

Solutions - Practice QR Problems

1) **Answer:** 22,080 tons

Solution: Let's first find how many pounds of garbage the Texas A&M dispose of each year. Each student throws away 640 pounds and there are 69,000 students, so that's $640 \times 69,000$ or 44,160,000 pounds of garbage. To convert from pounds to tons we divide by 2,000: Texas A&M disposes of $44,160,000 \div 2,000 = 22,080$ tons of garbage each year.

2) **Answer:** \$1,565

Solution: The value of her investment grows exponentially. The equation for its value is $\$725(1.08)^t$, where t is the number of years since she started it, in 2020. The year 2030 is 10 years after 2020, so $t = 10$.

The value of her investment in 2030 is $\$725(1.08)^{10} = \$1,565$, when rounded to the nearest whole number of dollars.

3) **Answer:** 3 minutes, 45 seconds

Solution: To solve this problem, you need to use the *distance* that Maria drives. You need to start by converting the minutes into hours: Maria's normal commute is 0.25 hours. Use this and the the speed of 50 miles an hour to calculate the distance:

$$0.25 \text{ hours} \times \frac{50 \text{ miles}}{\text{hour}} = 12.5 \text{ miles}$$

Let T be the time it will take her the speed is lowered to 40 miles an hour. Then, since she's driving the same 12.5 mile route:

$$\begin{aligned} T \text{ hours} \times \frac{40 \text{ miles}}{1 \text{ hour}} &= 12.5 \text{ miles} \\ T \text{ hours} &= \frac{12.5 \text{ miles}}{\frac{40 \text{ miles}}{1 \text{ hour}}} \\ T \text{ hours} &= 0.3125 \text{ hours} \end{aligned}$$

Turn this back into minutes:

$$0.3125 \text{ hours} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 18.75 \text{ minutes}$$

Finally,

$$0.75 \text{ minutes} \times \frac{60 \text{ seconds}}{1 \text{ minute}} = 45 \text{ seconds}$$

Her total time is 18 minutes, 45 seconds. Subtract this from the usual 15 minutes commute to get the answer: 3 minutes, 45 seconds.

4) **Answer:** 38%

Solution: This is a percentage change problem. Let P be the percentage of eligible Wellesley students who voted in 2014. You want to know what P is, and know that 52.3% is 35.9% more than P . In other words:

$$P + 0.359P = 0.523$$

$$(1 + 0.359)P = 0.523$$

$$1.359P = 0.523$$

$$P = \frac{0.523}{1.359} = 0.3848$$

Round to the nearest whole percentage to get the answer, 38%.

5) **Answer:** a

Solution: Notice that the horizontal axis is the t axis, and the vertical is the s axis. You can rewrite the linear equation you were given as follows:

$$\begin{aligned}5s + 15 - t &= 0 \\5s &= t - 15 \\s &= \frac{(t - 15)}{5} \\s &= \frac{1}{5}t - 3\end{aligned}$$

The coefficient of t , $\frac{1}{5}$ tells you the slope of the line. Since it is positive, the line must be increasing, ruling out (b) and (d). When t is equal to 0, $s = -3$, so the line must cross the s axis (the vertical axis) at -3 . This means that (a) must be the answer, as (c) crosses the s axis at a positive number, not a negative one.

6) **Answer:** c

Solution:

(i) is a linear, decreasing function, meaning it always decreases by the same number.

(ii) is an exponential decreasing function, meaning that it always decreases by the same percentage.

(iii) is a linear, increasing function, meaning it always increases by the same number.

(iv) is an exponential increasing function, meaning that it always increases by the same percentage.

So (iii) increases by the same number each year, and (ii) decreases by the same percentage each year. That's option (c).

7) **Answer:** c

Solution: The coefficient of x tells you about the slope of the line. Using this, we can see that:

Equation (i) is decreasing, because x is multiplied by -0.8 . The only line that is decreasing is (D), so (i) must match (D).

Equation (ii) is growing faster than the others, because its x coefficient, 0.9 , is the largest. This means it is the steepest line, so (ii) must match A.

Equation (iii) and (iv) have the same slope, so they are parallel. Equation (iii) starts at 4 , when x is 0 , while equation (iv) starts at 8 when x is 0 . This means that (iii) is lower than (iv), so (iii) matches C and (iv) matches B. The correct multiple choice letter is then (c).

8) **Answer:** a, b, and c

Solution: The volume of water in the reservoir is only increasing when water is entering it, indicated by a positive rate of change on the graph. So, the water is only rising over intervals that fall above the X-axis above. That will be from intervals 0 to C (answer options a, b, and c above). It may be tempting to classify B to C as a time period in which water is flowing out of the reservoir, but the decreasing line just means that water is entering at a slower and slower rate. Similarly for F to G: the line segment is increasing but it falls below the X-axis, meaning that water is leaving the reservoir during this period (just at a slower rate than it was before).

9) **Answer:** 10%

Solution: In 1994, there were $\frac{3,600}{4,000}=0.9 = 90\%$ as many tuberculosis cases in New York state as there had been in 1993. That means that there were $1-0.9 = 0.1 = 10\%$ fewer cases. The number of tuberculosis cases dropped by 10%.

10) **Answer:** 1,800,000 pounds

Solution: The volume of the pool is $30 \times 10 \times 3 = 900 \text{ m}^3$. Convert the volume into cubic centimeters:

$$\begin{aligned} 900 \text{ m}^3 \times \left(\frac{100 \text{ cm}}{1 \text{ m}} \right)^3 &= 900 \text{ m}^3 \times \frac{100^3 \text{ cm}^3}{1^3 \text{ m}^3} \\ &= 900 \times 100^3 \text{ cm}^3 \\ &= 900,000,000 \text{ cm}^3 \end{aligned}$$

Now use the fact that $1,000 \text{ cm}^3$ weight 2 pounds to find the weight of this water:

$$900,000,000 \text{ cm}^3 \times \frac{2 \text{ lbs}}{1,000 \text{ cm}^3} = 1,800,000 \text{ lbs}$$

11) **Answer:** (c) and (e)

Solution:

Option (a) is false. 48% of Republicans polled thought marijuana should be made legal. That is less than half, so most did not.

For option (b), you cannot tell whether this statement is true. You know that a greater percentage of liberals than of conservatives or moderates supported legalization of marijuana, but you do not know the percentage of legalization supporters who are liberals.

Option (c) is true. 87% of liberals supported legalization, and only 49% of conservatives did

For option (d), you cannot tell from the data given. You do not know what percentage of people who thought marijuana should not be legalized were moderate, or liberal.

Option (e) is true. 48% of people who attended religious services weekly supported legalization, whereas 83% of Democrats did.

12) **Answer:** 6,300 miles

Solution: Let's break Jess's flights into groups based on the pricing scheme above.

- Each of her first 10 flights earn her 250 miles. That's 2500 miles total.
- Each of her next 10 flights (i.e. flights 11 to 20) earns 300 miles. That's 3000 miles total.
- Her 21st and 22nd flights each earn her 400 miles. That's 800 miles total.

Overall, Jess has earned $2500 + 3000 + 800 = 6,300$ miles

13) **Answer:** 6,885 BTU

Solution: Let's first convert your apartment's floor space from square meters to square feet. To convert from meters to feet, we would multiply by 3.28. But since we are dealing with area (m^2), we need to multiply by 3.28^2 . The square footage of your apartment is $32 \times 3.28^2 = 344.2688 \text{ ft}^2$. Now to find the BTU of the air conditioner we need, we multiply by twenty: $344.2688 \times 20 \approx 6,885 \text{ BTU}$

14) **Answer:** 199 eggs per person

Solution: We know that it costs \$31,000,000 to vaccinate all the chickens in the country at a rate of \$0.14 a bird. This means that there are about $\$31,000,000/\$0.14 = 221,428,571$ chickens in the country. Each one lays 270 eggs each year, so that's $221,428,571 \times 270 = 59,785,714,170$ eggs laid by all chickens total in a year. If there are 300,000,000 people in the U.S., that means the average number of eggs eaten by each person is:

$$\frac{59,785,714,170 \text{ eggs}}{300,000,000 \text{ people}} = 199.29 \text{ eggs per person} \approx 199 \text{ eggs per person}$$

15) **Answer:** 2.6%

Solution: Since the crime rate is the percentage of people who were victims of a crime, you calculate it with $\frac{\text{total number of crime victims}}{\text{total population}}$. The denominator, the total population of this area, is $110,000 + 34,000 + 25,000 = 169,000$. For the numerator, we need to calculate the total number of crime victims:

Cambridge had 3.5% of 110,000 = $0.035 \times 110,000 = 3,850$.

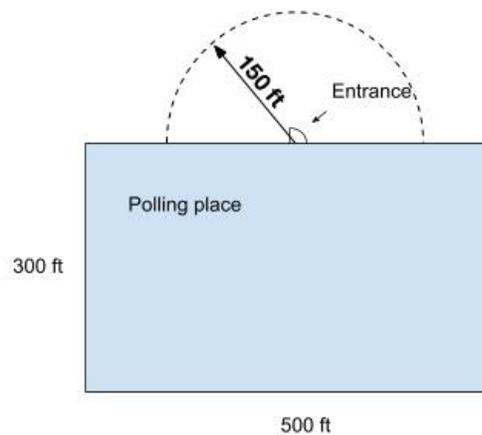
Watertown had 1.4% of 34,000 = $0.014 \times 34,000 = 476$.

Belmont had 0.6% of 25,000 = $0.006 \times 25,000 = 150$.

There were $3,850 + 476 + 150 = 4,476$ crime victims in this region. The total crime rate is thus $\frac{4,476}{169,000} = 0.026 = 2.6\%$, to the nearest tenth of a percentage.

16) **Answer:** $35,343 \text{ ft}^2$

Solution: Campaigning is prohibited 150 ft in every direction from the polling place entrance. What's the name for a shape formed by all points that are a set distance from some center point? It's a circle! In this case it's a semicircle (see the image below) since the campaigners cannot be in the building either. The campaigners cannot step inside the dotted line. To find the size of the area they cannot enter, we'll need to halve the equation for the area of a circle: $A = 0.5 \cdot \pi \cdot r^2 = 0.5 \cdot \pi \cdot (150 \text{ ft})^2 \approx 35,343 \text{ ft}^2$.



17) **Answer:** \$32.04

Solution: We'll use the rates of \$1.49 per gallon and 20 miles to the gallon to convert 430 miles into the amount it costs to drive this many miles:

$$Cost = 430 \text{ miles} \times \frac{1 \text{ gallon}}{20 \text{ miles}} \times \frac{\$1.49}{1 \text{ gallon}} = \$32.035 \approx \$32.04$$

18) **Answer:** 3.8 trips

Solution: This question is asking you to find the average number of trips taken, excluding people who took zero trips. This is asking you to calculate a weighted average in which certain trip numbers (e.g. 1 trip, 2 trips, etc.) that are more popular have more influence over the final average. We need to weight the trip numbers by their percentages and divide through by the percent total (don't worry that these percents no longer add up to 100):

$$\begin{aligned} \text{Avg trips taken} &= \frac{0.11 \cdot 1 + 0.10 \cdot 2 + 0.06 \cdot 3 + 0.05 \cdot 4 + 0.02 \cdot 5 + 0.03 \cdot 6 + 0.01 \cdot 7 + 0.01 \cdot 8 + 0.07 \cdot 9}{0.11 + 0.10 + 0.06 + 0.05 + 0.02 + 0.03 + 0.01 + 0.01 + 0.07} \\ &= \frac{0.11 + 0.20 + 0.18 + 0.20 + 0.10 + 0.18 + 0.07 + 0.08 + 0.63}{0.46} \\ &= \frac{1.75}{0.46} = 3.8 \end{aligned}$$

The average number of trips taken by people who took at least one trip is then 3.8.

19) **Answer:** \$564

Solution: The ratio of women's to men's pay in 1997 was 75% (or 0.75 as a decimal). Women in 1997 made \$423 a week on average. We can express all this in the following equation and solve for men's average pay:

$$0.75 = \frac{\$423}{\text{men's pay}}$$

$$0.75 \cdot \text{men's pay} = \$423$$

$$\text{men's pay} = \frac{\$423}{0.75}$$

$$\text{men's pay} = \$564$$

20) **Answer:** \$7.50

Solution: Let's first calculate the volume of mulch needed. The gardener wants to fill a rectangular prism that is 4 ft x 6 ft x 3 inches. To find the volume, we first convert inches to ft: 3 inches = 0.25 ft. The volume of mulch needed is then $4 \text{ ft} \times 6 \text{ ft} \times 0.25 \text{ ft} = 6 \text{ ft}^3$. Since the mulch costs \$1.25 per cubic foot and we need 6 cubic feet, this costs $6 \times \$1.25 = \7.50

21) **Answer:** Statements c and e are true.

Solution:

Statement (a) is false. The Apollo 11 computer had 72 (also written as 72×10^0) KB and punch cards had 8×10^{-2} KB of storage. To calculate how many punch cards worth of memory the Apollo computer had, we divide the former by the latter:

$$\frac{72 \times 10^0}{8 \times 10^{-2}} = \frac{72}{8} \times \frac{10^0}{10^{-2}} = 9 \times 10^2 = 900$$

So the Apollo 11 computer had as much memory as about 900 punch cards

Statement (b) is false. A Blue Ray disk holds 2.5×10^7 KB of memory. We can take this out of scientific notation by moving the decimal place to the right as many spaces as the exponent indicates (adding zeros as necessary): 2.5×10^7 KB = 25,000,000 KB. This is 25 million, not 250 million.

Statement (c) is true. Similar to part a, we need to divide the Blue Ray disk memory by the CD memory:

$$\frac{2.5 \times 10^7}{7 \times 10^5} = \frac{2.5}{7} \times \frac{10^7}{10^5} \approx 0.357 \times 10^2 = 35.7 \approx 36$$

Statement (d) is false. To figure out how many magnet tapes worth of memory a CD can hold, we divide CD memory by magnet tape memory:

$$\frac{4.8 \times 10^6}{2.3 \times 10^2} = \frac{4.8}{2.3} \times \frac{10^6}{10^2} \approx 2.09 \times 10^4 \approx 2 \times 10^4 = 20,000$$

So it would take 20,000 magnetic tapes to hold as much as one DVD, not 200.

Statement (e) is true. We divide the memory of the largest internal hard drive by the memory of a DVD to see how many DVD's it would take to hold as much memory as the largest internal hard drive:

$$\frac{1.8 \times 10^{10}}{4.8 \times 10^6} = \frac{1.8}{4.8} \times \frac{10^{10}}{10^6} = 0.375 \times 10^4 = 3,750$$

Statement (f) is false. To see how many more KB a DVD holds than a CD, we subtract the latter from the former. Note that we can only subtract these once they have the same exponent.

$$4.8 \times 10^6 - 7 \times 10^5 = 4.8 \times 10^6 - 0.7 \times 10^6 = 4.1 \times 10^6 = 4,100,000$$

This is 4.1 million, not 410 million.