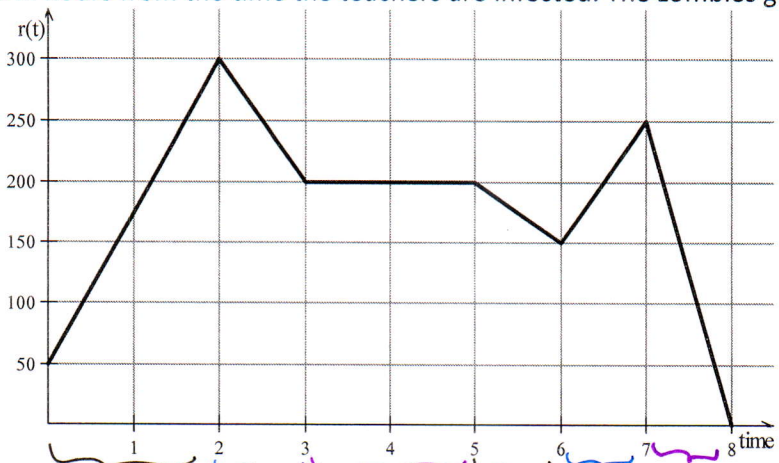
AP Calculus
Zombie Apocalypse Part 2

Name: Key
Date: _____ Per: ___

An evil former student who failed calculus (but passed AP Chemistry) has create a virus and infected all the teachers at Southwest High School. Initially 64 teachers were infected at 7 am ($t = 0$). The Zombie virus is passed through being poked by a special teacher appreciation day pen. The teachers are infecting students at a rate of 3 students per hour. Unfortunately, the student only got a 3 on the AP exam so his virus isn't foolproof, the Zombies are dying off at the rate r(t) shown in the graph below. Time, t, is measured in hours from the time the teachers are infected. The zombies get off work at 3 pm.



$\frac{300+50}{2} \cdot 2$ $\quad 2(200)$ $\quad \frac{150+250}{2}$

$\frac{300+200}{2} \cdot 1$ $\quad \frac{200+150}{2} \cdot 1$ $\quad \frac{1}{2}(1)(250)$

$350 + 250 + 400 + 175 + 200 + 125$

(a) How many zombies were made in the first 2 hours? How many zombies are there after 2 hours?

rate of zombies created

64 teachers $\times$ 3 $\frac{\text{students}}{\text{hour}}$ $\times$ 2 hours = 384 zombies made

64.3 zombies/hr = 192

64 + 384 = 448 zombies total

Start w/ | accumulate

$* \int_0^2 192\,dt = 192t\Big]_0^2$

(b) How many zombies died in the first 4 hours?

$\int_0^4 r(t)\,dt = 350 + 250 + (1)(200) = 800$ zombies died

(c) How many zombies are "alive" after 4 hours?

Zombies created = $\int_0^4 192\,dt = 192t\Big]_0^4 = 192(4-0) = 768$

+

Zombies initially = 64

−

Zombies died = $\int_0^4 r(t)\,dt = 800$

$768 + 64 - 800 = 32$ zombies

(d) Are all the zombies dead at the end of the day? If no, how many are left to come back tomorrow?

$\int_0^8 192\,dt = 192t\Big]_0^8 = 192(8-0) = 1536$

total zombies
1536 + 64 = 1600

$\int_0^8 r(t)\,dt = 350 + 250 + 400 + 175 + 200 + 125 = 1500$

total dead zombies
= 1500

NO, There are 1600 − 1500 = 100 zombies left.

(e) Is the number of zombies "alive" increasing or decreasing between $t = 4$ and $t = 5$?

Zombies alive = Zombies Created − Zombies dead

rate > 0 inc
< 0 dec

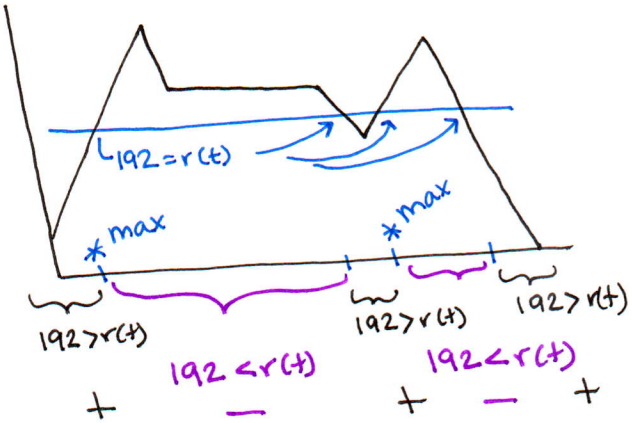
rate of zombies alive = rate of zombies Created − rate of dead zombies

192 − r(t) = 192 − 200 < 0

between t=4 +5 r(t)=200

The number of zombies alive is decreasing

(f) During what time intervals are the number of zombies at a relative maximum? Justify using calculus



derivative goes from + to −

192 − r(t) > 0

192 > r(t)

192 − r(t) < 0

192 < r(t)

max between t = 1, 2 and t = 6, 7

(g) Find the value and Explain the meaning of $\frac{1}{8}\int_0^8 r(t)\,dt$

$\frac{\int_0^8 r(t)\,dt}{8-0} = \frac{1500 \text{ zombies}}{8 \text{ hours}} = 187.5$ zombies per hour is the average rate of zombies/hr dying over 8 hours.

average