1. A

Let $4n$ and $n$ be the two numbers.

$4n + n = -15$ Their sum is $-15$.
$5n = -15$ Simplify.
$n = -3$
$4n = -12$
Since $-12$ is the smaller of two numbers, choice A is correct.

2. B

Average rate of change in profit

$$= \frac{\text{change in profit}}{\text{change in years}} = \frac{1{,}160{,}000 - 108{,}000}{2015 - 2010}$$

$$= \frac{1{,}052{,}000}{5} = 210{,}400$$

3. D

If $f(x)=\sqrt{x}+2$ and $g(x)=(x-1)^2$,
$f(a)=\sqrt{a}+2$.

$g(f(a))-2f(a)$
$=g(\sqrt{a}+2)-2(\sqrt{a}+2)$
$=((\sqrt{a}+2)-1)^2-2\sqrt{a}-4$
$=(\sqrt{a}+1)^2-2\sqrt{a}-4$
$=(\sqrt{a})^2+2\sqrt{a}+1-2\sqrt{a}-4$
$=a-3$

4. C

A system of two equations has no solution if the equations have the same slope but different $y$- intercepts. Change each equation in each answer choice into slope-intercept form.

A) $\frac{1}{5}x+\frac{1}{3}y=1 \Rightarrow y=-\frac{3}{5}x+3$

$3x-5y=15 \Rightarrow y=\frac{3}{5}x-3$

Their slopes are different, so they must have one solution.

B) $4x+3y=12 \Rightarrow y=-\frac{4}{3}x+4$

$3x-4y=6 \Rightarrow y=\frac{3}{4}x-\frac{3}{2}$

Their slopes are different, so they must have one solution.

C) $-3x+2y=7 \Rightarrow y=\frac{3}{2}x+\frac{7}{2}$

$\frac{1}{2}x-\frac{1}{3}y=3 \Rightarrow y=\frac{3}{2}x-9$

The slopes are the same, but their $y$- intercepts are different. Therefore, the system has no solution.

5. C

If a line in the $xy$- plane passes through the origin and has a slope of $-\frac{3}{4}$, the equation of the line is $y=-\frac{3}{4}x$.

Check each answer choice with the equation $y=-\frac{3}{4}x$.

A) Substitute $x=2$ and $y=-\frac{3}{2}$ in $y=-\frac{3}{4}x$.

$-\frac{3}{2}=-\frac{3}{4}(2)$ is true.

B) Substitute $x=-4$ and $y=3$ in $y=-\frac{3}{4}x$.

$3=-\frac{3}{4}(-4)$ is true.

C) Substitute $x=8$ and $y=-3$ in $y=-\frac{3}{4}x$.

$-3=-\frac{3}{4}(8)$ is not true.

Therefore, choice C is correct.

6. B

To find out the time it took for Mike to reach the finish line, solve the equation $-12t+1{,}500=0$ for $t$. Solving the equation for $t$ gives $t=125$. Substitute 125 for $t$ in the expression $-10.5t+1{,}500$.

$-10.5(125)+1{,}500=187.5$

Therefore, Maria has 187.5 meters to finish when Mike is on the finish line.

7. C

If the polynomial $f(x)$ is divided by $x+2$, the remainder is $f(-2)$. Based on the table, $f(-2)=2.5$. Therefore, when $f(x)$ is divided by $x+2$, the remainder is 2.5.

8. D

Set up a proportion for the following.

If $\frac{1}{2}$ tablespoon of ground coffee makes 4 cups of coffee, 3 tablespoons of ground coffee makes $c$ cups of coffee.

$$\frac{1/2 \text{ table spoon of ground coffee}}{4 \text{ cups of coffee}} = \frac{3 \text{ table spoons of ground coffee}}{c \text{ cups of coffee}}$$

$\frac{1}{2}c=3\cdot 4$ Cross Product

$c=24$ cups Simplify.

Since a thermos holds 2 quarts of liquid, which is 8 cups, 24 cups of coffee can be filled $24\div 8$, or 3 thermoses.

9. A

If the company sells $x$ feet of cable, the selling price is $30x$ and the cost of producing $x$ feet of cable is $C = 12.5x + 210$. Therefore,

$$\text{profit} = \text{selling price} - \text{cost}$$
$$= 30x - (12.5x + 210)$$
$$= 17.5x - 210$$

To make a profit, $17.5x - 210 > 0$.
Solving the inequality gives $x > 12$.

10. D

If the company sells 50 feet of cable, the profit is $17.5(50) - 210$, or 665 dollars.

11. C

If $x$ is the number of apple trees in Bernie's orchards, $2x$ is the number of apple trees in Alice's orchards, because Alice has twice as many apple trees as Bernie has. If $y$ is the number of peach trees in Alice's orchards, $1.5y$ is the number of peach trees in Bernie's orchards, because Bernie has 1.5 times as many peach trees as Alice. Therefore, the number of trees in Alice's orchards is $2x + y$ and the number of trees in Bernie's orchards is $x + 1.5y$. Since Alice's orchard has 110 more trees than Bernie's orchard, the expression $2x + y = x + 1.5y + 110$ is true. Since the total number of trees in both orchards is 1,050, the expression $2x + y + x + 1.5y + 110 = 1{,}050$ is true.

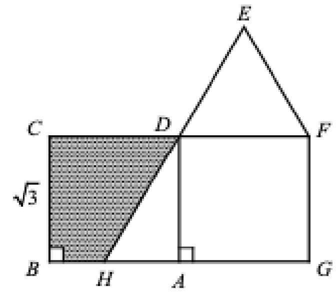
Choice C is correct.

12. D

Let $x =$ the number of miles he drove on the highway. Let $340 - x =$ the number of miles he drove in the city. The number of gallons of gas used is the number of miles drove divided by the gas mileage. Therefore, $\frac{x}{36} + \frac{340 - x}{24} = 10$.

| | |
|---|---|
| $72(\frac{x}{36} + \frac{340 - x}{24}) = 72(10)$ | LCD is 72. |
| $2x + 3(340 - x) = 720$ | Distributive Property |
| $2x + 1{,}020 - 3x = 720$ | Distributive Property |
| $-x = -300$ | |
| $x = 300$ | |

13. B




| | |
|---|---|
| $m\angle EDF = 60$ | Each $\angle$ of equilateral $\Delta$ is $60^\circ$. |
| $m\angle DHA = m\angle EDF$ | Corresponding angles are $\cong$. |
| $m\angle DHA = 60$ | Substitution |

Therefore, $\Delta DHA$ is a $30^\circ$-$60^\circ$-$90^\circ$ triangle.

| | |
|---|---|
| $HA \cdot \sqrt{3} = DA$ | In a $30^\circ$-$60^\circ$-$90^\circ$ $\Delta$, the longer leg is $\sqrt{3}$ times the shorter leg. |
| $HA \cdot \sqrt{3} = \sqrt{3}$ | $DA = CB = \sqrt{3}$ |
| $HA = 1$ | Divide each side by $\sqrt{3}$. |

Area of $\Delta DHA = \frac{1}{2} HA \cdot DA = \frac{1}{2}(1)(\sqrt{3}) = \frac{\sqrt{3}}{2}$

Area of shaded region is area of square $ABCD$ minus area of triangle $DHA$. Therefore,

area of shaded region $= 3 - \frac{\sqrt{3}}{2}$.

14. A

Rewrite the equation $x + 2y = 10$ as $y = -\frac{1}{2}x + 5$.

The slope of the line is $-\frac{1}{2}$. Any line parallel to the line can be written as $y = -\frac{1}{2}x + b$. If the line contains the point $(-2, 4)$, substitute $x = -2$ and $y = 4$ in the equation. $4 = -\frac{1}{2}(-2) + b \Rightarrow b = 3$

Therefore, $y = -\frac{1}{2}x + 3$ is parallel to $x + 2y = 10$ and contains the point $(-2, 4)$.

The slope of the second line which passes through the points $(6, 2)$ and $(-2, -2)$ is $\frac{2 - (-2)}{6 - (-2)}$ or $\frac{1}{2}$.

The point-slope form of the second line is $y - 2 = \frac{1}{2}(x - 6)$, which can be rewritten as $y = \frac{1}{2}x - 1$. Substitute $-\frac{1}{2}x + 3$ for $y$ in the equation to find the point of intersection.

$\frac{1}{2}x-1=-\frac{1}{2}x+3$ Substitution

$\frac{1}{2}x-1+\frac{1}{2}x=-\frac{1}{2}x+3+\frac{1}{2}x$ Add $\frac{1}{2}x$.

$x-1=3$ Simplify.

$x=4$

$y=\frac{1}{2}x-1=\frac{1}{2}(4)-1=1$

Therefore, the point of intersection $(r,s)=(4,1)$.

$r+s=4+1=5$

15. B

Actual earnings in 1995
Bank A $=10\times 0.4=4$ billion
Bank B $=10\times 0.29=2.9$ billion
Bank C $=10\times 0.15=1.5$ billion
Bank D $=10\times 0.08=0.8$ billion

Actual earnings in 2005
Bank A $=14\times 0.36=5.04$ billion
Bank B $=14\times 0.21=2.94$ billion
Bank C $=14\times 0.18=2.52$ billion
Bank D $=14\times 0.1=1.4$ billion

Bank B had actual amounts of earnings that were nearly equal in 1995 and 2005.

16. D

The actual earnings of Bank D rose from 0.8 billion in 1995 to 1.4 billion in 2005. The percent increase is

$\frac{\text{amount of increase}}{\text{amount in 1995}}=\frac{1.4-0.8}{0.8}=0.75$.

The percent increase of the actual earnings of Bank D from 1995 to 2005 is 75 percent.

17. C

$p=r-0.2r$ $p$ is 20% less than $r$.

$p=0.8r$ Simplify.

$r=s-0.2s$ $r$ is 20% less than $s$.

$r=0.8s$ Simplify.

$s=t-0.2t$ $s$ is 20% less than $t$.

$s=0.8t$ Simplify.

$p=0.8r=0.8(0.8s)=0.8(0.8(0.8t))=0.512t$

18. C

Let $m=$ the capacity of the medium container, then $4m=$ the capacity of the large container, and $\frac{4m}{9}=$ the capacity of the small container.

If $x$ small containers and $x$ large containers are needed to fill a water tank that could be filled with 120 medium size containers, then the equation $x(\frac{4m}{9})+x(4m)=120m$ can be used to solve the value of $x$.

$m(\frac{4}{9}x+4x)=120m$ Factor.

$(\frac{4}{9}x+4x)=120$ Divide each side by $m$.

$\frac{40}{9}x=120$ Simplify.

$\frac{9}{40}\cdot\frac{40}{9}x=\frac{9}{40}\cdot 120$ Multiply each side by $\frac{9}{40}$.

$x=27$

19. D

Let the number of female faculty members in engineering be $3x$ and let the number of male faculty members in engineering be $11x$. Then $3x+11x=56$.

$14x=56$ Simplify.

$x=4$ Divide each side by 14.

So, there are 12 female and 44 male faculty members in engineering.
Let the number of female faculty members in humanities be $9y$ and let the number of male faculty members in humanities be $4y$. Then $9y+4y=52$.

$13x=52$ Simplify.

$y=4$ Divide each side by 13.

So, there are 36 female and 16 male faculty members in humanities.

Now you are able to fill in the table.

| | Engineering | Humanities |
|---|---|---|
| Female | 12 | 36 |
| Male | 44 | 16 |
| Total | 56 | 52 |

There are altogether 48 female faculty members. If one female faculty member is randomly selected, the probability that she will be in humanities is $\frac{36}{48}=\frac{3}{4}$.

20. B

If the parabola has a minimum value at $x=1$, $x=1$ is the axis of symmetry. If $f(p)=f(-3)$, the distance from $p$ to $x=1$ is the same as the distance from $-3$ to $x=1$. Thus, $1-(-3)=p-1$.

$4=p-1$ Simplify.

$5=p$

21. A

$$x^2-x+y^2+2y-\frac{19}{4}=0$$

Add $\frac{19}{4}$ to each side.

$$x^2-x+y^2+2y=\frac{19}{4}$$

Add $(-1\times\frac{1}{2})^2$ and $(2\times\frac{1}{2})^2$ to complete the square for each variable.

$$x^2-x+\frac{1}{4}+y^2+2y+1=\frac{19}{4}+\frac{1}{4}+1$$

$$(x-\frac{1}{2})^2+(y+1)^2=6$$

The standard equation of a circle with center $(h,k)$ and radius $r$ unit is $(x-h)^2+(y-k)^2=r^2$.

Therefore, the radius of the circle is $\sqrt{6}$ and the area of the circle is $\pi(\sqrt{6})^2=6\pi$.

22. B

$g(x)=-(x^2-6x+5)-4(x-c)$

If $g(x)$ is divisible by $x+1$, $g(-1)=0$.

$$\begin{aligned}g(-1)&=-((-1)^2-6(-1)+5)-4(-1-c)\\&=-(1+6+5)+4+4c\\&=-12+4+4c\\&=-8+4c\end{aligned}$$

Therefore, if $g(-1)=0$, $-8+4c=0$ or $c=2$.

23. C

$$A_n=(1+\frac{r}{100})\cdot A_{n-1}+c$$

If Alan made an initial deposit of \$10,000 that earns at a fixed rate of 4 percent per year, and he adds a constant amount of \$3,000 to his account each year, then $A_0=10{,}000$, $r=4$ and $c=3{,}000$.

$$A_1=(1+\frac{4}{100})\cdot 10{,}000+3{,}000 \qquad n=1$$

$$=13{,}400$$

$$A_2=(1+\frac{4}{100})\cdot A_1+3{,}000 \qquad n=2$$

$$=(1+\frac{4}{100})\cdot 13{,}400+3{,}000 \qquad A_1=13{,}400$$

$$=16{,}936$$

$$A_3=(1+\frac{4}{100})\cdot A_2+3{,}000 \qquad n=3$$

$$=(1+\frac{4}{100})\cdot 16{,}936+3{,}000 \qquad A_2=16{,}936$$

$$=20{,}613.44$$

24. D

$$(x+3)(x-3)=4x$$
$$x^2-9=4x$$
$$x^2-4x-9=0$$

Use the quadratic formula to solve the equation.

$$\begin{aligned}x&=\frac{-b\pm\sqrt{b^2-4ac}}{2a}\\&=\frac{-(-4)\pm\sqrt{(-4)^2-4(1)(-9)}}{2(1)}\\&=\frac{4\pm\sqrt{16+36}}{2}=\frac{4\pm\sqrt{52}}{2}\\&=\frac{4\pm\sqrt{52}}{2}=\frac{4\pm2\sqrt{13}}{2}\\&=2\pm\sqrt{13}\end{aligned}$$

25. B

Since $(x^2-1)=(x+1)(x-1)$, $(x+1)(x-1)$ is the LCD of the numerator and the denominator.

$$\begin{aligned}\frac{\frac{1}{x+1}-1}{\frac{1}{x^2-1}+1}&=\frac{(\frac{1}{x+1}-1)(x+1)(x-1)}{(\frac{1}{x^2-1}+1)(x+1)(x-1)}\\&=\frac{(x-1)-(x+1)(x-1)}{1+(x+1)(x-1)}\\&=\frac{x-1-x^2+1}{1+x^2-1}\\&=\frac{x-x^2}{x^2}\\&=\frac{x(1-x)}{x^2}\\&=\frac{1-x}{x}\end{aligned}$$

26. A

The weighted average of two groups is the sum of the values of group 1 plus the sum of the values of group 2 divided by the total number of the values. In this question, the weighted average of two groups is 79.6, the sum of the values of boys is $81 \times 16$, the sum of the values of girls is $78n$, and the total number of values is $16+n$.
Use the weighted average formula.

$$79.6 = \frac{81 \times 16 + 78n}{16+n}$$

Multiply each side of the equation by $16+n$.

$$79.6(16+n) = 1296 + 78n$$
$$1273.6 + 79.6n = 1296 + 78n$$
$$1.6n = 22.4$$
$$n = \frac{22.4}{1.6}$$
$$= 14$$

27. A

| | |
|---|---|
| $2.95 + 0.12 = 3.07$ | Price within one SD |
| $2.95 + 2 \times 0.12 = 3.19$ | Price within two SD |
| $2.95 - 0.12 = 2.83$ | Price within one SD |
| $2.95 - 2 \times 0.12 = 2.71$ | Price within two SD |

The prices between \$2.71 and \$3.19 are within two standard deviations. Thus, \$2.69 is not within two standard deviations.

28. C

Volume of the cylindrical shape container
$= \pi r^2 h = \pi (10 \text{ cm})^2 (40 \text{ cm}) = 4{,}000\pi \text{ cm}^3$.
The container is 80 percent filled with punch, so the amount of punch in the container is
$4{,}000\pi \text{ cm}^3 \times 0.8 = 3{,}200\pi \text{ cm}^3$.
Since 1 fluid ounce $= 29.6 \text{ cm}^3$, dividing the amount of cubic centimeters by 29.6 will give the number of fluid ounces.
$(3{,}200\pi \text{ cm}^3) \div 29.6 \text{ cm}^3 \approx 339.63$ fluid ounces
To find out the number of cups, divide 339.63 by 12. $339.63 \div 12 \approx 28.3$

Therefore, the largest number of 12 ounce cups that she can pour from the container is 28.

29. D

$p(x) = 2x^3 - 5x^2 - 4x + 3$
Check each answer choice.

A) If $2x-1$ is a factor of $p(x)$, $p(\frac{1}{2}) = 0$.

$$p(\frac{1}{2}) = 2(\frac{1}{2})^3 - 5(\frac{1}{2})^2 - 4(\frac{1}{2}) + 3 = 0$$

Therefore, $2x-1$ is a factor of $p(x)$.

B) If $x+1$ is a factor of $p(x)$, $p(-1) = 0$.

$$p(-1) = 2(-1)^3 - 5(-1)^2 - 4(-1) + 3 = 0$$

Therefore, $x+1$ is a factor of $p(x)$.

C) If $x-3$ is a factor of $p(x)$, $p(3) = 0$.

$$p(3) = 2(3)^3 - 5(3)^2 - 4(3) + 3 = 0$$

Therefore, $x-3$ is a factor of $p(x)$.

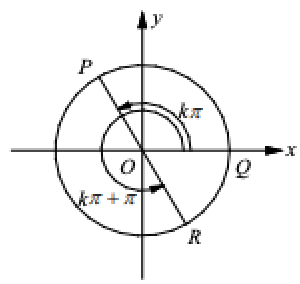
D) If $x-1$ is a factor of $p(x)$, $p(1) = 0$.

$$p(1) = 2(1)^3 - 5(1)^2 - 4(1) + 3 = -4 \neq 0$$

Therefore, $x-1$ is NOT a factor of $p(x)$.

Choice D is correct.

30. C




In the $xy$-plane above, the terminal side of $k\pi$ intersects the unit circle in quadrant II. In the unit circle, $\sin\theta = \frac{y}{1} = y$. If $\sin(k\pi) = a$, the $y$-coordinate of $P$ is $a$, for which $a > 0$. If the terminal side of $k\pi$ is in quadrant II, the terminal side of $k\pi + \pi$ intersects the unit circle in quadrant IV. The $y$-coordinate in quadrant II is positive but the $y$-coordinate in quadrant IV is negative. Therefore,

$$\sin(k\pi + \pi) = \frac{y}{1} = y = -a.$$

31. 1.5

The ratio of $a$ to $b$ is 2.25 times the ratio of $b$ to $a$. This can be written as $\frac{a}{b} = 2.25 \times \frac{b}{a}$.

$$\frac{a}{b} \cdot \frac{a}{b} = 2.25 \times \frac{b}{a} \cdot \frac{a}{b}$$ Multiply each side by $\frac{a}{b}$.