

**Section A. Each correct answer is worth 1 point.**

1. **How many** positive integral factors does 2018 have?
2. Solve for  $x$ :  $20x + 20 = 18x + 18$
3. **Twin primes** (sometimes called pairs of primes) are prime numbers that differ by two, such as 3 and 5, 11 and 13, etc. List all twin primes between 50 and 70.
4. Find the percent of decrease from 20 to 18.
5. Find  $0.\overline{2018} - 0.\overline{1820}$  and express as a fraction (that is, a ratio of two integers) in simplest form.
6. The cube root of 2018 (that is,  $\sqrt[3]{2018}$ ) lies between what two positive integers?
7. The six-digit number  $62a11b$  is divisible by 9 **and** divisible by 11. What is the value of  $b$ ?

**Section B. Each correct answer is worth 2 points.**

**NOTE: In Problems 8–12, there may be NO ANSWER, ONE correct answer, or SEVERAL correct answers. Be sure to read the problem carefully and answer appropriately.**

8. Two sides of a right triangle have lengths of 9 and 10. Find the exact length of the third side.
9. Solve for  $\theta$  (in degrees), with  $0^\circ < \theta < 360^\circ$ , if  $\cos \theta = \frac{1}{2}$ .
10. Two trains A and B are on a straight track and are 300 miles apart. Train A is going 40 mph and Train B is going 50 mph. If they continue to travel on that track at those speeds, how many miles apart will they be after 2 hours?
11. Solve for  $x$ :  $3x^2 - 5x + 1820 = 2018 - 5x + 3(x^2 + 7)$
12. If  $x^2 - x - 20 = -18$ , find the value of  $20x - 18$ .

**Section C. Each correct answer is worth 3 points.**

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| 13. Given that 3, $a$ , $b$ , $c$ , 0 is a Fibonacci-style sequence, find the value of $b$ . | <i>A</i>    |
| 14. Find the <b>exact</b> area of quadrilateral <i>QUAD</i> on the right.                    | 12          |
| 15. Solve the inequality $ x - 2  > 1$ , and graph its solution on the given number line.    | 30 <i>D</i> |

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**Section A. Each correct answer is worth 1 point.**

1. Give an example of an integer which is *not* a natural number.
2. Find the vertex of the quadratic function  $y = 20x^2 - 18x$ . Express as the ordered pair  $(x, y)$ , where  $x$  and  $y$  are written to the nearest hundredth.
3. J. Denny Beaver bought an item and paid \$20.18, including sales tax of 10.9%. What was the cost of the item before the sales tax?
4. Find the value of  $x$  in degrees, where  $x$  is an acute angle, if  $\cos^2(x) = 1 - \sin^2(20.18^\circ)$ .
5. Only one positive integer is exactly twice the sum of its digits. Find this two-digit number.
6. Solve for  $x$ :  $20^{18/(x-2)} = 20$ .
7.  $f(x) = x^3 - 20x^2 + 18x + 2018$ . If the domain is  $\{-1, 0, 1\}$ , find the *sum* of all the values of the range.

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**Section B. Each correct answer is worth 2 points.**

8. The two legs of a right triangle have lengths 7 and 24. Find the exact length of the altitude going to the hypotenuse.
9. Jenny Beaver's jogging path is an equiangular triangle with vertices  $X, Y$ , and  $Z$ . She jogs at a constant speed of 3 mph from  $X$  to  $Y$ , a constant speed of 4 mph from  $Y$  to  $Z$ , and a constant speed of 6 mph from  $Z$  back to  $X$ . What is her average speed of the entire round trip?
10. Express 2018 in **base 8**. For example, 29 is  $35_{\text{eight}}$  because  $3 \cdot 8^1 + 5 \cdot 8^0 = 29$ , and 375 is  $567_{\text{eight}}$  because  $5 \cdot 8^2 + 6 \cdot 8^1 + 7 \cdot 8^0 = 375$ .
11. If  $2x^3 - 0x^2 + 1x - 8$  is divided by  $x + 1$ , what is the remainder?
12. Simplify and express in numerical form:  $\log_{20} 20 + \log_{18} 1 + \log_3 9 - \log_2 8 + \log_4 2$ .

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**Section C. Each correct answer is worth 3 points.**

13. A right circular cone has the same volume as a sphere. If the base of the cone has the same radius as the sphere, find the height of the cone in terms of that radius  $r$ .
14. A set of five natural numbers has a mean, median, and mode. The mean is 2018, and the median is 2 more than the mode. The two non-median and non-mode numbers are 2018 and 2070. Write the value of the mode.
15. Find the value of  $n$  if  $\sum_{k=1}^n (3k - 1) = 100$ .