	A	B	C	D
Q1	2	1	-1	42
Q2	$\frac{2}{7}$	$\frac{1}{12}$	$\frac{1}{4}$	$-\frac{1}{2}$
Q3	$-\frac{1}{2}$	3	$\frac{3}{2}$	$\frac{2}{3}$
Q4	0	-4	$\frac{-3 \pm \sqrt{57}}{12}$	2
Q5	1, -1 or ±1	0, 2, 4	$\frac{7 \pm \sqrt{5}}{2}, \frac{7 \pm \sqrt{13}}{2}$	$\frac{-1}{3}, \frac{1}{5}$
Q6	70	10	6	0
Q7	9	-9	24	1027
Q8	4	3	7	$\frac{20}{7}$
Q9	4	2	7/2	4/5
Q10	105	$2\sqrt{10}$	5	6
Q11	20 hours*	45 minutes*	140 seconds*	24 minutes*
Q12	9	2	1/4	0
Q13	7	3	7	9
Q14	½	$1 + 2\sqrt{5}$ or $2\sqrt{5} + 1$	$\frac{-3 + \sqrt{5}}{2}$	-2

***NOTE: The units <u>must</u> be included in the answers to #11 to receive credit since some parts require unit conversions!**

1) A = 2, B = 1, C = –1, D = 42

A) Simplify each side of the inequality first. On the left you have $11x - 7$ and on the right you have $7x + 1$. Move the x's to the left and the constants to the right then divide by 4 and you'll get $x > 2$; which means 2 doesn't satisfy the inequality.

B) Fun Fact: both sides of this inequality are greater than or equal to zero. The only time this is true is when $x = 0$.

C) This expression is equivalent to $-(x+1)^2 \geq 0$ which can only be true when $x = -1$.

D) The square root of 48 is just below 7, so 7 is an integer that solves this inequality. 2401 is the square of 49, but as it's strictly less than, 49 doesn't work. We want all the numbers from 7 to 48, inclusive, which is 42 total.

2) A = $\frac{2}{7}$, B = $\frac{1}{12}$, C = $\frac{1}{4}$, D = 1

Work inside out! A) $g(2) = -\frac{3}{4}$, then $f(-\frac{3}{4}) = \frac{9}{7}$. Then subtract 1 to get $\frac{2}{7}$.

B) $f(2) = 6$, then $g(6) = -\frac{11}{12}$, then add 1 to get $\frac{1}{12}$.

C) Plug in $g(c) = 1$ and solve the equation $\frac{1-2c}{2c} = 1$. Multiply by $2c$ on both sides then add $2c$ to both sides and you'll get $1 = 4c$ or that $c = \frac{1}{4}$.

D) Re-write $g(x)$ as $\frac{1}{2x} - 1$. To maximize this, we want the term containing x to be as large as possible, but since x is in the denominator that means that x itself must be as small as possible. The smallest possible x on the given interval is 1

3) A = $-\frac{1}{2}$, B = 3, C = $\frac{3}{2}$, D = $\frac{2}{3}$

A) We have $2x^2 + 3x + 1 = 0 \rightarrow (2x+1)(x+1) = 0 \rightarrow 2x + 1 = 0 \ or \ x + 1 = 0 \rightarrow x = -\frac{1}{2} \ and \ x = -1$ are the two roots. The larger one is A = $x = -\frac{1}{2}$.

B) We have $x^2 + x - 12 = 0 \rightarrow (x-3)(x+4) = 0 \rightarrow x - 3 = 0 \ or \ x + 4 = 0 \rightarrow x = 3 \ and \ x = -4$ are the two roots. The larger one is B = $x = 3$.

C) We have $8x^2 - 14x + 3 = 0 \rightarrow (2x-3)(4x-1) = 0 \rightarrow 2x - 3 = 0 \ or \ 4x - 1 = 0 \rightarrow x = \frac{3}{2} \ and \ x = \frac{1}{4}$ are the two roots. The larger one is C = $x = \frac{3}{2}$.

D) This has a perfect square trinomial: $9x^2 - 12x + 4 = 0 \rightarrow (3x-2)^2 \rightarrow 3x - 2 = 0$. So, the answer is D = $x = \frac{2}{3}$.

4) A = 0, B = –4, C = $\frac{-3 \pm \sqrt{57}}{12}$, D = 2

A) $8 = 2^3$ so $8^{1-x} = 2^{3(1-x)}$ Then, we just equate exponents and solve: $2x + 3 = 3 - 3x$ to get $x = 0$.

B) Write $27^{2x} = 3^{6x}$ and $81^{x-2} = 3^{4x-8}$ and solve $6x = 4x - 8$ to get $x = -4$.

C) $49^{1/x} = 343^{1+2x} \rightarrow (7^2)^{\frac{1}{x}} = 7^{3+6x} \rightarrow \frac{2}{x} = 3 + 6x$ which gives us a quadratic equation: $6x^2 + 3x - 2 = 0$. We can solve this with the quadratic formula to get $x = \frac{-3\pm\sqrt{57}}{12}$.

D) This isn't one where you can just solve by equating exponents, but some power of 2 plus some power of 3 equals 25 should be somewhat familiar as the most famous Pythagorean triple of all: $3^2 + 4^2 = 5^2$. Here we have $x + 2 = 4$ and $2x - 2 = 2$; so, x should be 2.

5) A = 1, -1 or ±1, B = 0, 2, 4, C = $\frac{7\pm\sqrt{5}}{2}, \frac{7\pm\sqrt{13}}{2}$, D = $-\frac{1}{3}, \frac{1}{5}$

A) Either both expressions have the same sign or they have opposite signs. If they are the same, then we must solve $x - 2 = 2x - 1$ to get $x = -1$. If they are different, then we solve $2 - x = 2x - 1$ and get $x = 1$. The full solution is $x = \pm 1$.

B) Dropping the outside set of absolute value bars implies that $|x - 2| - 1$ is either 1 or -1, which means $|x - 2|$ is either 0 or 2. Solving $|x - 2| = 0$ is easy, it has only $x = 2$ as a solution. Solving $|x - 2| = 2$ has two solutions, they are 0 and 4. The full solution is $x = 0, 2, 4$.

C) Drop the absolute value bars to get two quadratic equations: $x^2 - 7x + 11 = 0$ and $x^2 - 7x + 9 = 0$. Solving both of these with the quadratic formula yields $x = \frac{7\pm\sqrt{5}}{2}, \frac{7\pm\sqrt{13}}{2}$.

D) Once again, we can split this fraction to make the solution easier. Write this as $|1 - \frac{1}{x}| = 4$. When we drop the absolute value sign, we either have $1 - \frac{1}{x} = 4$ or $1 - \frac{1}{x} = -4$. The first solves to $x = -\frac{1}{3}$ and the second solves to $x = \frac{1}{5}$. The full solution is therefore $x = -\frac{1}{3}, \frac{1}{5}$.

6) A = 70, B = 10, C = 6, D = 0

A) 13 half-gallons is 13/2 gallons which is 13*128/2 = 832 ounces. Each can is 12 ounces, so we divide this number by twelve and round up. 832/12=69.333… so she needs to open 70 cans to fill 13 half-gallon containers.

B) We have the system 12c + 16 b= 5*128 and c + b = 50. Using substitution, we can replace c in the first equation with c = 50 – b. Simplifying, we get 12(50 – b) + 16b = 640 -> 4b = 40 -> b = 10.

C) First, divide the volume of the fish tank by 128 and note the quotient and the remainder: 540 = 128(4) + 28. Now, note that 28 = 16 + 12. Thus, 540 = 128(4) + 16(1) + 12(1) and so we need 6 total containers to fill the tank.

D) This simplifies to (4*128/16) – (3*128/12) = 32 – 32 = 0.

7) A = 9, B = –9, C = 24, D = 1027

A) The divisibility by 9 rule states that the sum of the digits of an integer must be a multiple of 9 for an integer to be a multiple of 9, and 15 is not going to do it. It is easy enough to brainstorm up some examples of every other number.

B) $9240 = 2^3 \times 3 \times 5 \times 7 \times 11$ so $p = 11$ and $q = 2$, and we have $q - p = -9$.

C) All the even numbers are eliminated, as are multiples of 13. The list is 1, 3, 5, 7, 9, 11, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 41, 43, 45, 47, 49, 51 for a total of 24.

D) I'm asking for $2^2 + 3^2 + 5^2 + 7^2 + 11^2 + 13^2 + 17^2 + 19^2 = 1027$.

8) A = 4, B = 3, C = 7, D = $\frac{20}{7}$

A) Solve the second equation for x so that you get $x = 8y - 14$. Then plug this in for x in the first equation to get $16y - 28 + 3y = 10$ and solve to get $y = 2$, then plug back in to one of the equations to solve for x and find $x = 2$. 2 + 2 = 4.

B) Divide the second equation by 3 then solve for x or y and plug back into the first. You should end up with $x = 4$ and $y = -1$. 4 + (– 1) = 3.

C) Divide the second equation by 6 and then divide by x to get $y = \frac{12}{x}$. Plug this in to the first equation and solve your quadratic to get $x = 4$ and then back-substitute to get $y = 3$. 4 + 3 = 7.

D) Nastiness abounds here. Use substitution. x = 8y + 31 → 21y + 62 = -17 → 21y = -79 → y = -79/21.
x = 8(-79/21) + 31 = -632/21 + 651/21 = 19/21. -79/21 + 19/21 = 60/21 = 20/7.

9) A = 4, B = 2, C = $\frac{7}{2}$, D = $\frac{4}{5}$

A) The 2x in the middle indicates we need only even integers and they must lie between 3.6 and 11.04. The value of 2x which work are 4, 6, 8, and 10, (meaning x=2,3,4,5) so there are 4 solutions

B) Any squared number is at least 0, so we want to subtract the least amount possible. If x = 0, the value of the expression is 2.

C) Multiply both sides by x – 1 and rearrange into a quadratic equation $2x^2 - 7x + 3 = 0 \rightarrow (2x-1)(x-3) = 0$. The solutions are x = ½ and x = 3 and the sum of the solutions is $\frac{7}{2}$.

D) Cross multiply to get $x - 2 = 6x - 6$ which solves to $x = \frac{4}{5}$.

10) A = 105, B = $2\sqrt{10}$, C = 5, D = 6

A) If you combine all three of the numbers under one square root, you'll see two factors of 3(from the 15 and 21), two factors of 5 (from the 15 and 35), and two factors of 7 (from the 21 and 35). This means that the square root cancels the "squared" and the answer is 3*5*7 = 105.

B) $\sqrt{841} = 29$, so $\sqrt{11 + \sqrt{841}} = \sqrt{11 + 29} = \sqrt{40} = 2\sqrt{10}$.

C) The cube root of 729 is 9 so the problem reduces to the square root of 16 + 9, which is 5.

D) $2^5 + 2^5 = 2(2^5) = 2^1(2^5) = 2^{1+5} = 2^6$ so, x = 6.

11) A = 20 hours, B = 45 minutes, C = 140 seconds, 24 minutes

A) $\frac{1}{4} + \frac{2}{5} = \frac{13}{20}$ Then we divide 13 by $\frac{13}{20}$ to get 20 hours.

B) $\frac{2}{5} - \frac{1}{5} = \frac{1}{5}$ So, it takes 5 minutes per bucket and 9 buckets is 45 minutes.

C) $\frac{5}{7} + \frac{1}{4} = \frac{27}{28}$ Divide 135 by $\frac{27}{28}$ and we get 140 seconds.

D) $\frac{1}{2} + \frac{3}{4} = \frac{5}{4}$ Then divide 30 by $\frac{5}{4}$ to get 24 minutes.

12) A = 9, B = 2, C = ¼, D = 0

A) This factors into $(x-7)(x+2) = 0$ and the distance between roots is 9.

B) This factors into $(x-1)(x+1)(x-3) = 0$ and all the roots are 2 away from each other.

C) This factors into $(2x-1)(4x-3) = 0$ and the roots are ¼ apart.

D) This is equal into $(2x-1)^2 = 0$ so the distance between roots is 0.

13) A = 7, B = 3, C = 7, D = 9

A) The sum of the solutions is -b/a → -(-14)/2 = 7.

B) This factors into $(x-1)(x+1)(x-3)=0$, which has 3 solutions.

C) The roots do not move when you multiply the whole function by 2, because the y-value of the roots is 0 and 2*0 = 0. So, the sum of the roots is 7 because the quadratic factors to $(x-3)(x-4)$.

D) The solutions to a quadratic equation are equal distance away from the vertex. This means that they are $v+c$ and $v-c$ if c is the distance and v is the vertex. Their sum is then $v+c+v-c=2v$. Using this info, we just multiply 9/2 by 2 to get 9.

14) A = ½, B = $\mathbf{1+2\sqrt{5}}$ *or* $\mathbf{2\sqrt{5}+1}$, C = $\mathbf{\frac{-3+\sqrt{5}}{2}}$, D = –2

A) $\frac{1}{2}f(2+3)=\frac{1}{2}\times\frac{2}{2}=\frac{1}{2}$.

B) $g(2)=\sqrt{5}\ \rightarrow \left(2g(2)\right)+1=2\sqrt{5}+1$

C) $h(3)=\frac{-3+\sqrt{5}}{2}$

D) $g\left(\sqrt{3}\right)=2\ and\ f(2)=-2$.