1. Doug and Emily are driving cars on a track, and they both do 20 laps around a 1-mile track. Doug drives at an average of 60 miles per hour around the track while Emily drives at an average of 80 miles per hour. When Emily finishes her 20 laps, how many laps does Doug have left?

A. 0
B. 5
C. 10
D. 12
E. 4

2. Bryan and David go running in the park every morning. Bryan starts before David and is 30 meters ahead when David starts. Bryan runs at a rate of 2.5 meters per seond, while David runs at a rate of 4.0 meters per second. Which function shows the time t it takes David to catch up to Bryan?

A. $t = 30$
B. $4.0t = 30$
C. $2.5t = 30$
D. $1.5t = 30$
E. $1.5t = 60$

3. Ronny can walk 4 miles in t minutes. At that rate, how long will it take her to walk 11 miles?

A. $\frac{11t}{4}$
B. $t + 7$
C. $\frac{4t}{11}$
D. $\frac{t}{11}$
E. $\frac{4}{t}$

4. Two delivery trucks leave from a warehouse at the same time. The first one moves at 45 miles per hour and drives 1 hour west and 2 hours south. The second one moves at 60 miles per hour and drives 2 hours west and 1 hour south. What expression gives the distance between the two delivery trucks 3 hours after they leave the warehouse?

A. $\sqrt{(45+120)^2 + (90+60)^2}$
B. $\sqrt{(45-120)^2 - (90-60)^2}$
C. $\sqrt{(45-120)^2 + (90-60)^2}$
D. $\sqrt{(45-60)^2 + (90-120)^2}$
E. $\sqrt{(45-60)^2 + (90-45)^2}$

5. Neela ran uphill to her friend's house and it took her $\frac{t}{6}$ minutes. When she ran downhill back home, she ran 2.5 times as fast as she had uphill. How many minutes did her journey home take?

A. $\frac{5t}{12}$
B. $\frac{t}{15}$
C. $\frac{7}{30t}$
D. $\frac{12}{7t}$
E. $2.5t$

6. A monkey eats 13 bananas in 8 days. At this rate, how many bananas does the monkey eat in $8+n$ days where n is every additional day?

A. $\frac{13n}{8}$
B. $13 + \frac{n}{8}$
C. $13 + \frac{13n}{8}$
D. $13 + n$
E. $\frac{8+n}{13}$

7. A car's windshield washer fluid reservoir holds 540 ounces of washing fluid, and there is a small leak causing the fluid to leak out at a constant rate of 9 ounces per minute. The car is travelling at 50 miles per hour. If the reservoir starts full, in how many miles will the washer fluid reservoir be empty?

A. 45
B. 50
C. 55
D. 60
E. 65

8. A cylinder in a diesel engine displaces 2×10^3 cubic centimeters and there are 6×10^b oxygen molecules in the cylinder, what is the average number of oxygen molecules per cubic centimeter?

A. 3×10^3
B. 3×10^1
C. 3×10^0
D. 3×10^2
E. 3

For Questions 9-10, refer to the table below.

Monthly payment per $500 borrowed for various annual rates and numbers of payments			
Annual Interest Rate	Number of monthly payments		
	48	60	72
4%	11.29	9.21	7.82
7%	11.79	9.9	8.52
11%	12.92	10.87	9.52
13%	13.41	11.38	10.04

Paul is planning on purchasing a motorcycle, and he will need to borrow some money. The chart shows different monthly payments based on interest rates and loan terms.

9. Paul finds a motorcycle that costs $\$10{,}365$. He will have to borrow $\$7{,}000$. What will his monthly payment be if he borrows the money for 60 months at 11% interest?

A. $\$152.18$
B. $\$76.09$
C. $\$304.36$
D. $\$159.32$
E. $\$13.28$

10. Paul visits another dealership that is offering an end-of-the-year deal with 4% annual interest on loans for 48, 60, or 72 months. Paul can only manage to pay $\$100$ per month. What is the largest loan he can afford with his budget?

A. $\$4000$
B. $\$5000$
C. $\$6000$
D. $\$7000$
E. $\$8000$

11. A wheel of a tricycle is 5 inches in diameter. If it rolls along a line without slipping, how many inches has the wheel traveled after 50 revolutions?

A. 250π
B. 250
C. 500π
D. 500
E. 750π

12. Greg pushes a cart so that one wheel rotates $\frac{2\pi}{3}$ radians. What fraction of the circumference of the wheel has the wheel traveled?

A. $\frac{2\pi}{3}$

B. $\frac{1}{6}$

C. $\frac{1}{3}$

D. $\frac{2}{3}$

E. $\frac{3}{2}$

13. A cable has to be 7 mm thick for every 10 kg it supports. Which of the following expressions gives the thickness of the cable *in* centimeters required to support a weight of 300 stones? (Note: 1 stone $\approx$ 6.35 kg)

A. $\frac{(7)(6.35)(10)}{30}$

B. $\frac{(7)(6.35)(30)}{10}$

C. $\frac{(7)(6.35)}{(10)(10)(30)}$

D. $\frac{(7)(10)}{(6.35)(30)}$

E. $\frac{7}{(6.35)(30)}$

14. Chrissie is learning how to ride a unicycle with a wheel 30 inches in diameter. She can ride for 2 minutes before falling over. If she only moved in one direction and her wheel made 100 rotations during this time, what was her average speed *in feet per second* over that time interval?

A. 2.083π

B. 3.125π

C. 6.25π

D. 12.5π

E. 25π

15. A recipe for a turkey says to cook at $375°F$ for 35 minutes per 1.5 pounds. How long should a 9-pound turkey be cooked?

A. 3 hours

B. 2 hours 55 minutes

C. 3 hours 15 minutes

D. 3 hours 30 minutes

E. 4 hours

16. A motorcycle has wheels 24 inches in diameter. During 3 minutes, it makes 1620 revolutions. What is the average speed of the motorcycle, to the nearest mph? (Note: 5280 ft=1 mile)

A. 37 mph

B. 38 mph

C. 39 mph

D. 40 mph

E. 41 mph

17. There are 3 pieces of wood whose combined lengths equal to 75 inches. The lengths of the pieces are in the ratio $3:5:7$. What is the length, in inches, of the shortest piece?

A. 5 inches

B. 15 inches

C. 20 inches

D. 24 inches

E. 45 inches

18. Carlos, Rebecca, and Kylie all invest in a company and receive 40, 50, and 70 shares respectively. If the entire investment was $\$40{,}200$, then how much money did Carlos invest in the company?

A. $\$10{,}050$

B. $\$251.25$

C. $\$160$

D. $\$12{,}550$

E. $\$12{,}562.50$

19. The ratio of Roger's age to his son is $7:3$. If the sum of their age is 60, then how old is Roger's son?

A. 17 years old

B. 18 years old

C. 19 years old

D. 20 years old

E. 21 years old

20. What value for x makes the proportion below true?

$$\frac{8}{x-10}=\frac{4}{x+2}$$

A. 14
B. 7
C. 0
D. −7
E. −14

21. The local college accepts 2 out of every 11 students. If the school got 77,000 applicants this year, how many students were rejected from the school?

A. 63,000 students
B. 60,000 students
C. 14,000 students
D. 15,400 students
E. 56,000 students

22. Carol is baking cupcakes for a bake sale. She knows that 3 eggs will yield 5 cupcakes. If Carol wants to make 100 cupcakes, how many dozens of eggs would she have to buy?

A. 3 dozen
B. 4 dozen
C. 5 dozen
D. 6 dozen
E. 7 dozen

23. A larger rug is 30 feet long and 24 feet wide. What is the area, in square yards, of this rug?

A. $720\,yd^2$
B. $270\,yd^2$
C. $9\,yd^2$
D. $140\,yd^2$
E. $80\,yd^2$

24. James ran at a rate of 7 mph for the first 20 minutes of his run and 10 mph for 10 minutes after. What was the average rate, in miles per hour, that James ran during his 30 minute run?

A. 6 mph
B. 7 mph
C. 8 mph
D. 9 mph
E. 10 mph

25. A rectangular tabletop's length and width is in the ratio of 5:2. If the area of the tabletop is 90 square feet, then what is the perimeter of the tabletop in yards?

A. 16 yards
B. 36 yards
C. 90 yards
D. 14 yards
E. 9 yards

ANSWER KEY

1. B	**2. D**	**3. A**	**4. C**	**5. B**	**6. C**	**7. B**	**8. D**	**9. A**	**10. C**	**11. A**	**12. C**	**13. B**	**14. A**
15. D	**16. C**	**17. B**	**18. A**	**19. B**	**20. E**	**21. A**	**22. C**	**23. E**	**24. C**	**25. D**			

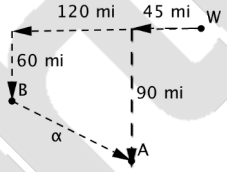
ANSWER EXPLANATIONS

1. **B.** When Emily finishes her 20 laps (20 miles), she would have spent $20\,miles * \frac{1\,hour}{80\,miles} = 0.25$ hours driving. In that same amount of time, Doug would have driven $0.25\,hours * \frac{60\,miles}{1\,hour} = 15$ miles (15 laps). So, at that time, Doug will still have $20 - 15 = 5$ laps left to drive.

2. **D.** If we set $t = 0$ to be the time at which David starts to run, then we can write Bryan's distance (B) as the formula $B = 30 + 2.5t$. David's distance (D) would be written as $D = 4t$. We set these distances to be equal and then solve for the time t that makes the equality true. The equality is when $B = D \rightarrow 30 + 2.5t = 4t$. Subtracting $2.5t$ on both sides, we get $30 = 1.5t$.

3. **A.** $11\,miles * \frac{t\,minutes}{4\,miles} = \frac{11t}{4}$ minutes for Ronny to walk 11 miles.

4. **C.** The first truck's distance traveled is calculated using the formula $distance = speed * time$. So, the first truck's distance traveled west is $d = 45\frac{mi}{hr} * 1hr = 45mi$ and his distance traveled south is $d = 45\frac{mi}{hr} * 2hrs = 90mi$. Likewise, the second truck's distance traveled west is $d = 60\frac{mi}{hr} * 2hrs = 120mi$ and his distance traveled south is $d = 60\frac{mi}{hr} * 1hr = 60mi$. This gives us the following diagram



The picture above illustrates the first truck's route starting from the warehouse (point W) to point A and the second truck's route from point W to point B. The distance between their locations after three hours is represented by $\propto$. To find $\propto$, we find the horizontal and vertical differences from point A to point B and use the Pythagorean Theorem to find $\propto$. The horizontal distance is $120\,mi - 45\,mi$ and the vertical distance is $90\,mi - 60\,mi$. So, plugging these values into the Pythagorean Theorem, we get $\propto = \sqrt{(120-45)^2 + (90-60)^2} = \sqrt{(45-120)^2 + (90-60)^2}$.

5. **B.** If Neela takes $\frac{t}{6}$ minutes to run uphill, and she runs 2.5 times as fast as her uphill speed on her way home, then she takes 2.5 times less time to complete the same commute. Thus, it will take her $\frac{t}{6}\left(\frac{1}{2.5}\right) = \frac{t}{15}$ minutes to get home.

6. **C.** $(8+n)days * \frac{13}{8}\frac{bananas}{days} = \frac{(8+n)13}{8} = \frac{13(8)+13n}{8} = 13 + \frac{13n}{8}bananas$.

7. **B.** First calculating the amount of fluid that is lost due to the leakage, we calculate $540 - 9t$ where t is in minutes. The fluid reservoir will be completely empty when $540 - 9t = 0$. Adding $9t$ to both sides, we get $540 = 9t$. Dividing both sides by 9, we get $60 = t$. So, in one hour, the reservoir will be empty. In one hour, the car will have traveled $1\,hour * 50\frac{miles}{hour} = 50\,miles$.

8. **D.** $\frac{6\times10^5\ molecules}{2\times10^3\ cubic\ centimeters}=3\times10^2\frac{molecules}{cubic\ centimeters}$.

9. **A.** Looking at the chart, we see that if Paul borrows the money for 60 months at 11% interest, he will have to pay 10.87 every month per $\$500$ borrowed. Paul is borrowing $\$7{,}000$, so his monthly payment can be calculated as $\$7{,}000*\frac{\$10.87}{\$500}=\$152.18$ per month.

10. **C.** We are looking for the maximum loan amount Paul can afford, so we want to look at the minimum rate of monthly payments. In this case, the minimum monthly payment amount offered with 4% annual interest for 48, 60, or 72 months is $\$7.82$ (the 72 month loan).We want to find the maximum loan amount x that would yield a monthly payment of less than $\$100$. This can be calculated by $\frac{\$7.82}{\$500}*x\le100$. $x\le100*\frac{\$500}{\$7.82}\rightarrow x\le\$6393.86$. So, the maximum loan amount he can afford is $\$6000$.

11. **A.** The circumference of the circle is calculated by the formula $C=\pi d$. Plugging in $d=5$, we get $C=5\pi$. So, for every revolution, the wheel travels 5π inches. After 50 revolutions, the wheel would have traveled $5\pi*50=250\pi$ inches.

12. **C.** One complete circle is 2π radians, so $\frac{2\pi}{3}$ radians is $\left(\frac{1}{3}\right)2\pi$ or $\frac{1}{3}$ of the circle.

13. **B.** We start with $7\,cm=10\,kg$. The distance isn't literally equivalent to the weight, but they are equivalent in their proportion to each other. This makes it easy to perform the upcoming calculations. First, find how thick of a cable is needed for $1\,kg$ by dividing both sides by 10: $\frac{7\,cm}{10}=1\,kg$. Next, convert the left side to centimeters by multiplying the left side by the proportion $\frac{1\,cm}{10\,mm}$. This gives us $\frac{7\,cm}{(10)(10)}=1\,kg$. Next, convert the left side to stone by multiplying it by the proportion $\frac{1\,stone}{6.35\,kg}$ to get $\frac{7\,cm}{(10)(10)}=\frac{1\,stone}{6.35}$. Isolate the unit of weight on the right side by multiplying both sides by 6.35 to get $\frac{(7)(6.35)}{(10)(10)}cm=1\,stone$. Finally, multiply both sides by 300 to get the right side equivalent to $300\,stone$. The final expression on the left side is $\frac{(7)(6.35)(300)}{(10)(10)}$. The only expression equivalent to this is answer choice (B).

14. **A.** Average speed is equal to the distance travelled divided by the time taken. In this case, the distance taken is equal to the number of revolutions times the circumference of the circle. The circumference of the circle is the diameter times π: 30π inches. The total distance covered is thus 100 rotations of this, or $100(30\pi)$ inches. The time taken was 2 minutes. However, we are looking for the speed in feet per second. Thus, we convert the distance by dividing it by 12, since there are 12 inches in a foot: $D=\frac{100(30\pi)}{12}$ inches. Time is multiplied by 60, for the 60 seconds in a minute: $T=2(60)=120$ seconds. The speed is thus $\frac{D}{T}=\frac{\frac{100(30\pi)}{12}}{120}$ seconds $=\frac{100(30\pi)}{12(120)}=\frac{3000\pi}{1440}=2.083\pi$.

15. D. The turkey is cooked at a rate of $\frac{1.5\,pounds}{35\,minutes}=\frac{1\,pound}{23\frac{1}{3}\,minutes}$, so if we want to cook 9 pounds, multiply top and bottom by 9: $\frac{9(1\,pound)}{9\left(23\frac{1}{3}\,minutes\right)}\rightarrow\frac{9\,pound}{210\,minutes}$. 210 minutes is 3 hours and 30 minutes (divide 210 by 60 to find the time in hours).

16. C. Here we use the fact that the word PER means DIVIDE. So we need $\frac{Miles}{Hour}$. Let's first convert from inches to miles. Find the unit equivalents and put the labels in the right places to make the labels cancel: $24\,inches\times\frac{1\,foot}{12\,inches}\times\frac{1\,mile}{5280\,feet}=\frac{1}{2640}\,miles$. Now I need to turn this diameter into the miles travelled. To do so, multiply by π to get the circumference $C=d\pi=\frac{1}{2640}\,mi\times\pi$ and then multiply the circumference times the number of revolutions $\frac{1}{2640}\times\pi\frac{mi}{rev}\times1620\,rev\approx1.93\,mi.$ Now we can find our number of hours, converting from 3 minutes: $3min\left(\frac{1hr}{60min}\right)=\frac{1}{20}hr.$ Finally we put these two pieces back into our original rate in miles per hour (miles divided by hours): $\frac{1.93mi}{\frac{1}{20}hr}=1.93*20\,mph=38.6\,mph$.

17. B. First, we set up an equation in which we use the ratio to find out how the 75 inches is divided amongst the three pieces: $3x+5x+7x=75\rightarrow15x=75\rightarrow x=5$. Now we plug in x to the smallest wood piece to find out its length: $3(5)=15\,inches$.

18. A. If the entire investment was worth $\$40{,}200$, then we can use algebra to figure out how much each share costs: $40x+50x+70x=40{,}200\rightarrow160x=40{,}200\rightarrow x=251.25$. If each share costs $\$251.25$, and Carlos has 40 shares he would have invested this much in the company: $40(251.25)=\$10{,}050$.

19. B. If the sum of their ages is 60, we can set up a simple equation to find out their individual ages: $7x+3x=60\rightarrow10x=60\rightarrow x=6$. Now we plug that into the ratio for the son's age: $3(6)=18\,years\,old$.

20. E. We cross multiply, getting: $8(x+2)=4(x-10)$. Now we can solve for x: $8x+16=4x-40\rightarrow4x=-56\rightarrow x=-14$.

21. A If 2 out of every 11 students are accepted, that means 9 out of 11 get rejected. We can use this new ratio to find out how many students were rejected this year: $\frac{9}{11}=\frac{x}{77{,}000}\rightarrow693{,}000=11x\rightarrow x=63{,}000$.

22. C. First, let's set up a proportion and solve for how many eggs Carol will need: $\frac{3}{5}=\frac{x}{100}\rightarrow300=5x\rightarrow x=60$. Now we divide the number of eggs to find out how many dozens we will need: $60\div12=5\,dozens\,of\,eggs$

23. E. The ratio of feet to yards is $3:1$. The ratio of square feet to square yards is $9:1$. The rugs area in square feet is $30\times24=720\,ft^2$. So we set that in our proportion for square yards: $\frac{1}{9}=\frac{x}{720}\rightarrow720=9x\rightarrow x=80\,yd^2$.

24. C. First, let's find out the total distance James ran. Don't forget to convert minutes to hours! We can do this by setting up proportions (miles/hours):

$$\text{First 20 minutes } \left(\frac{1}{3}\text{of hour}\right): \frac{7\ miles}{1\ hour} = \frac{x\ miles}{\frac{1}{3}\ hour} \rightarrow x = 2\frac{1}{3}\ miles$$

$$\text{Last 10 minutes } \left(\frac{1}{6}\text{of hour}\right): \frac{10\ miles}{1\ hour} = \frac{x\ miles}{\frac{1}{6}\ hour} \rightarrow x = 1\frac{2}{3}\ miles$$

If we add up the distances, we find that James ran 4 miles on his entire 30 minute ($\frac{1}{2}$ hour) run. Remember: $\frac{total\ distance}{total\ time} = average\ rate$. So: $\frac{4\ miles}{\frac{1}{2}\ hour} = 8\ mph$.

25. D. First let's find out the dimensions of the table in feet using algebra: $(5x)(2x) = 90 \rightarrow 10x^2 = 90 \rightarrow x^2 = 9 \rightarrow x = 3$. If $x = 3$, the dimensions of the tabletop must be 15 feet by 6 feet. Divide each by 3 feet to find yards: $15\ \cancel{feet} \times \frac{1\ yard}{3\ \cancel{feet}} = 5\ yards$; $6\ \cancel{feet} \times \frac{1\ yard}{3\ \cancel{feet}} = 2\ yards$. In yards, that is 5 yards by 2 yards. The perimeter than would be: $2(5) + 2(2) = 14\ yards$.