Percents

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 $\frac{\square}{\square}$, 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.

	Quantity A	**Quantity B**
1.	50 as a percent of 30	The percent increase from 30 to 80

2. If Ken's salary were 20% higher, it would be 20% less than Lorena's. If Lorena's salary is $60,000, what is Ken's salary?

(A) $36,000
(B) $40,000
(C) $42,500
(D) $42,850
(E) $45,000

Greta's salary was x thousand dollars per year, then she received a y% raise. Annika's salary was y thousand dollars per year, then she received an x% raise. x and y are positive integers.

	Quantity A	**Quantity B**
3.	The dollar amount of Greta's raise	The dollar amount of Annika's raise

Roselba's annual income exceeds twice Jane's annual income and both pay the same percent of their respective incomes in transportation fees.

4.

Quantity A	**Quantity B**
The annual amount Jane pays in transportation fees	Half the annual amount Roselba pays in transportation fees

An item's price was discounted by 16%. Later, the discounted price was increased by 16%.

5.

Quantity A	**Quantity B**
The original price	The price after the discount and increase

6. 12 is 5 percent of what number?

7. 7 percent of 9 is what percent of 7?

%

8. What percent of 13 is 20 percent of 195?

%

9. 25 percent of 30 is 75 percent of what number?

10. What is the percent increase from 50 to 60?

% increase

11. If x were reduced by 30%, the resulting number would be 63. What is the value of x?

12. What is 230% of 15% of 400?

13. 45% of 80 is x% more than 24. What is the value of x?

14. 10 percent of 30 percent of what number is 200 percent of 6?

15. If $y \neq 0$, what percent of y percent of 50 is 40 percent of y?

%

16. If $a \neq 0$, 200 percent of 4 percent of a is what percent of $\frac{a}{2}$?

%

17. If positive integer m were increased by 20%, decreased by 25%, and then increased by 60%, the resulting number would be what percent of m?

%

18.

Quantity A	**Quantity B**
The price of an item after five consecutive 10% discounts are applied	50% of the price of the item

19. Raymond borrowed $450 at 0% interest. If he pays back 0.5% of the total amount every 7 days, beginning exactly 7 days after the loan was disbursed, and has thus far paid back $18, with the most recent payment made today, how many days ago did he borrow the money?

(A) 6
(B) 8
(C) 25
(D) 42
(E) 56

At a warehouse, an order was shipped out, reducing the number of parts in inventory by half. Then a shipment of parts was received, increasing the current number of parts in inventory by 50%.

	Quantity A	**Quantity B**
20.	The number of parts in inventory before the two shipments	The number of parts in inventory after the two shipments

A house valued at $200,000 two years ago lost 40% of its value in the first year and a further 20% of that reduced value during the second year.

	Quantity A	**Quantity B**
21.	The current value of the house	$100,000

22. 1% of 200% of 360 is what percent of 0.1% of 60?

23. If Mary has half as many cents as Nora has dollars, then Nora has what percent more cents than Mary does? (100 cents = 1 dollar)

(A) 100%
(B) 200%
(C) 1,990%
(D) 19,900%
(E) 20,000%

24. The number that is 50% greater than 60 is what percent less than the number that is 20% less than 150?

(A) 5%
(B) 10%
(C) 15%
(D) 20%
(E) 25%

25. A cockroach population doubles every 3 days. In 30 days, by what percent would a cockroach population increase?

(A) 900%
(B) 1,000%
(C) 9,999%
(D) 102,300%
(E) 102,400%

26. After a 15% discount, the price of a computer was $612. What was the price of the computer before the discount?

(A) $108.00
(B) $520.20
(C) $703.80
(D) $720.00
(E) $744.00

At the end of April, the price of fuel was 40% greater than the price at the beginning of the month. At the end of May, the price of fuel was 30% greater than the price at the end of April.

	Quantity A	**Quantity B**
27.	The price increase in April	The price increase in May

28. Aloysius spends 50% of his income on rent, utilities, and insurance, and 20% on food. If he spends 30% of the remainder on video games and has no other expenditures, what percent of his income is left after all of the expenditures?

(A) 30%
(B) 21%
(C) 20%
(D) 9%
(E) 0%

29. In 1970, company X had 2,000 employees, 15% of whom were women, and 10% of these women were executives. In 2012, the company had 12,000 employees, 45% of whom were women. If 40% of those women were executives, what was the percent increase in the number of women executives from 1970 to 2012?

30. 75% of all the boys and 48% of all the girls at Smith High School take civics. If there are 20% fewer boys than there are girls in the school, what percent of all the students take civics?

Airline A and airline B both previously charged $400 for a certain flight. Airline A then reduced its price by 25%. Airline B responded by reducing its price by 55% but adding $150 in fees. Then, airline A increased its reduced price by 10%.

	Quantity A	**Quantity B**
31.	The final price of the flight on airline A	The final price of the flight on airline B

p is 75% of q and p equals $2r$.

	Quantity A	**Quantity B**
32.	$0.375q$	r

$0 < x < 100$

	Quantity A	**Quantity B**
33.	x% of 0.5% of 40,000	0.05% of 2,000% of $40x$

Profit Per Student (in Dollars) at Dan's Dojo, 2000–2004

2000	60
2001	80
2002	80
2003	100
2004	162

34. At Dan's Dojo, the percent increase from 2004 to 2005 (not shown) was the same as the percent increase from 2000 to 2001. What was the profit per student for 2005?

$ ☐

35. If x is 0.5% of y, then y is what percent of x?

(A) 199%
(B) 200%
(C) 2,000%
(D) 19,900%
(E) 20,000%

Bill pays 20% tax on his gross salary of $5,000 each month and spends 25% of the remaining amount on rent.

	Quantity A	**Quantity B**
36.	The monthly tax paid on Bill's salary	The rent paid monthly by Bill

37. Four people shared a dinner with an $80 bill and tipped the waiter 15 percent of this amount. If each person contributed equally to paying the bill and tip, how much did each person pay?

(A) $20.00
(B) $23.00
(C) $23.75
(D) $24.00
(E) $25.00

The price of a certain stock rose by 25 percent and then decreased by y percent. After the decrease, the stock was back to its original price.

	Quantity A	**Quantity B**
38.	y	25

39. A chemist is mixing a solution of acetone and water. She currently has 30 ounces mixed, 10 of which are acetone. How many ounces of acetone should she add to her current mixture to attain a 50/50 mixture of acetone and water if no additional water is added?

(A) 2.5
(B) 5
(C) 10
(D) 15
(E) 20

By the end of July, a certain baseball team had played 80% of the total games to be played that season and had won 50% of those games. Of the remaining games for the season, the team won 60%.

	Quantity A	**Quantity B**
40.	Percent of total games won for the season	52%

	Quantity A	**Quantity B**
41.	0.4 percent of 4 percent of 1.25	0.002

42. Jane has a 40-ounce mixture of apple juice and seltzer that is 30% apple juice. If she pours 10 more ounces of apple juice into the mixture, what percent of the mixture will be seltzer?

(A) 33%
(B) 44%
(C) 50%
(D) 56%
(E) 67%

Half of the shirts in a closet are white and 30% of the remaining shirts are gray.

	Quantity A	**Quantity B**
43.	The percent of the shirts in the closet that are not white or gray.	20%

The length and width of a painted rectangle were each increased by 10%.

	Quantity A	**Quantity B**
44.	The percent increase in the area of the painted rectangle	10%

45. If 35% of x equals 140, what is 20% of x?

(A) 9.8
(B) 39.2
(C) 80
(D) 320
(E) 400

46. A population of a colony of bacteria increases by 20 percent every 3 minutes. If at 9:00am the colony had a population of 144,000, what was the population of the colony at 8:54am?

(A) 100,000
(B) 112,000
(C) 120,000
(D) 121,000
(E) 136,000

The price of an item is greater than \$90 and less than \$150.

47.

Quantity A	**Quantity B**
The price of the item after a 10%-off discount and then a \$20-off discount	The price of the item after a \$10-off discount and then a 20%-off discount

48. The number that is 20 percent less than 300 is what percent greater than 180?

(A) 25

(B) $33\frac{1}{3}$

(C) 50

(D) $66\frac{2}{3}$

(E) 75

49. A tank that was 40% full of oil was emptied into a 20-gallon bucket. If the oil fills 35% of the bucket's volume, then what is the total capacity of the tank, in gallons?

(A) 8.75

(B) 15

(C) 16

(D) 17.5

(E) 19

50. If 150 were increased by 60% and then decreased by y percent, the result would be 192. What is the value of y?

(A) 20

(B) 28

(C) 32

(D) 72

(E) 80

51. If x is 150% greater than 200, x is what percent greater than 50% of 500?

(A) 0

(B) 20

(C) 50

(D) 100

(E) 200

52. 16 ounces of birdseed mix contains 10% sesame seed by weight. How much sesame seed must be added to produce a mix that is 20% sesame seed by weight?

(A) 1 ounce
(B) 1.6 ounces
(C) 2 ounces
(D) 2.4 ounces
(E) 4 ounces

a, b, and c are positive.

	Quantity A	**Quantity B**
53.	$(a + b)\%$ of c	$c\%$ of $(a + b)$

Conference Ticket Advance Discounts	
5-29 days in advance	15%
30-59 days in advance	30%
60-89 days in advance	40%

54. Helen paid $252 for a conference ticket. If she had purchased the ticket one day later, she would have paid $306. How many days in advance did she purchase the ticket?

(A) 5
(B) 30
(C) 59
(D) 60
(E) 89

Percents Answers

1. **(C).** 50 as a percent of 30 is $\left(\frac{50}{30}\times 100\right)\% = 166.\overline{6}\%$. (Note: it's incorrect to calculate "50 percent of 30," which is 15. This asked for 50 *as a percent* of 30, which is equivalent to asking, "What percent of 30 is 50?")

To find the percent increase from 30 to 80, use the percent change formula:

$$\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}}\times 100\right)\%$$

$$\text{Percent Change} = \left(\frac{80-30}{30}\times 100\right)\% = 166.\overline{6}\%$$

The two quantities are equal. Note that doing the final calculation in each quantity is not necessary, because both equal $\frac{50}{30} \times 100$.

2. **(B).** The question asks for Ken's salary, so set a variable: call Ken's salary k. Lorena's salary is \$60,000. Now, translate the equation in the first sentence.

"If Ken's salary were 20% higher" can be translated as Ken's salary + 20% of Ken's salary, or $k + 0.2k$. "It would be 20% less than Lorena's" can be translated as (Lorena's salary – 20% of Lorena's salary), or 60,000 – (0.2)(60,000). This is equivalent to (0.8)(60,000). Now solve:

$$1.2k = 0.8(60{,}000)$$
$$1.2k = 48{,}000$$
$$k = 40{,}000$$

Ken's salary is \$40,000.

3. **(C).** Because the problem never indicates real values, pick your own smart numbers. If $x = 100$ and $y = 50$, then:

> Greta's salary was \$100,000 and she received a 50% raise. Greta's raise, therefore, was \$50,000.
> Annika's salary was \$50,000 and she received a 100% raise. Annika's raise, therefore, was \$50,000.

The two quantities are equal. This holds true for any positive numbers chosen for x and y, because x percent of y = y percent of x. Thus, any two numbers can be used—just as 50% of 100 = 100% of 50, it is also true that 1% of 2,000 = 2,000% of 1, or a% of b = b% of a.

4. **(B).** Roselba's income is more than twice as great as Jane's income. If both pay the same percent of income in transportation fees, that means Roselba must pay *more* than twice as much as Jane in transportation fees. Quantity B is greater.

Alternatively, use smart numbers. Call Jane's income $100. Roselba's income, then, is greater than $200. If both pay 10% in transportation fees, then Jane pays $10 and Roselba pays more than $20. Half of Roselba's amount equals more than $10.

5. **(A).** The problem doesn't indicate any specific values, so pick a smart number. Because this is a percent problem, call the original price $100. Quantity A equals $100.

Decreasing a value by 16% is the same as taking (100 – 16)% = 84% of the number: so (0.84)(100) = $84. To increase the value by 16%, take 116% of the number, or multiply by 1.16: (1.16)(84) = $97.44.

Quantity A is greater.

6. **240.** Translate the question as $12 = 0.05x$ and solve on the calculator: $x = 240$. Alternatively, translate the question as $12 = \frac{5}{100}x$ and solve on paper:

$$12 = \frac{1}{20}x$$
$$(12)(20) = x$$
$$x = 240$$

7. **9**. Always translate the phrase "what percent" as $\frac{x}{100}$. Translate the question as:

$$0.07(9) = \frac{x}{100}(7)$$
$$0.63 = \frac{7x}{100}$$
$$63 = 7x$$
$$9 = x$$

Incidentally, the pattern "x percent of y = y percent of x" always holds true! Here, 7% of 9 = 9% of 7, but it is also true that 2% of 57 = 57% of 2, etc. This works with any two numbers. If you notice this, then you can "fill in the blank" on the answer immediately: "what percent" must be 9%.

Finally, notice that the answer is 9 and not 0.09 or 9%. The question asks “what percent,” so the percent is already incorporated into the sentence—the “what” by itself represents only the number itself, 9.

8. **300.** Always translate the phrase "what percent" as $\frac{x}{100}$. Translate the question as:

$$\frac{x}{100}(13) = 0.2(195)$$

$$\frac{13x}{100} = 39$$

$$13x = 3{,}900$$

$$x = 300$$

Alternatively, take 20 percent of 195 ($0.2 \times 195 = 39$) and rephrase the question: "What percent of 13 is 39?" Since 39 is three times as big as 13, the answer is 300.

9. **10.** Translate the question as $0.25(30) = 0.75x$ and solve on the calculator: $x = 10$.

Alternatively, write the percents in simplified fraction form and solve on paper:

$$\frac{1}{4}(30) = \frac{3}{4}x$$

$$30 = 3x$$

$$x = 10$$

10. **20% increase.** Use the percent change formula:

$$\text{Percent Change} = \left(\frac{Difference}{Original} \times 100\right)\%$$

$$\text{Percent Change} = \left(\frac{60-50}{50} \times 100\right)\% = \left(\frac{10}{50} \times 100\right)\% = (0.2 \times 100)\% = 20\%$$

11. **90.** Because 30% less than x is the same as 70% of x, translate as follows: $0.7x = 63$. Use the calculator to get $x = 90$. Alternatively, solve on paper:

$$\frac{7}{10}x = 63$$

$$x = (63)\left(\frac{10}{7}\right)$$

$$x = (9)(10)$$

$$x = 90$$

12. **138.** Translate into decimals (for the percents, move the decimal two places to the left) and use the calculator to solve:

$x = 2.3(0.15)(400)$

$x = 138$

Alternatively, translate into fractions and solve on paper:

$$\frac{230}{100} \times \frac{15}{100} \times 400 =$$

$$\frac{23}{10} \times \frac{15}{1} \times 4 =$$

$$\frac{23}{2} \times \frac{3}{1} \times 4 =$$

$$\frac{23}{1} \times \frac{3}{1} \times 2 = 138$$

13. **50.** The left-hand side of the equation is given: 45% of 80 is (0.45)(80) = 36. The problem then becomes: "36 is x% more than 24." From this step, there are two possible approaches.

One approach is to translate the equation and solve:

$$36 = 24 + \frac{x}{100}(24)$$

$$12 = \frac{24x}{100}$$

$$12\left(\frac{100}{24}\right) = x$$

$$50 = x$$

Alternatively, the increase (36 – 24) is 12, so rephrase the statement as "12 is x% of 24." Recognizing that 12 is half of 24, x must be 50. Or, translate and solve:

$$12 = \frac{x}{100}(24)$$

$$12\left(\frac{100}{24}\right) = x$$

$$50 = x$$

14. **400.** Translate as decimals and use the calculator to solve, keeping in mind that taking 200% of a number is the same as doubling it, or multiplying by 2:

$$\begin{aligned} 0.10(0.30)x &= 2(6) \\ 0.03x &= 12 \\ x &= 400 \end{aligned}$$

Alternatively, translate as fractions and solve on paper:

$$\left(\frac{1}{10}\right)\left(\frac{3}{10}\right)x = 2(6)$$

$$x = 12\left(\frac{100}{3}\right)$$

$$x = 400$$

15. **80.** The question already contains a variable (y). Use another variable to represent the desired value. Represent "what" with the variable x, and isolate x to solve. Notice that by the end, the y variables cancel out:

$$\left(\frac{x}{100}\right)\left(\frac{y}{100}\right)50 = \left(\frac{40}{100}\right)y$$

At this point, there are *many* options for simplifying, but do simplify before multiplying anything. Here is one way to simplify:

$$\left(\frac{x}{100}\right)\left(\frac{y}{2}\right) = \left(\frac{2}{5}\right)y$$

$$x = \frac{2y(100)(2)}{5y}$$

$$x = 80$$

16. **16.** 200% of 4% is the same as 2 × 4% (note that 200% equals the plain number 2), or 8%. Rephrase the question as "8% of a is what percent of $\frac{a}{2}$?" Without translating to an equation, this can

be simplified by multiplying both sides of the "equation" by 2 (remember that "is" means "equals"):

8% of a is what percent of $\frac{a}{2}$?

16% of a is what percent of a?

Thus, the answer is 16.

Alternatively, translate the words into math:

$$\left(\frac{200}{100}\right)\left(\frac{4}{100}\right)a=\left(\frac{x}{100}\right)\left(\frac{a}{2}\right)$$

$$\left(\frac{2}{25}\right)a=\frac{xa}{200}$$

$$\left(\frac{2}{25}\right)a\left(\frac{200}{a}\right)=x$$

$$16=x$$

17. **144.** If m were increased by 20%, decreased by 25%, and then increased by 60%, it would be multiplied by 1.2, then 0.75, then 1.6. Since (1.2)(0.75)(1.6) = 1.44, doing these manipulations is the same as increasing by 44%, or taking 144% of a number (this is true regardless of the value of m).

Alternatively, pick a real value for m. Because this is a percent problem, 100 is a good number to pick. First, 100 is increased by 20%: (100)(1.2) = 120. Next, 120 is decreased by 25%, which is the same as multiplying by 75%: (120)(0.75) = 90. Finally, 90 is increased by 60%: (90)(1.6) = 144. The new number is 144 and the starting number was 100, so the new number is $\left(\frac{144}{100}\right)$% of the original number, or 144%.

18. **(A).** Say the item costs $100. After the first 10% discount, the item costs $90. After the second, the item costs $81 (the new discount is only $9, or 10% of 90). After the third discount, the item costs $81 – $8.10 = $72.90. What is the trend here? The cost goes down with each discount, yes, but the discount itself also gets smaller each time; it is only a $10 discount the very first time. The total of the five discounts, then, will be less than $50.

If the item costs $100 to start, then the value for Quantity B will be $50, or a total discount of $50. This is greater than the total discount described for Quantity A.

Finally, make sure to answer (A) for the higher price—don't accidentally pick (B) for the "better deal"!

19. **(E).** 1% of $450 is $4.50, so 0.5% is $2.25. That's the amount Raymond pays back every week. Because he has paid back $18 in total, divide 18 by 2.25 to determine the total number of payments: $\frac{\$18}{\$2.25}=8$.

So Raymond has made 8 payments, once every 7 days. The payments themselves spread over only a

7-week period (in the same way that 2 payments spread over only a 1-week period). Raymond waited 1 week to begin repayment, however, so a total of 8 weeks, or 56 days, have passed since he borrowed the money.

20. **(A).** The number of parts in inventory first decreased by 50%, then increased by 50%. If the initial number of parts in inventory was x, the number after both shipments was $x(0.50)(1.5) = 0.75x$. The number of parts after the shipments was 75% of the number before, which is fewer. Quantity A is greater.

Alternatively, choose a smart number to test. If $x = 100$, then the inventory first decreased to 50, and then increased from 50 to 75. Quantity A is 100 and Quantity B is 75.

Finally, it is possible to solve this question using logic. The 50% decrease is taken as a percent of the original number. The 50% increase, however, is taken as a percent of the new, *smaller* number. The increase, therefore, must be smaller than the decrease, making the final value smaller than the original.

21. **(B).** To reduce \$200,000 by 40%, multiply by 0.6 (reducing by 40% is the same as keeping 60%): \$200,000(0.6) = \$120,000.

To reduce \$120,000 by 20%, multiply by 0.8 (reducing by 20% is the same as keeping 80%): \$120,000(0.8) = \$96,000. Quantity B is greater.

22. **12,000%.** Translate the statement into an equation. Since one of the percents is a variable, fractions are preferable to decimals:

$$\frac{1}{100}\times\frac{200}{100}\times 360=\frac{x}{100}\times\frac{0.1}{100}\times 60$$

Because 100 appears twice on the bottom of both sides of the equation, multiply each side of the equation by 10,000 (or 100 twice) to cancel the 100's out:

$$\frac{1}{\cancel{100}}\times\frac{200}{\cancel{100}}\times 360=\frac{x}{\cancel{100}}\times\frac{0.1}{\cancel{100}}\times 60$$

$$200\times 360=x(0.1)(60)$$

$$\frac{200\times 360}{60}=x\left(\frac{1}{10}\right)$$

$$200\times 6\times 10=x$$

$$x=12{,}000$$

The answer is 12,000%. (The phrase "what percent" translates into math as $\frac{x}{100}$. Additionally, $\frac{12{,}000}{100}$ is the same thing as 12,000%, just as $\frac{50}{100}$ is equal to 50%. While 12,000% may seem quite large, it is correct.)

Alternatively, use decimals, while still writing "what percent" as a fraction. Then, use the calculator to solve:

$$(0.01)(2)(360) = \frac{x}{100}(0.001)(60)$$

$$7.2 = \frac{x}{100}(0.06)$$

$$120 = \frac{x}{100}$$

$$12{,}000 = x$$

23. **(D).** Because no actual amounts of money are stated in the question, use smart numbers to solve this problem. If Mary has half as many cents as Nora has dollars, then, as an example, if Nora had $10, Mary would have 5 cents. Nora's $10 equals 1,000 cents. To determine what *percent more* cents Nora has, use the percent change formula:

$$\text{Percent Change} = \text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100\right)\%$$

$$\text{Percent Change} = \text{Percent Change} = \left(\frac{1{,}000-5}{5} \times 100\right)\% = 19{,}900\%$$

Any example in which "Mary has half as many cents as Nora has dollars" will yield the same result. Note that the percent change formula is required—a percent *more* (or percent increase) is not the same as a percent *of* something.

To do the problem algebraically (which is more difficult than using a smart number, as above), use M for Mary's cents and N for Nora's cents. Divide N by 100 in order to convert from cents to dollars, $\frac{N}{100}$, and set up an equation to reflect that Mary has half as many cents as Nora has dollars:

$$M = \frac{1}{2}\left(\frac{N}{100}\right)$$

$$M = \frac{N}{200}$$

$$200M = N$$

Therefore, Nora has 200 times as many cents. 200 times *as many* is 199 times *more*. To convert 199 times *more* to a percent, add two zeros to get 19,900%.

24. **(E).** Rather than trying to write out the whole statement as math, note that "the number that is 50% greater than 60" can be calculated: 1.5(60) = 90. Similarly, "the number that is 20% less than 150" is 0.8(150) = 120. The question can be rephrased as "90 is what percent less than 120?" Use the percent change formula. Since the question specifies a "percent *less,*" the "original" number is 120:

$$\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100\right)\% = \left(\frac{30}{120} \times 100\right)\% = 25\%$$

25. **(D).** The percent increase is the difference between the amounts divided by the original,

converted to a percent. If the population doubles, mathematically the increase can be written as a power of 2. In the 30-day interval, if the original population is 1, it will double to 2 after three days —so, 2^1 represents the population after the first increase, the second increase would then be 2^2 and so on. Since there are 10 increases, the final population would be 2^{10} or 1,024. Therefore, the difference, 1,024 – 1, is 1,023. Use the percent change formula to calculate percent increase:

Percent Change =

$$\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100 \right)\% = \left(\frac{1{,}023}{1} \times 100 \right)\% = 102{,}300\%$$

Note that the new number *is* 102,400% of the original, but that was not the question asked—the percent *increase* is 102,300%.

26. **(D).** Call the original price x. That price is discounted by 15% to get 612:

$$0.85x = \$612$$
$$x = \$720$$

Do not add 15% of \$612 to \$612. The 15% figure is a percent of the unknown original number, not of \$612.

27. **(B).** Call the original price x. At the end of April, the total price was $1.4x$. The price increase in April was $1.4x - 1x = 0.4x$.

In May, the price increased an additional 30% over April's final price of $1.4x$. Thus, the price at the end of May was $(1.3)(1.4)x$, or $1.82x$. The price increase in May was $1.82x - 1.4x = 0.42x$.

Since x is positive, $0.42x$ (42% of x) is greater than $0.4x$ (40% of x). Quantity B is greater.

Alternatively, use smart numbers. If the original price was \$100, April's increase would result in a price of \$140 and May's increase would be (1.3)(140) = \$182. Thus, April's increase was \$40 and May's increase was \$42. May's increase will be greater no matter what number is used as the starting price (it is reasonable in GRE problems to assume that a price must be a positive number).

28. **(B).** The 50% spent on rent, utilities, and insurance and the 20% spent on food are both percents of the total, so sum the percents: 50% + 20% = 70%. After these expenditures, Aloysius has 30% left. He then spends 30% *of the remaining 30%* on video games. 30% of 30% = 0.30 × 0.30 = 0.09, or 9% of the total, so 30% – 9% = 21% of his income remains.

Alternatively, use smart numbers. If Aloysius's income is \$100, he would spend \$50 on rent, utilities, and insurance, and \$20 on food, for a total of \$70. Of his remaining \$30, he would spend 30%, or \$9, on video games, leaving \$21, or 21%, of the original amount.

29. **7,100%.** In 1970, company X had 0.15(2,000) = 300 female employees. Of those, 0.10(300) = 30 were female executives.

In 2012, company X had 0.45(12,000) = 5,400 female employees. Of those, 0.40(5,400) = 2,160 were female executives.

Percent Change = $\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100\right)\%$

Percent Change = $\text{Percent Change} = \left(\frac{2130}{30} \times 100\right)\% = 7{,}100\%$

30. **60%.** Use smart numbers. There are 20% fewer boys than girls, so choose 100 for the number of girls (100 is a good number to pick for percent problems). Thus, there are (100)(0.8) = 80 boys in the

school. If 75% of all the boys take civics, then 0.75(80) = 60 boys take civics. If 48% of all the girls take civics, then 0.48(100) = 48 girls take civics.

Therefore, 60 + 48 = 108 students take civics and there are 180 total students:

$$\left(\frac{108}{180}\times 100\right)\% = 60\%$$

31. **(C).** Airline A reduced its price by 25% to ($400)(0.75) = $300, but then increased that price by 10% to ($300)(1.1) = $330. Airline B reduced its fare to ($400)(0.45) = $180, but added $150 in fees, bringing the total price to $180 + $150 = $330. The two quantities are equal.

32. **(C).** Write an equation from the first part of the given information: $p = 0.75q$. Since $p = 2r$, substitute $2r$ for p in the first equation:

$$\begin{aligned} 2r &= 0.75q \\ r &= 0.375q \end{aligned}$$

The two quantities are equal.

Alternatively, use smart numbers. If q is 8, then p is (8)(0.75) = 6. (Note: because you have to multiply q by 0.75, or $\frac{3}{4}$, try to pick something divisible by 4 for q, so that p will be an integer.)

Therefore, r is $\frac{6}{2} = 3$.

Since $0.375q = (0.375)(8) = 3$, the value for r is also 3. The two quantities are equal.

33. **(A).** When a percent contains a variable, use fractions to translate. Quantity A is:

$$\frac{x}{100}\times\frac{0.5}{100}\times\frac{40{,}000}{1} = x(0.5)(4) = 2x$$

Quantity B is:

$$\frac{0.05}{100}\times\frac{2{,}000}{100}\times\frac{40x}{1} = (0.05)(2)(4x) = 0.4x$$

Since x is positive, Quantity A is greater (this is true even if x is a fraction).

Alternatively, use smart numbers. If $x = 50$, then Quantity A equals:

$$\frac{50}{100}\times\frac{0.5}{100}\times\frac{40{,}000}{1}=(0.5)(0.5)(400)=100$$

Quantity B equals:

$$\frac{0.05}{100}\times\frac{2{,}000}{100}\times\frac{(40)(50)}{1}=(0.05)(2)(4)(50)=20$$

Quantity A is greater.

34. **216.** The percent increase from 2000 to 2001 is:

$$\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100 \right)\%$$

$$\text{Percent Change} = \left(\frac{20}{60} \times 100 \right)\% = 33.\overline{3}\%$$

Now, apply a $33.\overline{3}\%$, or $\frac{1}{3}$, increase to 2004's figure. The GRE calculator cannot accept a repeating decimal; instead, divide 162 by 3 to get the amount of increase, and then add 162 to get the new profit per student in 2005: $162 \div 3 + 162 = 216$.

35. **(E).** First, write "x is 0.5% of y" as math. Make sure you don't accidentally interpret 0.5% as 50%!

$$x = \frac{0.5}{100} \times y$$

The question asks "y is what percent of x?", so solve for y:

$$100x = 0.5y$$

$$200x = y$$

If y is 200 times x, multiply by 100 to convert to a percent:

$$\frac{200x}{1} \times \frac{100}{100} = \frac{20{,}000x}{100}$$

The answer is 20,000%. (For reference, if one number is 2 times as big as the other, it is 200% the size—add two zeros. So, 200 times as big = 20,000%.)

Alternatively, use smart numbers. If $y = 100$, then $x = \frac{0.5}{100}(100) = 0.5$. Next, answer the question, "100 is what percent of 0.5?" Pick a new variable to translate the "what percent" portion of the sentence:

$$100 = \frac{n}{100} \times 0.5$$

$$10{,}000 = 0.5n$$

$$20{,}000 = n$$

(In translating percents problems to math, always translate "what percent" as a variable over 100.)

36. **(C).** Bill's tax is (0.20)($5,000) = $1,000. Thus, his remaining salary is $4,000. His rent is therefore (0.25)($4000) = $1,000. The two quantities are equal.

37. **(B).** If four people shared the $80 bill equally, then each person paid for one-quarter of the bill, or $\frac{\$80}{4} = \$20$.

The tip is calculated as a percent of the bill. Because the question asks about the amount that each (one) person paid, calculate the 15% tip based solely on one person's portion of the bill ($20): (0.15)(20) = $3.

In total, each person paid $20 + $3 = $23.

Alternatively, find the total of the bill plus tip and take one-fourth of that for the total contribution of each person. The total of bill and tip is $80 + (0.15)($80) = $80 + $12 = $92. One-fourth of this is $\frac{\$92}{4} = \$23$.

38. **(B).** Use a smart number for the price of the stock; for a percent problem, $100 is a good choice. The price of the stock after a 25% increase is (1.25) × $100 = $125.

Next, find the percent decrease (y) needed to reduce the price back to the original $100. Because $125 – $25 = $100, rephrase the question: 25 is what percent of 125?

$$25 = \frac{x}{100}(125)$$

$$\frac{2{,}500}{125} = x$$

$$x = 20$$

You have to reduce 125 by 20% in order to get back to $100. Therefore, Quantity A is 20%, so Quantity B is greater.

39. **(C).** The chemist now has 10 ounces of acetone in a 30-ounce mixture, so she must have 20 ounces of water. The question ask how many ounces of acetone must be added to make this mixture a 50% solution. No additional water is added, so the solution must finish with 20 ounces of water. Therefore, she also needs a total of 20 ounces of acetone, or 10 more ounces than the mixture currently contains.

Note that one trap answer is (B), or 5. This answer is not correct because the final number of ounces in the solution is *not* 30; when the chemist adds acetone, the amount of total solution also increases—adding 5 ounces acetone would result in a solution that is $\frac{15}{(30+5)}$ acetone, which is not equivalent to a 50% mixture.

40. **(C).** Choose a smart number for the total number of games; for a percent problem, 100 is a good number to pick. If the total number of games for the season is 100 and the team played 80% of them by July, then the team played (100)(0.8) = 80 games. The team won 50% of these games, or (80)(0.5) =

40 games.

Next, the team won 60% of its *remaining* games. As there were 100 total games and the team has played 80 of them, there are 20 games left to play. Of these, the team won 60%, or (20)(0.6) = 12 games.

Therefore, the team has won a total of 40 + 12 = 52 games out of 100, or 52% of its total games. The two quantities are equal.

Alternatively, this problem could be done using weighted averages, where the total percent of games won is equal to the sum of all of the individual percents multiplied by their weightings. In this case:

Total Percent Won = (50%)(80%) + (60%)(100% – 80%) × 100%
Total Percent Won = [(0.5)(0.8) + (0.6)(0.2)] × 100%
Total Percent Won = [(0.4) + (0.12)] × 100%
Total Percent Won = 0.52 × 100%
Total Percent Won = 52%

41. **(B).** In order to compare, use the calculator to find 0.4 percent of 4 percent of 1.25 (be careful with the decimals!):

$0.004 \times 0.04 \times 1.25 = 0.0002$

Or, as fractions:

$$\frac{0.4}{100} \times \frac{4}{100} \times 1.25 = \frac{2}{1{,}000} = 0.0002$$

Quantity B is greater.

42. **(D).** Originally, Jane had a 40-ounce mixture of apple and seltzer that was 30% apple. Since 0.30(40) = 12, 12 ounces were apple and 28 ounces were seltzer.

When Jane pours 10 more ounces of apple juice into the mixture, it yields a mixture that is 50 ounces total, still with 28 ounces of seltzer. Now, the percent of seltzer in the final mixture is $\frac{28}{50} \times 100 =$ 56%.

43. **(A).** Choose a smart number for the total number of shirts in the closest; this is a percent problem, so 100 is a good number to pick. Out of 100 shirts, half, or 50, are white.

You know 30% of the *remaining* shirts are gray. If there are 50 white shirts, there are also 50 remaining shirts and so (0.3)(50) = 15 gray shirts. Therefore, there are 50 + 15 = 65 total shirts that are white or gray, and 100 – 65 = 35 shirts that are neither white nor gray. Since 35 out of 100 shirts are neither white nor gray, exactly 35% of the shirts are neither white nor gray.

Alternatively, use algebra, though that is trickier on a problem such as this one. Set a variable, such as x, for the total number of shirts. The number of white shirts is $0.5x$ and the remaining shirts would equal $x - 0.5x = 0.5x$. The number of gray shirts, then, is $(0.5x)(0.3) = 0.15x$. Thus, there are $0.5x + 0.15x = 0.65x$ white or gray shirts, and $x - 0.6x = 0.35x$ shirts that are neither white nor gray. Therefore, $0.35x \div x = 0.35$, or 35%.

44. **(A).** Choose smart numbers for the dimensions of the rectangle—for instance, length = 20 and width = 10.

The original area of the rectangle = length × width = 200

After a 10% increase for both the length and the width, the area becomes $22 \times 11 = 242$.

Use the formula for percent change:

$$\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100\right)\%$$

$$\left(\frac{242-200}{200} \times 100\right)\% = \left(\frac{42}{200} \times 100\right)\% = \left(\frac{21}{100} \times 100\right)\% = 21\%$$

Quantity A is greater.

Alternatively, use logic. The formula for area requires multiplying the length and the width. If just one side is increased by 10%, then the overall area will increase by 10%. If two sides are increased by 10%, then the overall area will increase by more than 10%.

45. **(C).** Translate the given information into math:

$$\frac{35}{100}x = 140$$

$$x = 140 \times \frac{100}{35}$$

$$x = 400$$

Next, find 20% of x, or 0.20(400) = 80.

46. **(A).** Every 3 minutes, the population increases by 20% (which is the same as multiplying by 1.2). Beginning at 8:54am, this change would occur at 8:57am and again at 9:00am. Use the variable x to represent the original quantity. Note that the 20% increase occurs twice:

$$x(1.2)(1.2) = 144{,}000$$

$$x = 100{,}000$$

Note that you cannot just reduce 144,000 by 20% twice, because 20% is not a percent of 144,000—it is a percent of the unknown, original number.

Alternatively, begin from 144,000 and calculate "backwards":

From 8:57am to 9:00am: $y(1.2) = 144{,}000$, so $y = \dfrac{144{,}000}{1.2} = 120{,}000$.

From 8:54am to 8:57am: $z(1.2) = 120{,}000$, so $z = \dfrac{120{,}000}{1.2} = 100{,}000$.

47. **(D).** Reducing a number by a percent involves multiplication; reducing a number by a fixed amount involves subtraction. The order of operations (PEMDAS) will make a difference.

One possible value for the item is \$100. In this case, the value of Quantity A = (\$100)(0.9) – \$20 = \$70. The value of Quantity B = (\$100 – \$10)(0.80) = \$72. Here, Quantity B is greater.

However, a greater starting value may change the result, because a 20% discount off a greater starting value can result in a much greater decrease. For a $140 item, the value of Quantity A = ($140)(0.9) – $20 = $106. The value of Quantity B = ($140 – $10)(0.80) = $104. Here, Quantity A is greater. The relationship cannot be determined from the information given.

48. **(B).** 20% less than 300 is the same as 80% of 300, or 0.80(300) = 240. The question is "240 is what percent greater than 180?"

Percent Change = $\left(\frac{Difference}{Original} \times 100\right)\%$

Percent Change = $\text{Percent Change} = \left(\frac{60}{180} \times 100\right)\% = 33.\overline{3}\%$

49. **(D).** First find the volume of oil in the bucket. The oil fills 35% of the bucket's 20-gallon volume, or (20)(0.35) = 7 gallons of oil.

These 7 gallons originally filled 40% of the tank. If T is the volume of the tank, $T(0.4) = 7$, so $T =$ 17.5 gallons.

50. **(A).** First, find the value of 150 increased by 60%: (150)(1.6) = 240. If 240 were then decreased by y percent, the result would be 192. Because 240 is decreased by 48 to get 192, the question can be rephrased: 48 is what percent of 240?

$$48 = \frac{x}{100}(240)$$

$$48\left(\frac{10}{24}\right) = x$$

$$x = 20$$

51. **(D).** "150% greater than 200" means 150% of 200, or 300, *added back to* 200. This is the not the same figure as 150% *of* 200. Thus, 150% greater than 200 is 200 + (200)(1.5) = 500.

50% of 500 = 250. Translate the question as "500 is what percent greater than 250?" Since 500 is twice 250, it is 100% greater than 250.

Alternatively, use the percent change formula.

$$\text{Percent Change} = \left(\frac{\textit{Difference}}{\textit{Original}} \times 100 \right)\%$$

$$\text{Percent Change} = \left(\frac{500 - 250}{250} \times 100 \right)\% = 100\%$$

52. **(C).** A 16-ounce mix that contains 10% sesame by weight has 1.6 ounces of sesame. It might be tempting to think that adding another 1.6 ounces would make a mixture that is 20% sesame. However, this is incorrect—adding 1.6 ounces of sesame will also add 1.6 ounces to the total amount of seed in the jar, reducing the concentration of sesame in the mix: $\left(\frac{3.2 \text{ ounces sesame}}{17.6 \text{ ounces total}} \times 100 \right)\% =$ 18.18%.

Instead, write an equation expressing the ratio of sesame to the total mixture, where x is the amount of sesame to add; this equals the desired 20% (or $\frac{1}{5}$) figure:

$$\frac{1.6+x}{16+x}=\frac{1}{5}$$

Cross-multiply and solve for x:

$$\begin{aligned} 5(1.6+x) &= 16+x \\ 8+5x &= 16+x \\ 4x &= 8 \\ x &= 2 \end{aligned}$$

53. **(C).** It is always the case that, for two positive quantities, M% of $N = N$% of M. In this case, (a + b) makes the problem appear more complicated, but the principle still applies. Algebraically:

Quantity A	**Quantity B**
$\frac{(a+b)}{100}\times c$	$\frac{c}{100}\times(a+b)$

Both quantities can be simplified to $\frac{c(a+b)}{100}$. The two quantities are equal.

54. **(B).** Helen bought a ticket for $252; if she had bought it one day later, she would have paid $54 more. There are three possibilities that represent the dividing lines between the given discount levels:

Possibility 1: She bought the ticket 60 days in advance for a 40% discount (if she'd bought it one day later, or 59 days in advance, she would have received a 30% discount instead).

Possibility 2: She bought the ticket 30 days in advance for a 30% discount (if she'd bought it one day later, or 29 days in advance, she would have received a 15% discount instead).

Possibility 3: She bought the ticket 5 days in advance for a 15% discount (if she'd bought it one day later, or 4 days in advance, she would not have received any kind of discount).

This question is harder than it looks, do not calculate a percent change between $252 and $306. The discounts are *percents of the full-price ticket*, which is an unknown value. Call it x.

Note that the only three possible answers are 5, 30, and 60 (answers (A), (B), and (D), respectively); 59 days ahead and 89 days ahead do not represent days for which the next day (58 and 88 days ahead,

respectively) results in a change in the discount.

Possibility 1 (60 days in advance): $252 would represent a 40% discount from the original price, so the original price would be $252 = 0.6$x$, and x would be $420.

If the full ticket price is $420, then buying the ticket 1 day later would result in a 30% discount instead, or ($420)(0.7) = $294. The problem indicates, however, that Helen would have paid $306, so Possibility 1 is not correct.

Possibility 2 (30 days in advance): $252 would represent a 30% discount from the original price, so the original price would be $252 = 0.7$x$ and x would be $360.

If the full ticket price is $360, then buying the ticket 1 day later would result in a 15% discount instead, or ($360)(0.85) = $306. This matches the figure given in the problem, so Possibility 2 is correct; you do not need to test Possibility 3. Helen bought the ticket 30 days in advance.