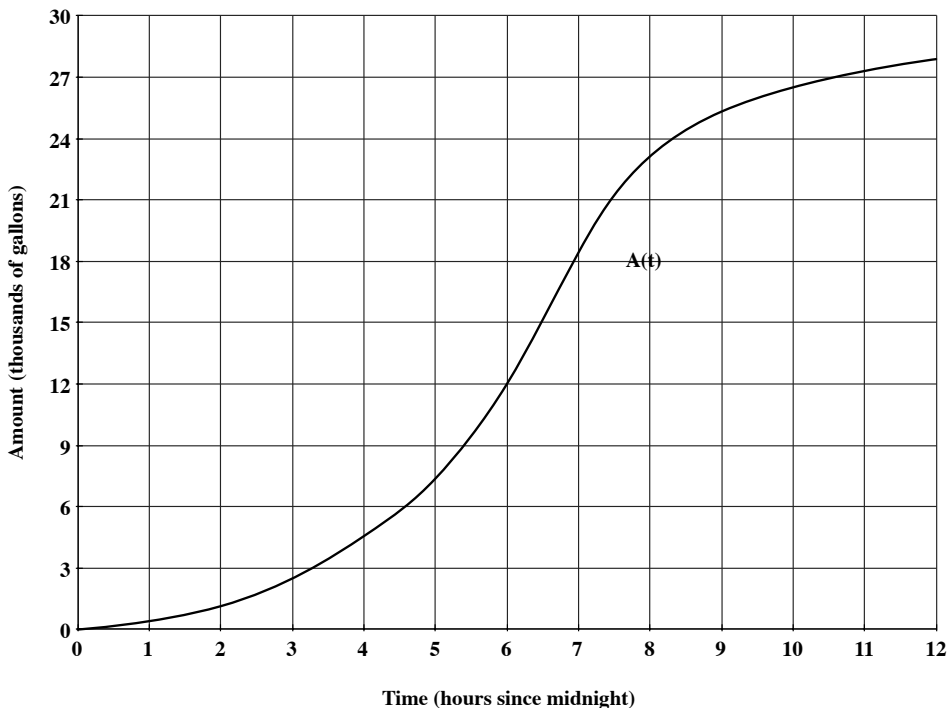


2. (13 points) The graph below gives the amount of water,  $A(t)$ , that flows out of a reservoir over a 12-hour period beginning at midnight. The amount,  $A(t)$ , is in thousands of gallons and the time  $t$  is in hours after midnight.



Show and label your work in the graph.

- (a) During how many one-hour intervals is water flowing out at an average rate of 1.5 thousand gallons per hour?

number of one-hour intervals with average rates of 1.5 (Circle one): 0 1 2 3 4 5

- (b) Find the largest overall rate of flow out of the reservoir.

\_\_\_\_\_ thousand gallons per hour

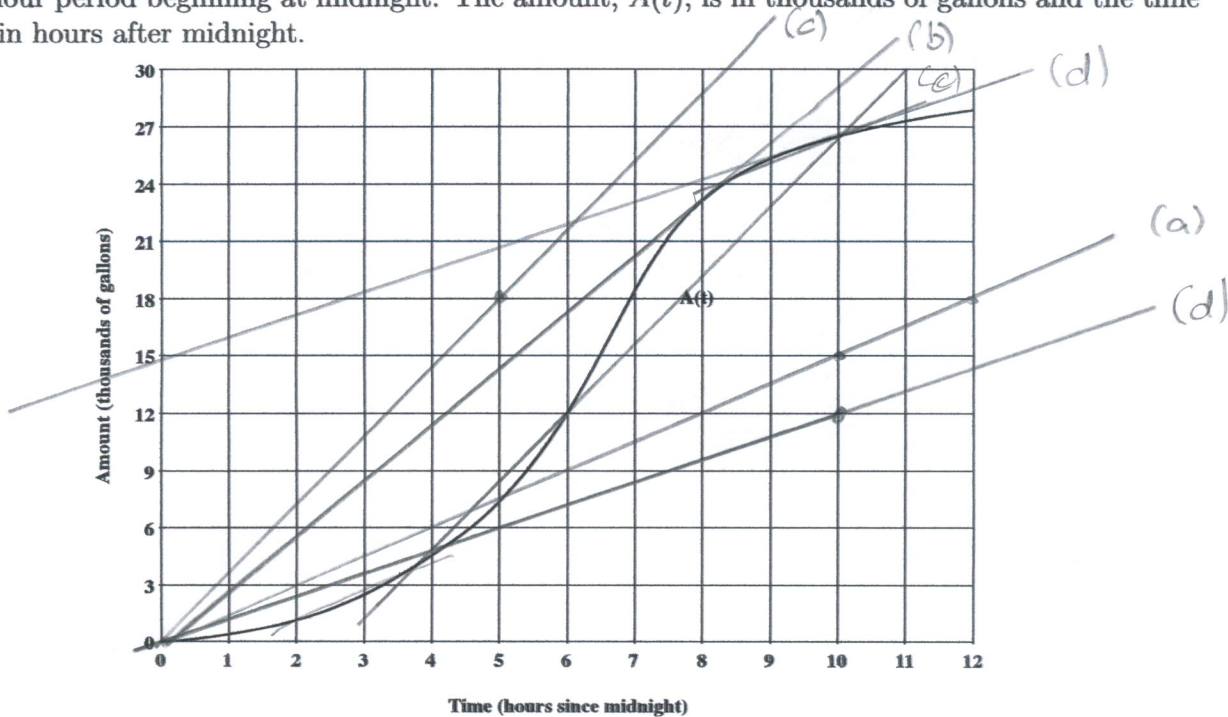
- (c) Find a value of  $t$  such that  $\frac{A(t) - A(6)}{t - 6} = 3.6$ .

$t =$  \_\_\_\_\_ hours

- (d) Suppose water flows into the reservoir at a constant rate of 1.2 thousand gallons per hour. What is the smallest amount of water needed in the reservoir at midnight so that the reservoir never has a shortage in this 12-hour period?

\_\_\_\_\_ thousand gallons

2. (13 points) The graph below gives the amount of water,  $A(t)$ , that flows out of a reservoir over a 12-hour period beginning at midnight. The amount,  $A(t)$ , is in thousands of gallons and the time  $t$  is in hours after midnight.



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- (a) During how many one-hour intervals is water flowing out at an average rate of 1.5 thousand gallons per hour?

number of one-hour intervals with average rates of 1.5 (Circle one): 0 1 2 3 4 5

- (b) Find the largest overall rate of flow out of the reservoir.

SLOPE OF LARGEST DIAG. LINE TO  $A(t)$

POINTS  $(0,0)$   $(10,29)$

$$\text{SLOPE} = \frac{29-0}{10-0} = 2.9$$

2.9 thousand gallons per hour

- (c) Find a value of  $t$  such that  $\frac{A(t) - A(6)}{t - 6} = 3.6$ .

DRAW REFERENCE WITH SLOPE 3.6.

SLIDE RULER PARALLEL TO A SECANT THROUGH GRAPH AT 6

EITHER ACCEPTED

$t = 4$  or  $10$  hours

- (d) Suppose water flows into the reservoir at a constant rate of 1.2 thousand gallons per hour. What is the smallest amount of water needed in the reservoir at midnight so that the reservoir never has a shortage in this 12-hour period?

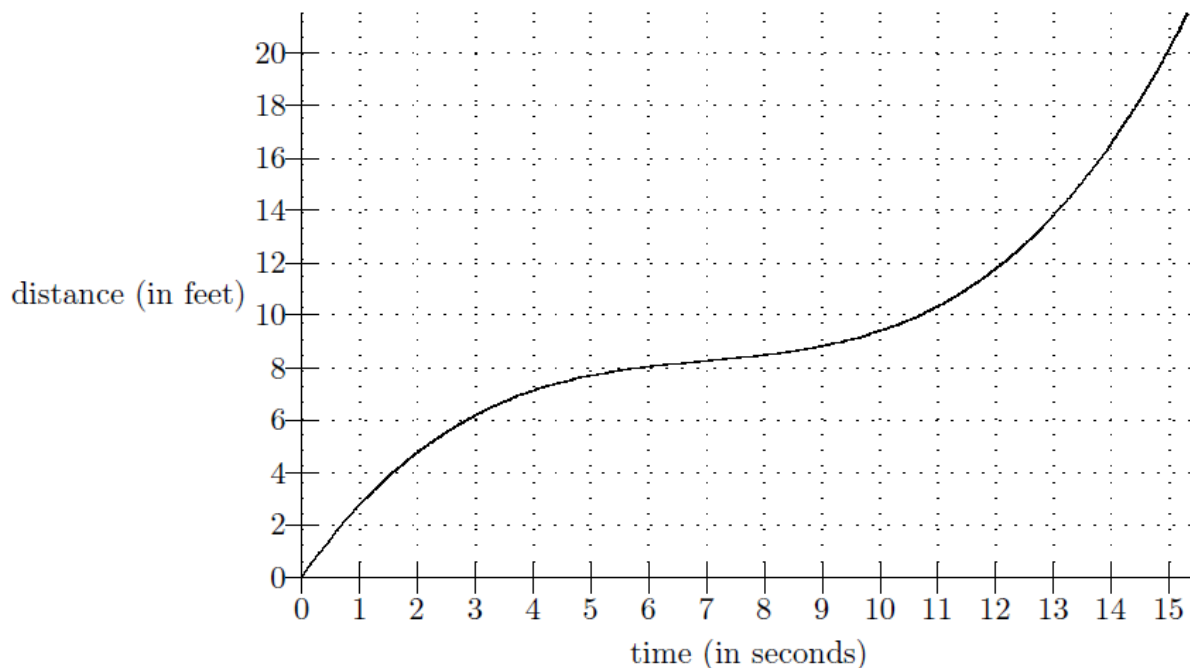
DRAW THE "WATER IN" REFERENCE LINE.

MATCH SLOPES!

LARGEST GAP = ?

15 thousand gallons

**Problem 2** (14pts) Anna is walking on a straight road. The following is the graph of Anna's distance versus time.



Let  $D(t)$  denote the distance Anna traveled in  $t$  seconds.

a) (3pts) Find a time at which Anna's average trip speed is 1.2 feet per second.

ANSWER: At  $t =$  \_\_\_\_\_ seconds

b) (4pts) **Translate** the following statement into **English**:  $\frac{D(10)-D(2)}{10-2} = 0.7$ . Include correct units.

c) (4pts) **Translate** the following statement into **functional notation** and find the value of  $h$  that makes the statement true:

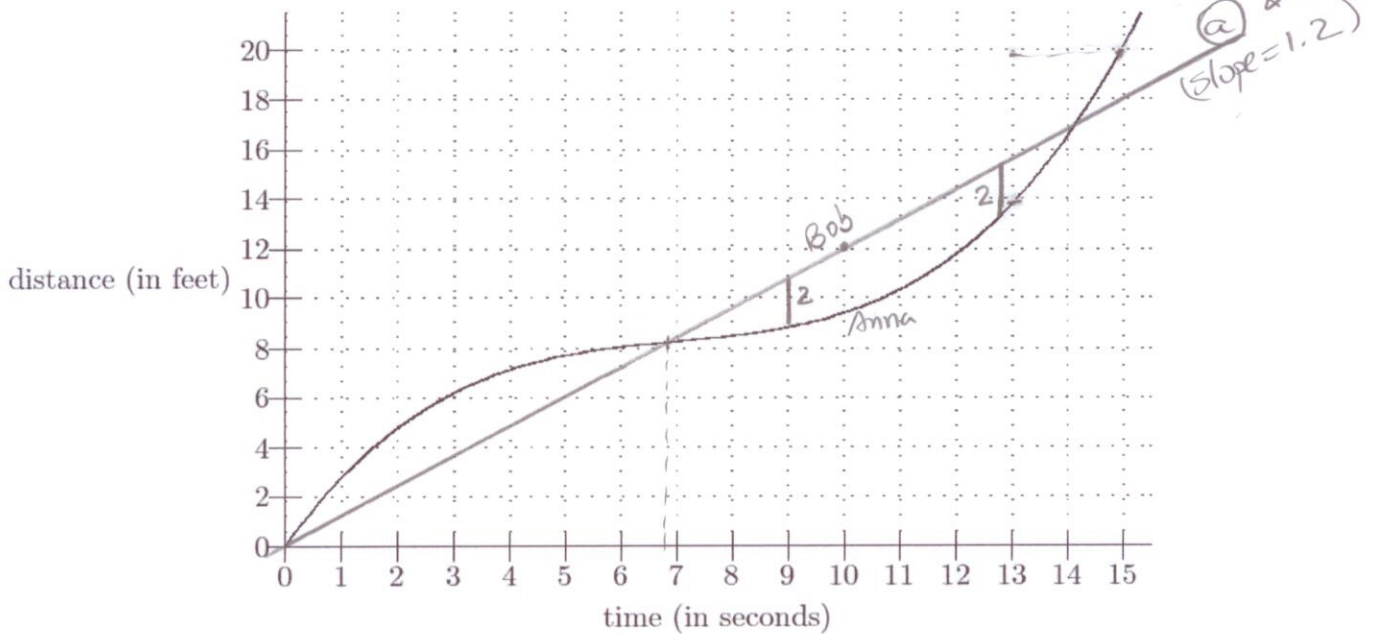
***“Anna traveled 6 feet during the  $h$ -second interval starting at  $t = 13$ .”***

Translation: \_\_\_\_\_,  $h =$  \_\_\_\_\_ seconds

d) (3pts) Suppose Bob starts walking from the same place, at the same time, and in the same direction as Anna, but he moves at a constant speed of 1.2 feet/second. At what time(s), if any, will Bob be 2 feet ahead of Anna?

ANSWER: At  $t =$  \_\_\_\_\_ seconds (list all)

**Problem 2** (14pts) Anna is walking on a straight road. The following is the graph of Anna's distance versus time. (a) & (b)



Let  $D(t)$  denote the distance Anna traveled in  $t$  seconds.

a) (3pts) Find a time at which Anna's average trip speed is 1.2 feet per second.

ATS = slope of diagonal = 1.2  
at  $t \approx 6.9$  sec

$[6.7, 7]$

ANSWER: At  $t = 6.9$  seconds

b) (4pts) Translate the following statement into English:  $\frac{D(10) - D(2)}{10 - 2} = 0.7$ . Include correct units.

Anna's average speed from 2 to 10 minutes was 0.7 ft/sec

c) (4pts) Translate the following statement into functional notation and find the value of  $h$  that makes the statement true:

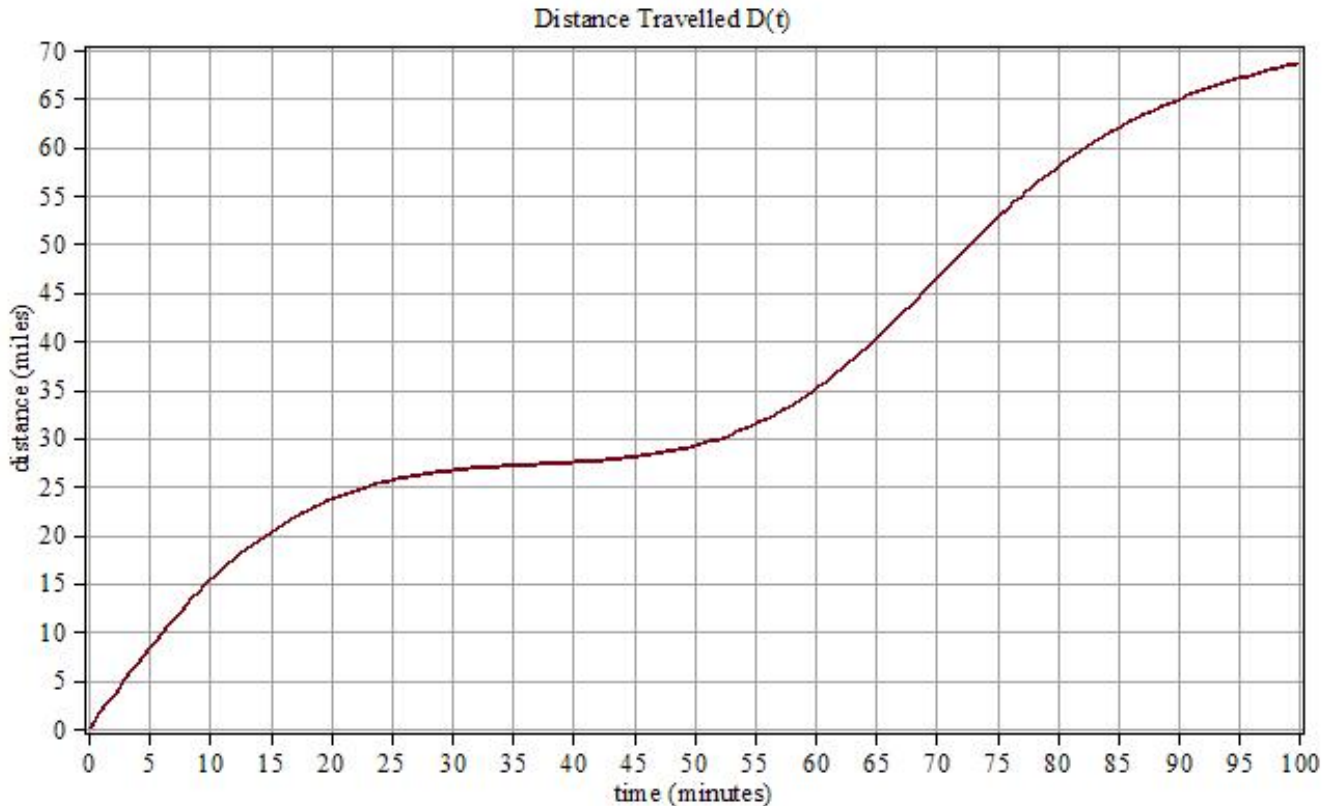
*"Anna traveled 6 feet during the  $h$ -second interval starting at  $t = 13$ ."*

Translation:  $D(13+h) - D(13) = 6$ ,  $h = 2$  seconds

d) (3pts) Suppose Bob starts walking from the same place, at the same time, and in the same direction as Anna, but he moves at a constant speed of 1.2 feet/second. At what time(s), if any, will Bob be 2 feet ahead of Anna?

ANSWER: At  $t = 9, 12.8$  seconds (list all)

1. The following is the graph of distance travelled by a truck versus time. Label your lines you use in your graph. For example, next to the line you drew to compute part (b), write (b) so we can follow your work. Include units in your answers.

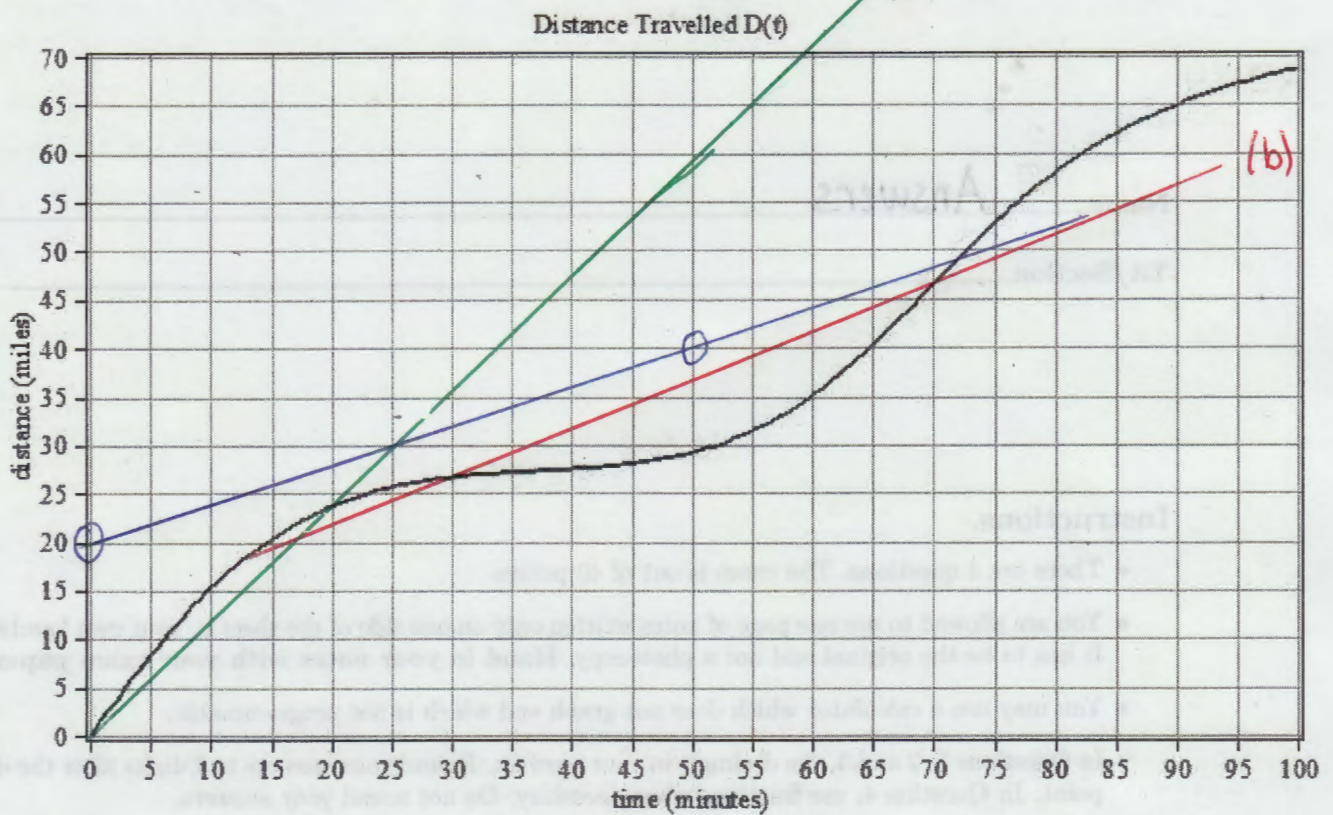


(a) (3 points) What is the Average Trip Speed at  $t = 20$  minutes.

(b) (3 points) Translate the question  $\frac{D(70) - D(30)}{40} = ?$  into English using a complete sentence (in this case a question) and use the graph to compute the answer.

(c) (4 points) At  $t = 0$  a car starts 20 miles ahead of the truck on the same road and travels at a speed of 0.4 miles per minute. Graph the distance of the car above. When will the truck catch the car?

1. The following is the graph of distance travelled by a truck versus time. Label your lines you use in your graph. For example, next to the line you drew to compute part (b), write (b) so we can follow your work. Include units in your answers.



- (a) (3 points) What is the Average Trip Speed at  $t = 20$  minutes.

$$ATS = 1.18 \text{ miles/min}$$

$$[1.00, 1.36]$$

- (b) (3 points) Translate the question  $\frac{D(70) - D(30)}{40} = ?$  into English using a complete sentence (in this case a question) and use the graph to compute the answer.

What is the average speed of the truck from  $t=30$  to  $t=70$  minutes?

$$AS = 0.50 \text{ miles/min}$$

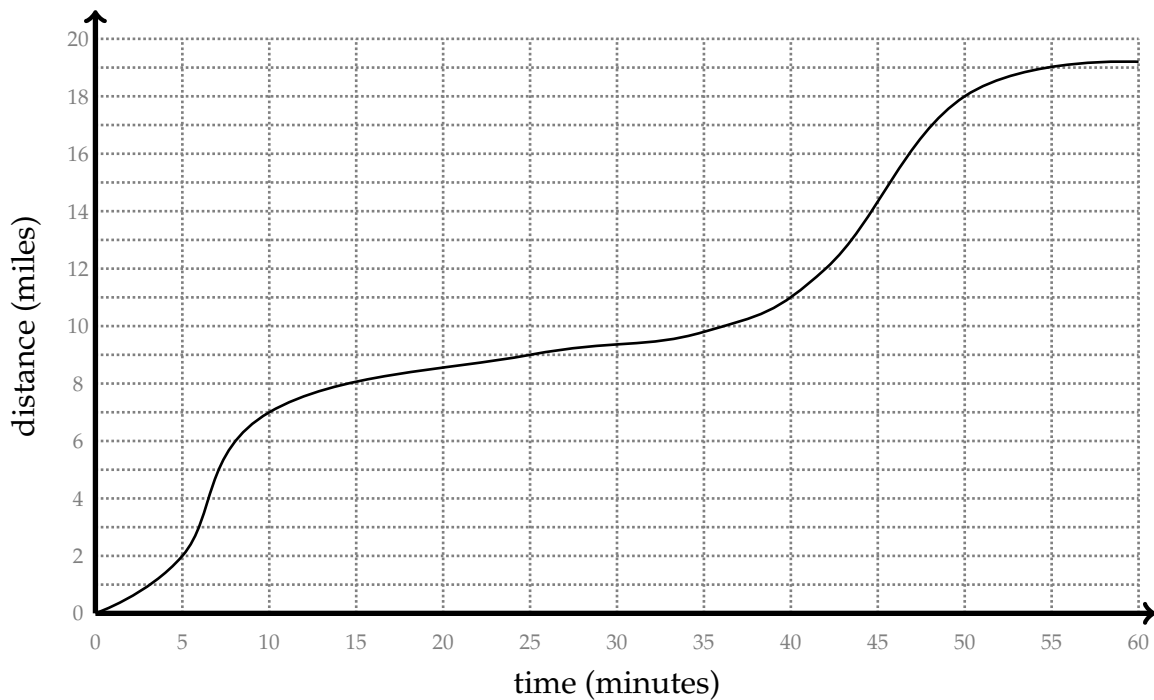
$$[0.45, 0.55]$$

- (c) (4 points) At  $t = 0$  a car starts 20 miles ahead of the truck on the same road and travels at a speed of 0.4 miles per minute. Graph the distance of the car above. When will the truck catch the car?

(0, 20) for the starting point  
 in 50 minutes, it will travel  $50 \times 0.4 = 20$  miles  
 so (50, 20+20) is a second point on the line.  
 The truck will reach the car at  $t=72$  minutes

$$[67, 77]$$

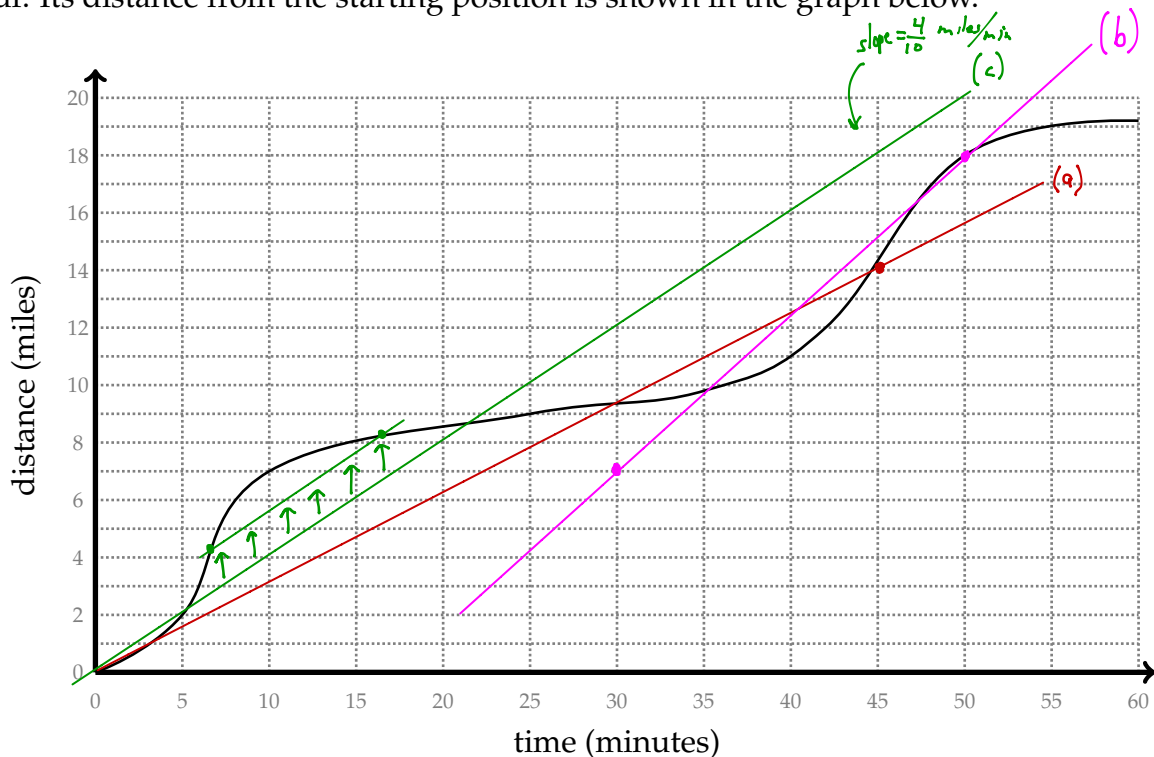
1. [4 points per part] A flappy bird flies in one direction across the sky over the course of an hour. Its distance from the starting position is shown in the graph below.



- (a) Find the average trip speed at 30 minutes.
- (b) Find the average speed from 35 minutes to 50 minutes.
- (c) Find a 10-minute time interval in which the bird traveled 4 miles.  
(There are a few possible answers; you only need to give one.)
- (d) Let  $D(t)$  denote the distance the bird has traveled after  $t$  minutes.  
Translate the following inequality into plain English:

$$\frac{D(15) - D(5)}{15 - 5} > \frac{D(30) - D(20)}{30 - 20}$$

1. [4 points per part] A flappy bird flies in one direction across the sky over the course of an hour. Its distance from the starting position is shown in the graph below.



- (a) Find the average trip speed at 30 minutes.

$$\frac{14}{45} = 0.31 \text{ miles/minute}$$

- (b) Find the average speed from 35 minutes to 50 minutes.

$$\frac{18-7}{50-30} = 0.56 \text{ miles/minute}$$

- (c) Find a 10-minute time interval in which the bird traveled 4 miles.  
(There are a few possible answers; you only need to give one.)

6.5 to 16.5 minutes

- (d) Let  $D(t)$  denote the distance the bird has traveled after  $t$  minutes.  
Translate the following inequality into plain English:

$$\frac{D(15) - D(5)}{15 - 5} > \frac{D(30) - D(20)}{30 - 20}$$

The average speed from 5 to 15 minutes was greater than the average speed from 20 to 30 minutes.