons of water.

(a) How many gallons of water leak out of the tank from time $t = 0$ to $t = 3$ minutes?

(b) How many gallons of water are in the tank at time $t = 3$ minutes?

(c) Write an expression for $A(t)$, the total number of gallons of water in the tank at time t.

(d) At what time t, for $0 \le t \le 120$, is the amount of water in the tank a maximum? Justify your answer.

a.) $\int_0^3 \sqrt{t+1}\,dt$

b.) $30 + \int_0^3 (8 - \sqrt{t+1})\,dt$

c.) $A(t) = 30 + \int_0^t (8 - \sqrt{x+1})\,dx$

d.) $A'(t) = 8 - \sqrt{t+1}$

$64 = t+1$

$+$ $-$

0 63 120

Since there is only one critical number ($t = 63$) and $a'(t)$ changes from positive to negative at $t = 63$ on the interval $(0, 120)$, $t = 63$ is the absolute maximum.