UIL Number Sense Contest

Shortcuts for the More Experienced

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UIL High School Number Sense Test Problem Sequencing

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Problems 41 — 50 ***

1) **Laws of Exponents**
2) **Right Triangle Problems**
3) **Coordinate Geometry Problems**
4) **Regular Polygon Problems**
5) **Inequalities**

Problems 51 — 60 ***

1) **Applications of Theorems from Geometry**
2) **Direct and Inverse Variation**
3) **Sequences & Series (Finite & Infinite)**

Problems 51 — 70 ***

1) **Complex Numbers**
2) **Logarithms & Logarithmic Equations**
3) **Permutations & Combinations**
4) **Probability**
5) **Conics**
6) **Binomial Theorem (Expansion)**

Problems 61 — 70 ***

1) **Volume & Surface Area**
2) **Greatest Integer**
3) **Application of Remainder Theorem**
4) **Trigonometry**
5) **Determinants**
6) **Matrices**
7) **Vectors**
8) **Composite Functions**

Problems 71 — 80

1) **Value of Domain of a Given Function**
2) **Bases Involving Decimal Fractions**
3) **Polar/Rectangular Coordinates**
4) **Modular Arithmetic**
5) **Limits**
6) **Derivative**
7) **Slopes of Tangent Lines**
8) **Horizontal & Vertical Asymptotes**
9) **Determining Critical Values**
10) **Maximum & Minimum Problems**
11) **Definite Integration**

***** A type of problem from a particular section could appear later in the test.**
Example: A base problem could appear as problem #55, but should not appear earlier than problem #21.

Special Numbers -- What Pops into Your Mind?

1728	**1024**
1331	**289**
1.732...	**2.828...**
3.141...	**2.718...**
1.618	**720**
0.08333...	**0.0625**
1,1,2,3,5,8, ...	**2,1,3,4,7,11,...**
1,3,6,10,15,21, ...	**7,24,25**

Notes:

Mental Math -- How fast can you work these?

1. **6.25% of 48 =**

2. **144 ÷ 0.08333... =**

3. **6! × 5! =**

4. **Truncate $\sqrt{7}$ to a whole number**

5. **The 10^{th} term of 1,1,2,3,5,8, ... is**

6. **The 9^{th} triangular number is**

Notes:

Math Magic (Number Sense Tricks)

A. **Memorize the first 35 squares, the first 15 cubes, and the square roots of 2, 3, 5, 6, 7, 8, & 10.**

B. **Know the "One-sies" equivalents. (Fractions-Decimals-Percents)**

C. $\frac{12}{17} + \frac{17}{12} = ?$ **(Is it a trick? Is it magic? See proof)**

$\frac{12}{17} + \frac{17}{12} = 2\ \frac{25}{204}$ **(Is it magic ?)**

$\frac{a}{b} + \frac{b}{a}$ **Proof**

Let $x = \frac{a}{b} + \frac{b}{a}$

$x = \frac{(a^2 + b^2)}{ab}$ **(common denominator)**

$x - 2 = \frac{(a^2 + b^2)}{ab} - 2$ **(subtract 2 from both sides)**

$x - 2 = \frac{(a^2 + b^2 - 2ab)}{ab}$ **(common denominator)**

$x - 2 = \frac{(a - b)^2}{ab}$ **(binomial square)**

$x = 2 + \frac{(a - b)^2}{ab}$ **(solve for x)**

Any questions on any of these?

(41) $16_7 + 25_7 + 34_7$ = _____ $_7$

(42) $\sqrt{16 \times 18 + 1}$ = _____

(43) 96×0.3125 = _____

(44) The leg opposite the 45° angle in a right triangle is $\sqrt{18}$. The hypotenuse is _____

(45) The sum of the product of the roots taken two at a time of $3x^3 + 4x^2 - 17x - 6 = 0$ is _____

(46) If $xy = -1$ and $x + y = 5$ then $x^3 + y^3$ = ____

(47) If $9^{(x)} = 2187$ then $9^{(x-1)}$ = _____

(48) Find k, so that 917k55 is the smallest 6-digit number divisible by 11. _____

(49) The slope of a line containing the points (3, 2) and (— 4, 5) is _____

***(50)** $41\frac{2}{3}$% of 3690 — 58.7 = _____

(51) If $\log_x 108 - \log_x 4 = 3$ then x = _____

(52) Let $(10 + 5i)(8 - 4i) = a + bi$. Find $a + b$. ___

(53) If A is 24% more than B and B is 25% more than C, then A is _____ % more than C.

(54) $48^2 + 76^2$ = _____

(55) $11^4 \div 14$ has a remainder of _____

(56) If $\frac{x}{8}$ has a remainder of 7 and $\frac{y}{8}$ has a remainder of 5 then $\frac{xy}{8}$ has a remainder of ____

(57) 422×311 = _____

(58) How many different sets of 5 books can be made from 8 different books? _____

(59) The Cartesian product of the sets {f,i,v,e} and {f,o,u,r} contain how many ordered pairs? ____

***(60)** $8^4 \times 6^3 \div 4^2$ = _____

Any questions on any of these?

(61) $405 \times 111 =$ _____

(62) $(234_7 + 432_7) \div 6$ has a remainder of _____

(63) $\sin\left(\arccos\left(\frac{24}{25}\right)\right) =$ _____

(64) A bag contains 12 white and k yellow golf balls. Find k if the probability of randomly drawing a yellow ball is 25%. _____

(65) If $g(x) = 3x^2 - 4x + 2$, then $g(g(1)) =$ _____

(66) $1 + 3 + 8 + 21 + ... + 144 =$ _____

(67) $A = \begin{bmatrix} -1 & 3 \\ 5 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 7 & 3 \\ 5 & -1 \end{bmatrix}$. $|AB| =$ _____

(68) The Greatest Integer Function is written as $f(x) = [x]$. Find $\left[\tan \frac{2\pi}{3}\right]$. _____

(69) $\sin\left(\frac{5\pi}{6}\right) - \cos\left(\frac{4\pi}{3}\right) + \tan(3\pi) =$ _____

***(70)** $14 \times 24 \times 34 \times 44 =$ _____

(71) $6! \div 5! + 4! \div 3! - 2! \div 1! =$ _____

(72) $\sqrt{103041} =$ _____

(73) $\frac{1}{6} + \frac{1}{15} + \frac{1}{20} + \frac{1}{24} =$ _____

(74) The next term of 2, 3, 4, 6, 9, 14, ... is _____

(75) The horizontal asymptote for $f(x) = \frac{3 - 4x}{x - 5}$ is $y =$ _____

(76) If $f(x) = 3x^2 - 4x + 2$, then $f'(-1) =$ _____

(77) If the rectangular coordinates of the polar coordinates $(2, \frac{\pi}{4})$ are (x, y), then $x \times y =$ _____

(78) $\int_2^4 (x + 3)\, dx =$ _____

(79) Change $\frac{11}{36}$ to a base 6 decimal. _____

***(80)** 428.571 x 349 = _____