The class before the exam there will be a chance to earn extra credit. Groups of two to three can present a solution to one of the problems below. Up to 4% can be earned:

- [1] Mastery of the problem: Do you understand the problem and all of the steps used to solve it? Would you be able to solve the problem if given a slightly different question?
- [1] Presentation of the problem: You are presenting material to your classmates that will be on their exam next week! Take care to explain your steps and why you take them but your group also needs to complete your presentation in under 10 minutes!
- [1] Presentation: Do you interact with the class? Do you make eye contact?
- [1] Fielding questions: Can you understand the questions and give a cohesive answer?

Word Problem Practice

1. Describe the relationship between position, velocity and acceleration using calculus.

   The gravity (acceleration imposed on an object by the planet) on mars is $3.69\frac{\mathrm{m}}{\mathrm{s}^2}$. If NASA accidentally steered Spirit off a cliff 7250m high (yes, they get that deep), find a function to describe the velocity t seconds after Spirit falls off the edge. What speed would Sprit be going when it hit the ground?

2. Assume a population grows exponentially with an initial population of 2200 and a year later there are 2253. The death rate is known to be $d(t) = 1460e^{0.018t}$ people per year, find the area between these curves for $0 \leq t \leq 10$. What does the area represent?

3. Breathing is cyclic and a full respiratory cycle from the beginning of inhalation to the end takes about 5 seconds. The maximum rate of airflow into the lungs is about $.5\frac{\mathrm{L}}{\mathrm{s}}$. Thus the function $\frac{1}{2}\sin\left(\frac{2\pi t}{5}\right)\frac{\mathrm{L}}{\mathrm{s}}$ is a reasonable model for the rate of air flow in and out of the lungs. Use this model to find the volume of inhaled air in the lungs at time T.

4. The gravity (acceleration imposed on an object by the planet) on mars is $3.69\frac{\mathrm{m}}{\mathrm{s}^2}$. Let's consider what could happen if NASA's next Mars explorer has "boosters" which will let the explorer fly up with a maximum upwards velocity of 5 meters per second. If the new explorer jumped off the edge of a cliff 7250m with a maximum upwards velocity, find a function to describe the velocity t seconds after the explorer jumps off the edge. What speed would the explorer be going when it hit the ground?

5. Explain what marginal cost, marginal revenue, and marginal profit is.

   A company produces widgets and find that it has some economies of scale. That is, each additional widget produced is slightly cheaper to produce and on average costs less. The company estimates that the marginal cost for producing x items is $\$20e^{-.125x} + 2$ but the fixed cost (producing no widgets is $100). Find the cost of making 50 widgets?

   If widgets are sold for $9.99 each, find the marginal revenue of the company and determine how many widgets they should make to maximize profits.

6. The linear density of a rod of length 4 meters is given by $\rho(x) = 9 + 2\sqrt{x}$ measured in kilograms per meter, where x is measured in meters from one end of the rod. Find the total mass of the total rod. Which half of the rod has more mass (the first 2 meters or the last 2 meters)?

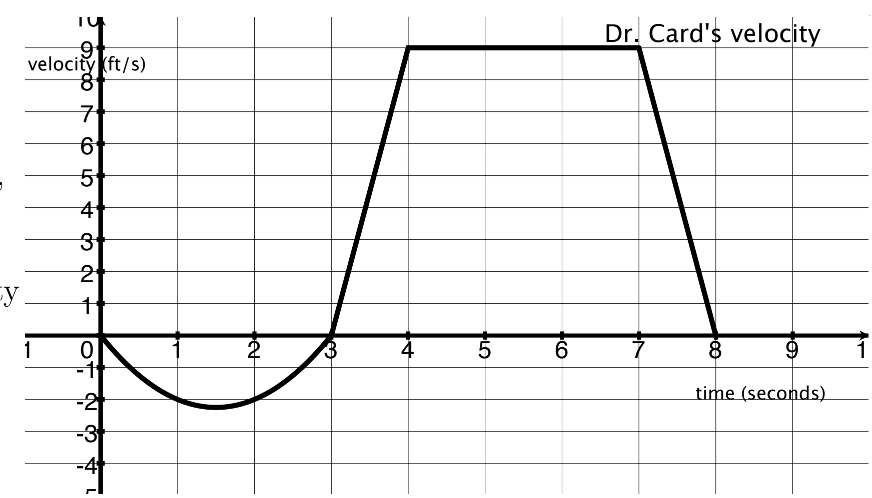
7. Kobayashi has won the hot dog-eating world championship six times. Recently he challenged a giant bear to a 3 minute hot dog-eating contest. Kobayashi found that the rate he can eat hot dogs goes down as time goes by and can be modeled by $k(t) = \frac{12}{(t+1)^2} + 24$, were t is measured in minutes. The bear isn't quite as used to the system and seems to start with a slower rate that gets larger and is well modeled by $b(t) = 8t^3 + 20$. Find out how many hot dogs Kobayashi and the bear eat and determine who won the context.

8. A brokerage account is being managed by parents and has had an increasing rate of growth over that time. Generally the account has increased by $f(t) = 3 * e^{.03t}$ dollars t years after the account was opened. Let $g(t) = 1$ record the yearly fee charged by the parents. Graph $f(t)$ and $g(t)$. Approximate the amount of money earned in the first three years. Clearly indicate your methods. Explain what $\int_0^3 f(t) - g(t)\, dt$ means in real world terms.

9. Oil leaked from a tank at a rate of $r(t)$ liters per hour. The rate decreased as time passed and values of the rate at two hour time intervals are shown in the table. Find lower and upper estimates for the total amount of oil that leaked out.

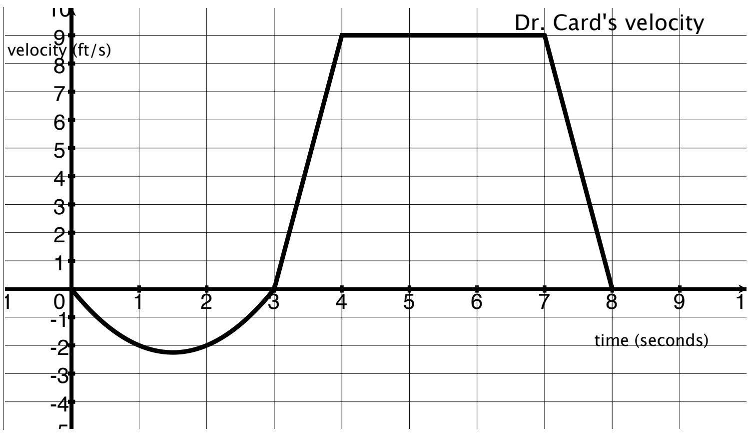
t (hours)	0	2	3	6	7	10
$f(t)$ (Liters/hour)	8.7	7.6	6.8	6.2	5.7	5.3

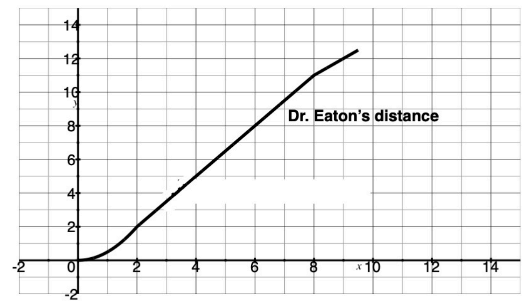
10. Dr. Card ran a race and had his velocity tracked on the graph below. Find the length of the race using what ever methods you like, but make sure you compute the distance exactly. We note that Dr. Card's velocity is comprised of a parabola and series of lines. Also, Dr. Card began the race facing the wrong way!



11. One wifi network has capped download speeds (y) to bursts of 100Mbps. However, the more time t a link is active, the cap is modified downwards (to help keep the network from being overwhelmed). The capped download speed d, can be approximated by $d = 100 - t$. About how long will it take to download a movie that is 16384 megabits.

12. Consider the graphs recording the velocity of Dr. Ryan Card and the displacement of Dr. Julie Eaton during a short race. Who can run faster? What is his/her top speed? Approximately how far has Dr. Card run after 3 seconds? Approximately how far has Dr. Eaton run after 3 seconds? If the race is 12 feet long, who wins and at what time?





13. Consider the graphs depicting the median income for white Americans (top/red line) and Black Americans (bottom/blue line). The red line is described by the equation $y = 566x + 40,738$. The blue line is described by the equation $y = 390x + 21,970$.

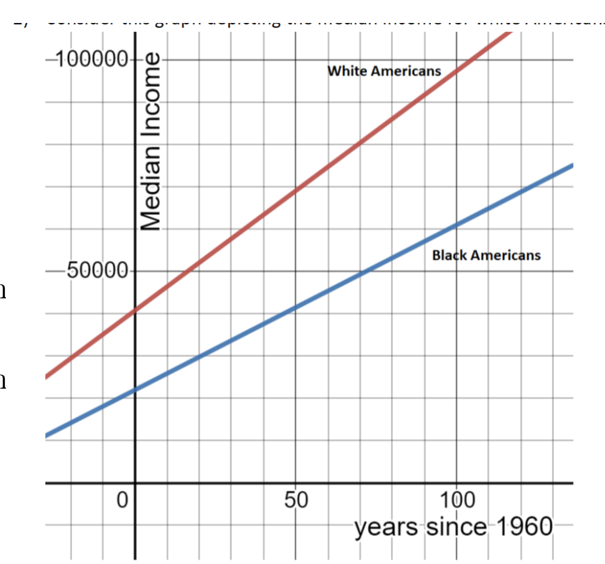
(a) What is the meaning of the area between the red and blue lines from $x = 0$ to $x = 100$ (where x is years since 1960).

(b) Estimate the area identified in part a. Clearly indicate your process.

(c) Find the area between the curves from $x = 0$ to $x = 50$.

(d) Find the area between the curves from $x = 50$ to $x = 100$.

(e) Is income inequality between the two races growing or shrinking? Justify your answer.



14. Create your own problem. You must have this approved by the instructor.