Rates and Work

For questions in the Quantitative Comparison format ("Quantity A" and "Quantity B" given), the answer choices are always as follows:

(A) Quantity A is greater.
(B) Quantity B is greater.
(C) The two quantities are equal.
(D) The relationship cannot be determined from the information given.

For questions followed by a numeric entry box , you are to enter your own answer in the box. For questions followed by a fraction-style numeric entry box , you are to enter your answer in the form of a fraction. You are not required to reduce fractions. For example, if the answer is $\frac{1}{4}$, you may enter $\frac{25}{100}$ or any equivalent fraction.

All numbers used are real numbers. All figures are assumed to lie in a plane unless otherwise indicated. Geometric figures are not necessarily drawn to scale. You should assume, however, that lines that appear to be straight are actually straight, points on a line are in the order shown, and all geometric objects are in the relative positions shown. Coordinate systems, such as *xy*-planes and number lines, as well as graphical data presentations, such as bar charts, circle graphs, and line graphs, *are* drawn to scale. A symbol that appears more than once in a question has the same meaning throughout the question.

1. Running on a 10-mile loop in the same direction, Sue ran at a constant rate of 8 miles per hour and Rob ran at a constant rate of 6 miles per hour. If they began running at the same point on the loop, how many hours later did Sue complete exactly 1 more lap than Rob?

   (A) 3
   (B) 4
   (C) 5
   (D) 6
   (E) 7

2. Svetlana ran the first 5 kilometers of a 10-kilometer race at a constant rate of 12 kilometers per hour. If she completed the entire 10-kilometer race in 55 minutes, at what constant rate did she run the last 5 kilometers of the race, in kilometers per hour?

   (A) 15
   (B) 12
   (C) 11
   (D) 10
   (E) 8

3. A standard machine fills paint cans at a rate of 1 gallon every 4 minutes. A deluxe machine fills gallons of paint at twice the rate of a standard machine. How many hours will it take a standard machine and a deluxe machine, working together, to fill 135 gallons of paint?

(A) 1
(B) 1.5
(C) 2
(D) 2.5
(E) 3

4. Wendy can build a birdhouse in 15 hours and Miguel can build an identical birdhouse in 10 hours. How many hours will it take Wendy and Miguel, working together at their respective constant rates, to build a birdhouse? (Assume that they can work on the same birdhouse without changing each other's work rate.)

(A) 5
(B) 6
(C) 7
(D) 8
(E) 9

5. Machine A, which produces 15 golf clubs per hour, fills a production lot in 6 hours. Machine B fills the same production lot in 1.5 hours. How many golf clubs does machine B produce per hour?

[ ] golf clubs per hour

6. Davis drove from Amityville to Beteltown at 50 miles per hour, and returned by the same route at 60 miles per hour.

Quantity A	**Quantity B**
Davis's average speed for the round trip, in miles per hour	55

7. If a turtle traveled $\frac{1}{30}$ of a mile in 5 minutes, what was its speed in miles per hour?

(A) 0.02
(B) $0.1\overline{6}$
(C) 0.4
(D) 0.6

(E) 2.5

Akilah traveled at a rate of x miles per hour for $2x$ hours.

	Quantity A	Quantity B
8.	The number of miles Akilah traveled	$3x$

9. Claudette traveled the first $\frac{2}{3}$ of a 60-mile trip at 20 miles per hour (mph) and the remainder of the trip at 30 mph. How many minutes later would she have arrived if she had completed the entire trip at 20 mph?

$\boxed{}$ minutes

10. Rajesh traveled from home to school at 30 miles per hour. Then he returned home at 40 miles per hour, and finally he went back to school at 60 miles per hour, all along the same route. What was his average speed for the entire trip, in miles per hour?

(A) 32
(B) 36
(C) 40
(D) 45
(E) 47

11. Twelve workers pack boxes at a constant rate of 60 boxes in 9 minutes. How many minutes would it take 27 workers to pack 180 boxes, if all workers pack boxes at the same constant rate?

(A) 12
(B) 13
(C) 14
(D) 15
(E) 16

12. To service a single device in 12 seconds, 700 nanorobots are required, with all nanorobots working at the same constant rate. How many hours would it take for a single nanorobot to service 12 devices?

(A) $\frac{7}{3}$
(B) 28
(C) 108
(D) 1,008

(E) 1,680

13. If a baker made 60 pies in the first 5 hours of his workday, by how many pies per hour did he increase his rate in the last 3 hours of the workday in order to complete 150 pies in the entire 8-hour period?

(A) 12
(B) 14
(C) 16
(D) 18
(E) 20

14. Nine identical machines, each working at the same constant rate, can stitch 27 jerseys in 4 minutes. How many minutes would it take 4 such machines to stitch 60 jerseys?

(A) 8
(B) 12
(C) 16
(D) 18
(E) 20

15. Brenda walked a 12-mile scenic loop in 3 hours. If she then reduced her walking speed by half, how many hours would it take Brenda to walk the same scenic loop two more times?

(A) 6
(B) 8
(C) 12
(D) 18
(E) 24

16. A gang of criminals hijacked a train heading due south. At exactly the same time, a police car located 50 miles north of the train started driving south toward the train on an adjacent roadway parallel to the train track. If the train traveled at a constant rate of 50 miles per hour, and the police car traveled at a constant rate of 80 miles per hour, how long after the hijacking did the police car catch up with the train?

(A) 1 hour
(B) 1 hour and 20 minutes
(C) 1 hour and 40 minutes
(D) 2 hours
(E) 2 hours and 20 minutes

17. Each working at a constant rate, Rachel assembles a brochure every 10 minutes and Terry assembles a brochure every 8 minutes.

Quantity A	Quantity B
The number of minutes it will take Rachel and Terry, working together, to assemble 9 brochures	40

18. With 4 identical servers working at a constant rate, a new Internet search provider processes 9,600 search requests per hour. If the search provider adds 2 more identical servers, and server work rate never varies, the search provider can process 216,000 search requests in how many hours?

(A) 15
(B) 16
(C) 18
(D) 20
(E) 24

19. If Sabrina can assemble a tank in 8 hours, and Janis can assemble a tank in 13 hours, then Sabrina and Janis working together at their constant respective rates can assemble a tank in approximately how many hours?

(A) 21
(B) 18
(C) 7
(D) 5
(E) 2

20. Phil collects virtual gold in an online computer game and then sells the virtual gold for real dollars. After playing 10 hours a day for 6 days, he collected 540,000 gold pieces. If he immediately sold this virtual gold at a rate of $1 per 1,000 gold pieces, what were his average earnings per hour, in real dollars?

(A) $5
(B) $6
(C) $7
(D) $8
(E) $9

21. After completing a speed training, Alyosha translates Russian literature into English at a rate of 10 more than twice as many words per hour as he was able to translate before the training. If he was previously able to translate 10 words per minute, how many words can he now translate in an hour?

(A) 30
(B) 70
(C) 610
(D) 1,210
(E) 1,800

22. Jenny takes 3 hours to sand a picnic table; Laila can do the same job in $\frac{1}{2}$ hour. Working together at their respective constant rates, Jenny and Laila can sand a picnic table in how many hours?

(A) $\frac{1}{6}$
(B) $\frac{2}{9}$
(C) $\frac{1}{3}$
(D) $\frac{3}{7}$
(E) $\frac{5}{6}$

One worker strings 2 violins in 3 minutes. All workers string violins at the same constant rate.

	Quantity A	Quantity B
23.	The number of minutes required for 12 workers to string 720 violins	The number of violins that 5 workers can string in 24 minutes

24. Riders board the Jelly Coaster in groups of 4 every 15 seconds. If there are 200 people in front of Kurt in line, in approximately how many minutes will Kurt board the Jelly Coaster?

(A) 5
(B) 8
(C) 10

(D) 13
(E) 20

A team of 8 chefs produce 3,200 tarts in 5 days. All chefs produce tarts at the same constant rate.

	Quantity A	Quantity B
25.	The number of chefs needed to produce 3,600 tarts in 3 days	The number of days that 4 chefs need to produce 4,800 tarts

26. Working together at their respective constant rates, robot A and robot B polish 88 pounds of gemstones in 6 minutes. If robot A's rate of polishing is $\frac{3}{5}$ that of robot B, how many minutes would it take robot A alone to polish 165 pounds of gemstones?

(A) 15.75
(B) 18
(C) 18.75
(D) 27.5
(E) 30

27. Car A started driving north from point X traveling at a constant rate of 40 miles per hour. One hour later, car B started driving north from point X at a constant rate of 30 miles per hour. Neither car changed direction of travel. If each car started with 8 gallons of fuel, which is consumed at a rate of 30 miles per gallon, how many miles apart were the two cars when car A ran out of fuel?

(A) 30
(B) 60
(C) 90
(D) 120
(E) 150

28. One robot, working independently at a constant rate, can assemble a doghouse in 12 minutes. What is the maximum number of <u>complete</u> doghouses that can be assembled by 10 such identical robots, each working on <u>separate</u> doghouses at the same rate for $2\frac{1}{2}$ hours?

(A) 20
(B) 25
(C) 120
(D) 125
(E) 150

29. Working continuously 24 hours a day, a factory bottles Soda Q at a rate of 500 liters per second and Soda V at a rate of 300 liters per second. If twice as many bottles of Soda V as of Soda Q are filled at the factory each day, what is the ratio of the volume of a bottle of Soda Q to a bottle of Soda V?

(A) $\frac{3}{10}$

(B) $\frac{5}{6}$

(C) $\frac{6}{5}$

(D) $\frac{8}{3}$

(E) $\frac{10}{3}$

Rates and Work Answers

1. **(C).** If Sue completed exactly one more lap than Rob, she ran 10 more miles than Rob. If Rob ran d miles, then Sue ran $d + 10$ miles. Rob and Sue began running at the same time, so they ran for the same amount of time. Let t represent the time they spent running. Fill out a chart for Rob and Sue, using the formula Distance = Rate × Time (D = RT):

	D (miles)	=	R (miles per hour)	×	T (hours)
Rob	d	=	6	×	t
Sue	$d + 10$	=	8	×	t

There are two equations:

$$d = 6t \quad d + 10 = 8t$$

Substitute $6t$ for d in the second equation and then solve for t:

$$\begin{aligned} 6t + 10 &= 8t \\ 10 &= 2t \\ 5 &= t \end{aligned}$$

2. **(D).** To calculate Svetlana's speed during the second half of the race, first calculate how long it took her to run the first half of the race. Svetlana ran the first 5 kilometers at a constant rate of 12 kilometers per hour. These values can be used in the $D = RT$ formula:

D (km)	=	R (km per hr)	×	T (hr)
5	=	12	×	t

Svetlana's time for the first part of the race is $\frac{5}{12}$ hours, or 25 minutes.

She completed the entire 10-kilometer race in 55 minutes, so she ran the last 5 kilometers in 55 – 25 = 30 minutes, or 0.5 hours. Now create another chart to find the rate at which she ran the last 5 kilometers:

D (km)	=	R (km per hr)	×	T (hr)
5	=	r	×	0.5

$$5 = 0.5r$$

$$10 = r$$

Svetlana ran the second half of the race at a speed of 10 kilometers per hour.

3. **(E).** The question asks for the amount of time in hours, convert the work rates from gallons per minute to gallons per hour. First, calculate the rate of the standard machine:

$$\frac{1 \text{ gallon}}{4 \text{ minutes}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = \frac{60 \text{ gallons}}{4 \text{ hours}} = 15 \text{ gallons per hour}$$

Since the deluxe machine's rate is twice the standard machine's rate, the deluxe machine can fill 15 × 2 = 30 gallons of paint per hour. Together, the machines can fill 15 + 30 = 45 gallons of paint per hour. Now apply the formula for work, $W = RT$:

$$\begin{aligned} 135 &= 45 \times T \\ 3 &= T \end{aligned}$$

4. **(B).** Use two separate lines in a $W = RT$ chart, one for Wendy and one for Miguel, to calculate their respective rates. Building 1 birdhouse equals doing 1 unit of work:

	W (birdhouses)	=	R (birdhouses per hour)	×	T (hours)
Wendy	1	=	R_W	×	15
Miguel	1	=	R_M	×	10

Thus, Wendy's rate is $\frac{1}{15}$ birdhouses per hour, and Miguel's rate is $\frac{1}{10}$ birdhouses per hour. Since Wendy and Miguel are working together, add their rates:

	W (birdhouses)	=	R (birdhouses per hour)	×	T (hours)
Wendy + Miguel	1	=	$\frac{1}{15}+\frac{1}{10}$	×	t

Now solve for t by first combining the fractions:

$$1 = \left(\frac{1}{15} + \frac{1}{10} \right) t$$

$$1 = \left(\frac{2}{30} + \frac{3}{30} \right) t$$

$$1 = \left(\frac{5}{30} \right) t$$

$$\frac{30}{5} = t$$

$$6 = t$$

5. **60 golf clubs per hour.** First, calculate the size of a production lot. Machine A works at a rate of 15 golf clubs per hour and completes a production lot in 6 hrs. Plug this information into the $W = RT$ formula:

W (clubs)	=	R (clubs per hour)	×	T (hours)
w	=	15	×	6

w = 15 clubs per hour × 6 hours = 90 clubs

Therefore, a production lot consists of 90 golf clubs. Since machine *B* can complete the lot in 1.5 hours, use the $W = RT$ chart a second time to calculate the rate for machine B:

W (clubs)	=	R (clubs per hour)	×	T (hours)
90	=	r	×	1.5

Make the calculation easier by converting 1.5 hours to $\frac{3}{2}$ hours:

$$90 = \frac{3}{2}r$$
$$\frac{2}{3} \times 90 = r$$
$$2 \times 30 = r$$
$$60 = r$$

6. (**B**)**.** Never take an average speed by just averaging the two speeds (50 mph and 60 mph). Instead, use the formula Average Speed = Total Distance ÷ Total Time. Fortunately, for Quantitative Comparisons, you can often sidestep actual calculations.

Davis's average speed can be thought of as an average of the speed he was traveling at every single moment during his journey—for instance, imagine that Davis wrote down the speed he was going during every second he was driving, then he averaged all the seconds. Since Davis spent more *time* going 50 mph than going 60 mph, the average speed will be closer to 50 than 60, and Quantity B is greater. If the distances are the same, average speed is always weighted towards the *slower* speed.

To actually do the math, pick a convenient number for the distance between Amityville and Beteltown—for instance, 300 miles (divisible by both 50 and 60). If the distance is 300 miles, it took Davis 6 hours to drive there at 50 mph, and 5 hours to drive back at 60 mph. Using Average Speed = Total

Distance ÷ Total Time (and a total distance of 600 miles, for both parts of the journey), you get the following:

$$\text{Average Speed} = \frac{600 \text{ miles}}{11 \text{ hours}}$$

Average Speed = 54.54 … (which is less than 55)

The result will be the same for any value chosen. Quantity B is greater.

7. **(C).** The turtle traveled $\frac{1}{30}$ of a mile in 5 minutes, which is $\frac{1}{12}$ of an hour. Using the $D = RT$ formula, solve for r:

D (mile)	=	R (miles per hour)	×	T (hours)
$\frac{1}{30}$	=	r	×	$\frac{1}{12}$

$\frac{1}{30} = \frac{1}{12}r$

$\frac{12}{30} = r$

$0.4 = r$

8. **(D).** Use $D = RT$:

Distance = $x(2x)$
Distance = $2x^2$

Which is greater, $2x^2$ or $3x$? If $x = 1$, then $3x$ is greater. But if $x = 2$, then $2x^2$ is greater.

Without information about the value of x, the relationship cannot be determined.

9. **20 minutes.** First, figure out how long it took Claudette to travel 60 miles under the actual conditions. The first leg of the trip was $\frac{2}{3}$ of 60 miles, or 40 miles. To travel 40 miles at a rate of 20 miles per hour, Claudette spent $\frac{40}{20}$ = 2 hours = 120 minutes. The second leg of the trip was the remaining 60 – 40 = 20 miles. To travel that distance at a rate of 30 miles per hour, Claudette spent $\frac{20}{30} = \frac{2}{3}$ hour = 40 minutes. In total, Claudette traveled for 120 + 40 = 160 minutes.

Now consider the hypothetical trip. If Claudette had traveled the whole distance of 60 miles at 20 miles per hour, the trip would have taken $\frac{60}{20}$ = 3 hours = 180 minutes.

Finally, compare the two trips. The real trip took 160 minutes, so the hypothetical trip would have taken 180 – 160 = 20 minutes longer.

10. **(C).** Do not just average the three speeds, as Rajesh spent more time at slower rates than at higher rates, weighting the average toward the slower rate(s). To compute the average speed for a trip, figure out the total distance and divide by the total time.

Pick a convenient distance from home to school, one that is divisible by 30, 40, and 60—say 120 miles (tough for Rajesh, but easier for you).

The first part of the journey (from home to school) took $\frac{120}{30}$ = 4 hours. The second part of the journey took $\frac{120}{40}$ = 3 hours. The third part of the journey took $\frac{120}{60}$ = 2 hours.

The total distance Rajesh traveled is 120 + 120 + 120 = 360 miles. The total time was 4 + 3 + 2 = 9 hours. Finally, his average speed for the entire trip was $\frac{360}{9}$ = 40 miles per hour.

11. **(A).** To solve a Rates & Work problem with multiple workers, modify the standard formula *Work* = *Rate* × *Time* to this:

Work = *Individual Rate* × *Number of Workers* × *Time*

Use the first sentence to solve for an individual worker's rate. Plug in the fact that 12 workers pack boxes at a constant rate of 60 boxes in 9 minutes:

Work = *Individual Rate* × *Number of Workers* × *Time*

60 boxes = (R)(12)(9 minutes)

$R = \frac{5}{9}$ boxes per minute

In other words, each worker can pack $\frac{5}{9}$ of a box per minute. Plug that rate back into the formula, but use the details from the second sentence in the problem:

Work = *Individual Rate* × *Number of Workers* × *Time*

$$180 = \left(\frac{5}{9}\right)(27)(T)$$

$$180 = 15T$$

$$12 = T$$

12. **(B).** To solve a Rates & Work problem with multiple workers, modify the standard formula *Work* = *Rate* × *Time* to this:

Work = *Individual Rate* × *Number of Workers* × *Time*

Solve for an individual nanorobot's rate, using the fact that 700 nanorobots can service 1 device in 12 seconds. Notice that the "work" here is 1 device:

$$Work = Individual\ Rate \times Number\ of\ Workers \times Time$$

$$1 \text{ device} = (R)(700)(12 \text{ seconds})$$

$$R = \frac{1}{8{,}400} \text{ devices per second}$$

That is, each nanorobot can service $\frac{1}{8,400}$ of a device in 1 second. Plug that rate back into the formula, but using the details from the second sentence in the problem:

Work = *Individual Rate* × *Number of Workers* × *Time*

$$12 \text{ devices} = \left(\frac{1}{8,400} \text{ devices per second}\right)(1)(T)$$

$$T = 100{,}800 \text{ seconds}$$

The answer is 100,800 seconds. Divide by 60 to convert this time to 1,680 minutes; divide by 60 again to get 28 hours.

13. **(D)**. The question asks by how many pies per hour the baker's rate of pie-making increased, so determine his rate for the first 5 hours and his rate in the last 3 hours. The difference is the ultimate answer:

Rate for last 3 hours – Rate for first 5 hours = Increase

The rate for the first 5 hours was 60 pies ÷ 5 hours = 12 pies per hour.

In the last 3 hours, the baker made 150 – 60 = 90 pies. The rate in the last 3 hours of the workday was thus 90 pies ÷ 3 hours = 30 pies per hour.

Now find the difference between the two rates of work:

30 pies per hour – 12 pies per hour = 18 pies per hour

14. **(E).** To solve a Rates & Work problem with multiple workers, modify the standard formula *Work* = *Rate* × *Time* to this:

Work = *Individual Rate* × *Number of Workers* × *Time*

Solve for an individual machine's rate, using the fact that 9 machines can stitch 27 jerseys in 4 minutes:

Work = *Individual Rate* × *Number of Workers* × *Time*

27 jerseys = (R)(9)(4 minutes)

$R = \frac{3}{4}$ jersey per minute

That is, each machine can stitch $\frac{3}{4}$ of a jersey in 1 minute. Plug that rate back into the formula, but using the details from the second sentence in the problem:

$$Work = Individual\ Rate \times Number\ of\ Workers \times Time$$

$$6 = \left(\frac{3}{4}\right)(4)(T)$$

$$T = 20$$

15. **(C)**. This question compares an actual scenario with a hypothetical one. Start by figuring out the rate (speed) for Brenda's actual walk. Since she walked 12 miles in 3 hours, she walked at a rate of $12 \div 3 = 4$ miles per hour.

Now, in the hypothetical situation, she would walk the loop two more times, for a total additional distance of $12 \times 2 = 24$ miles. Her hypothetical speed would be half of 4 miles per hour, or 2 miles per hour.

Walking 24 miles at a rate of 2 miles per hour would take Brenda $24 \div 2 = 12$ hours.

Alternatively, note that both of the changes—doubling the distance and halving the rate—have the same effect: Each change makes the trip take twice as long as it would have before. So the time required for this hypothetical situation is multiplied by four: $3 \times 4 = 12$ hours.

16. **(C).** In this "chase" problem, the two vehicles are moving in the same direction, with one chasing the other. To determine how long it will take the rear vehicle to catch up, *subtract* the rates to find out how quickly the rear vehicle is gaining on the one in front.

The police car gains on the train at a rate of $80 – 50 = 30$ miles per hour. Since the police car needs to close a gap of 50 miles, plug into the $D = RT$ formula to find the time:

$$50 = 30t$$

$$\frac{5}{3} = t$$

The time it takes to catch up is $\frac{5}{3}$ hours, or 1 hour and 40 minutes.

17. **(C).** "Cheat" off the easier quantity. In 40 minutes (from Quantity B), Rachel would assemble $40 \div 10 = 4$ brochures and Terry would assemble $40 \div 8 = 5$ brochures, for a total of $4 + 5 = 9$ brochures. Thus, Quantity A is also 40, and the two quantities are equal.

18. **(A).** If the search provider adds 2 identical servers to the original 4, there are now 6 servers. Because $6 \div 4 = 1.5$, the rate at which all 6 servers work is 1.5 times the rate at which 4 servers work:

9,600 searches per hour × 1.5 = 14,400 searches per hour

Now apply this rate to the given amount of work (216,000 searches), using the $W = RT$ formula:

$216{,}000 = 14{,}400 \times T$
$216{,}000 \div 14{,}400 = 15$ hours

19. **(D).** Since Sabrina and Janis are working together, add their rates. Sabrina completes 1 tank in 8

hours, so she works at a rate of $\frac{1}{8}$ tank per hour. Likewise, Janis works at a rate of $\frac{1}{13}$ tank per hour. Now, add these fractions:

$$\frac{1}{8}+\frac{1}{13}=\frac{13}{104}+\frac{8}{104}=\frac{21}{104}$$ tanks per hour, when working together.

Next, plug this combined rate into the $W = RT$ formula to find the time. You might also notice that since the work is equal to 1, the time will just be the reciprocal of the rate:

	Work (tank)	=	*Rate* (tanks per hour)	×	*Time* (min)
Sabrina & Janis:	1	=	$\frac{21}{104}$	×	$\frac{104}{21}$

At this point, you do not need to do long division or break out the calculator! Just approximate: $\frac{104}{21}$ is about 100 ÷ 20 = 5.

Alternatively, use some intuition to work the answer choices and avoid setting up this problem at all! You can immediately eliminate (A) and (B), since these times exceed either worker's individual time. Also, since Sabrina is the faster worker, Janis's contribution will be less than Sabrina's. The two together won't work twice as fast as Sabrina, but they will work *more* than twice as fast as Janis. Therefore, the total time should be more than half of Sabrina's individual time, and less than half of Janis's individual time. $4 < t < 6.5$, which leaves (D) as the only possible answer.

20. **(E).** To solve for average earnings, fill in this formula:

Total earnings ÷ Total hours = Average earnings per hour

Since the gold-dollar exchange rate is \$1 per 1,000 gold pieces, Phil's real dollar earnings for the 6 days were 540,000 ÷ 1,000 = \$540. His total time worked was 10 hours per day × 6 days = 60 hours. Therefore, his average hourly earnings were \$540 ÷ 60 hours = \$9 per hour.

21. **(D).** To find the new rate in words per hour, start by setting up an equation to find this value:

New words per hour = 10 + 2(Old words per hour)

The old rate was given in words per minute, so convert to words per hour:

10 words per min × 60 min per hour = 600 words per hour

Now plug into the equation:

New words per hour = 10 + 2(600) = 1,210

Note that it would be dangerous to start by working with the rate per minute. If you did so, you might calculate 10 + 2(10) = 30 words per minute, then 30 × 60 = 1,800 words per hour. This rate is inflated because you added an additional 10 words per minute instead of per hour. Perform the conversions right away!

22. **(D).** Since the two women are working together, add their rates. To find their individual rates, divide work by time. Never divide time by work! (Also, be careful when dividing the work by $\frac{1}{2}$. The rate is the reciprocal of $\frac{1}{2}$, or 2 tables per hour.)

Find Jenny and Laila's combined rate, then divide the work required (1 table) by this rate: 1 table ÷ $\frac{7}{3}$ table per hour = $\frac{3}{7}$ hour.

	Work (tables)	=	*Rate* (table per hour)	×	*Time* (hours)
Jenny	1	=	$\frac{1}{3}$	×	3
Laila	1	=	2	×	$\frac{1}{2}$
Jenny & Laila	1	=	$\frac{1}{3}+2=\frac{7}{3}$	×	$\frac{3}{7}$

23. **(A).** First, figure out the individual rate for 1 worker: 2 violins ÷ 3 minutes = $\frac{2}{3}$ violin per minute. (Always divide work by time to get a rate.) Now apply $W = RT$ separately to Quantity A and Quantity B.

Quantity A:

$R = 12 \times$ the individual rate $= 12 \times \frac{2}{3} = 8$ violins per minute

$W = 720$ violins

Solve for T in $W = RT$:

$720 = 8T$

$90 = T$

Quantity B:

$R = 5 \times$ the individual rate $= 5 \times \frac{2}{3} = \frac{10}{3}$ violins per minute

$T = 24$ minutes

Solve for W in $W = RT$:

$$W = \left(\frac{10}{3}\right)(24)$$

$$W = 80$$

Since 90 > 80, Quantity A is greater.

24. **(D).** To find Kurt's wait time, determine how long it will take for 200 people to board the Jelly Coaster. The problem states that 4 people board every 15 seconds. Since there are four 15-second periods in one minute, this rate converts to 16 people per minute. To find the time, divide the "work" (the people) by this rate:

200 people ÷ 16 people per minute = 200 ÷ 16 = 12.5 minutes.

The question asks for an approximation, and the closest answer is (D). In theory there may be an additional 15 seconds while Kurt's group is boarding (the problem doesn't really say), but Kurt's total wait time would still be approximately 13 minutes.

25. **(C).** To solve a Rates & Work problem with multiple workers, modify the standard formula *Work* = *Rate* × *Time* to this:

Work = *Individual Rate* × *Number of Workers* × *Time*

Solve for an individual chef's rate, using the fact that 8 chefs produce 3,200 tarts in 5 days:

Work = *Individual Rate* × *Number of Workers* × *Time*
3,200 tarts = (R)(8)(5 days)
R = 80 tarts per day

That is, each chef can produce 80 tarts per day. Plug that rate back into the formula for each of the quantities:

Quantity A
Work = *Individual Rate* × *Number of Workers* × *Time*
3,600 = (80)(*Number of Workers*)(3)
Number of Workers = 15

Quantity B
Work = *Individual Rate* × *Number of Workers* × *Time*
4,800 = (80)(4)(Time)
Time = 15 days

The number of chefs in Quantity A is equal to the number of days in Quantity B.

26. **(E).** When rate problems involve multiple situations, it can help to set up an initial "skeleton" $W = RT$ chart for the solution. That way, you can determine what data is needed and fill in that data as you find it. Since the question asks how long robot A will take alone, the chart will look like this:

	Work (pounds)	=	*Rate* (pounds per min)	×	*Time* (min)
Robot A	165	=	A's rate	×	t

Work is known and the question asks for time, so robot A's rate is needed. Call the rates a and b. Now set up another chart representing what you know about the two robots working together.

	Work (pounds)	=	*Rate* (pounds per min)	×	*Time* (min)
Robot A	$6a$	=	a	×	6
Robot B	$6b$	=	b	×	6
A & B together	$6(a + b) = 88$	=	$a + b$	×	6

Now, $6(a + b) = 88$ and, from the question stem, robot A's rate is $\frac{3}{5}$ of B's rate. This can be written as $a = \frac{3}{5}b$. To solve for a, substitute for b:

$$a = \left(\frac{3}{5}\right)b$$

$$\left(\frac{5}{3}\right)a = b$$

$$6(a+\left(\frac{5}{3}\right)a) = 88$$

$$6\left(\frac{8}{3}\right)a = 88$$

$$\left(\frac{48}{3}\right)(a) = 88$$

$$a = 88\left(\frac{3}{48}\right)$$

$$a = 88\left(\frac{1}{16}\right) = \left(\frac{88}{16}\right) = \frac{11}{2}$$

So A's rate is $\frac{11}{2}$ pounds per minute. Now just plug into the original chart:

	Work (pounds)	=	*Rate* (pounds per min)	×	*Time* (min)
Robot A	165	=	$\frac{11}{2}$	×	30

The time robot A takes to polish 165 pounds of gems is $165/\frac{11}{2} = \frac{330}{165} = 30$ minutes.

27. **(C)**. The question asks (indirectly) how far the two cars traveled, as those distances are necessary

to find the distance between them. Since the cars go in the same direction, the skeleton equation is as follows:

> Car A's distance – Car B's distance = Distance between cars
> All distances refer to the time when car A ran out of fuel.

Since the limiting factor in this case is A's fuel supply, calculate how far the car is able to drive before running out of fuel. This in itself is a rate problem of sorts:

> 30 miles per gallon × 8 gallons = 240 miles

So car A will end up 240 miles north of its starting point, which happens 240 ÷ 40 = 6 hours after it started. What about car B? It started an hour later and thus traveled (30 miles per hour)(6 hours – 1 hour) = 150 miles by that time.

Therefore, the two cars were 240 – 150 = 90 miles apart when car A ran out of fuel.

28. **(C)**. Note that choice (D) is a trap. This issue is relatively rare, but it's worthwhile to be able to recognize it if you see it. In this case, each robot is *independently* assembling complete doghouses. Since the question asks for the number of *completed* doghouses after $2\frac{1}{2}$ hours, any *incomplete* doghouses must be removed from the calculations.

Since one robot completes a doghouse in 12 minutes, the individual hourly rate is $60 \div 12 = 5$ doghouses per hour.

Therefore, each robot produces $5 \times 2.5 = 12.5$ doghouses in $2\frac{1}{2}$ hours. (Or just divide the 150 total minutes by 12 minutes per doghouse to get the same result.)

However, the questions asks about *completed* doghouses, and the robots are working independently, so drop the decimal. Each robot completes only 12 complete doghouses in the time period, for a total of $12 \times 10 = 120$ doghouses.

29. **(E)**. If twice as many bottles of Soda V as of Soda Q are filled at the factory each day, then twice as many bottles of Soda V as of Soda Q are filled at the factory each second.

Use smart numbers for the number of bottles filled each second. Since twice as many bottles of Soda V are produced, the output in one second could be 100 bottles of Soda V and 50 bottles of Soda Q. Using these numbers, the volume of the Q bottles is 500 liters ÷ 50 bottles = 10 liters per bottle and the volume of the V bottles is 300 liters ÷ 100 bottles = 3 liters per bottle. The ratio of the volume of a bottle of Q to a bottle of V is 10 liters ÷ 3 liters = $\frac{10}{3}$.