UIL HIGH SCHOOL MATHEMATICS MAGIC MEMORIZATION

1 hour = 60 minutes

1 minute = 60 seconds

1 foot = 12 inches

1 yard = 3 feet = 36 inches

1 pound = 16 ounces

1 gallon = 4 quarts = 128 ounces

1 quart = 2 pints = 32 ounces

1 pint = 2 cups = 16 ounces

1 cup = 8 ounces

1 gallon = 231 cubic inches

1 square mile = 640 acres

1 inch = 2.54 centimeters

1 foot = 30.48 centimeters

Normal body temperature = 98.6°F = 37°C

Boiling point of water = 212°F = 100°C

Freezing point of water = 32°F = 0°C

1 cubic foot = 1728 cubic inches

1 cubic yard = 27 cubic feet

16 tablespoons = 1cup

1 square foot = 144 square inches

1 square yard = 9 square feet

3 teaspoons = 1 tablespoon

1 mile = 1760 yards = 5280 feet

10 millimeters = 1 centimeter

1square mile = 640 acres

100 centimeters = 1000 millimeters = 1 meter

1 hectometer = 100 meters

1000 meters = 1 kilometer

1 dekameter = 10 meters

10 decimeters = 1 meter

1 year = 12 months = 365 days

Leap year = 366 days

DAYS IN MONTHS

January (31)	February (28 or 29)	March (31)
April (30)	May (31)	June (30)
July (31)	August (31)	September (30)
October (31)	November (30)	December (31)

PRIME NUMBERS

2	3	5	7	11	13	17	19	23	29	31	37	41
43	47	53	59	61	67	71	73	79	83	89	97	

GEOMETRY

(1) Sum of exterior angles of a regular polygon is 360°.

(2) Sum of interior angles of a regular polygon = 180°(n - 2)

(3) Measure of exterior angle = $\frac{360°}{n}$

(4) Measure of interior angle = $\frac{180° * (n-2)}{n}$

(5) Area of a regular polygon

(A) Given side : $\frac{ns^2}{4\tan(180°/n)}$

(B) Given apothem : $na^2\tan(180°/n)$

(C) Given radius : $\frac{nr^2\sin(360°/n)}{2}$

(6) Square

(A) Area = side^2 = $\frac{(diagonal)^2}{2}$ (B) Perimeter = 4s

(C) Length of diagonal = $s\sqrt{2}$

(7) Triangle

(A) Area = $\frac{1}{2}bh$

(8) Equilateral triangle

(A) Area $= \frac{s^2\sqrt{3}}{4} = \frac{h^2\sqrt{3}}{3}$ (B) Perimter = 3s

(9) Rectangle

(A) Area = lw (B) Perimeter = 2(l + w)

(10) Parallelogram

(A) Area = bh

(11) Trapezoid

(A) Area $= \frac{height(base_1 + base_2)}{2}$

(12) Rhombus

Area $= \frac{(diagonal)^2}{2}$

(13) Circle

(A) Area $= \pi r^2$ (B) Circumference $= 2\pi r = \pi d$

(14) Rectangular solid

(A) Surface Area = 2(lw + lh + wh)

(B) Inner diagonal $= \sqrt{length^2 + width^2 + height^2}$

(C) Volume = lwh

(15) Cube

(A) Total Surface Area $= 6e^2$ (B) Volume $= e^3$

(C) Inner diagonal $= e\sqrt{3}$

(16) Sphere

(A) Surface Area $= 4\pi r^2$ (B) Volume $= \frac{4}{3}\pi r^3$

(17) Right Circular Cylinder

(A) Lateral Area $= 2\pi rh$ (B) Total Surface Area $= 2\pi r^2 + 2\pi rh$

(C) Volume = $\pi r^2 h$

(18) Right Circular Cone

(A) Lateral Area = πrl (Note : l = slant height)

(B) Total Surface Area = $\pi rl + \pi r$ (C) Volume = $\frac{1}{3}\pi r^2$

MORE ADVANCED FORMULAS

(1) Compound Interest : $A = P(1 + \frac{r}{n})^{nt}$

(2) Compounding interest continuously : $A = Pe^{rt}$

(3) Laws of Sines : $\frac{Sin(A)}{a} = \frac{Sin(B)}{b} = \frac{Sin(C)}{c}$

(4) Laws of Cosines : $c^2 = a^2 + b^2 - 2abSin©$

(5) Heron's Formula : Area = $\sqrt{s(s-a)(s-b)(s-c)}$, where A is the area of a triangle with sides a, b, and c; s = semi-perimeter = $\frac{a+b+c}{2}$

(6) Radius (r) of circle inscribed in a triangle with sides a, b, and c :

$r = \frac{\sqrt{s(s-a)(s-b)(s-c)}}{s}$

(7) The area of a triangle given the length of two sides (a and b) and an included angle, C.

$A = \frac{1}{2}abSinC$

(8) Area of a sector of a circle given the radius, r, of the circle and the measure of the intercepted arc in radians, $\theta = \frac{1}{2}r^2\theta$.

(9) Area of a segment of a circle given the radius, r, of the circle and the intercepted arc in radians, $\theta = \frac{1}{2}r^2(\theta - \sin\theta)$

MISCELLANEOUS

(1) Arithmetic mean of a and b = $\frac{a+b}{2}$

Note : Arithmetic Mean = $\frac{a_1 + a_2 + a_3 + ...a_n}{n}$

(2) Geometric mean of a nd b = $\sqrt{ab}$

Note : Geometric Mean = $\sqrt[n]{a_1 a_2 a_3 ... a_n}$

(3) Harmonic mean of a nd b = $\frac{GeometricMean^2}{ArithmeticMean} = \frac{2ab}{a+b}$

Note : Harmonic mean of 3 terms = $\frac{3a_1 a_2 a_3}{a_1 a_2 + a_1 a_3 + a_2 a_3}$

(4) Mode : number that appears the most

(5) Range : difference of smallest and largest number given

(6) If $ax^2 + bx + c = 0$, then

(A) $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

(B) Discriminant = $b^2 - 4ac$

(C) Sum of the roots = $-\frac{b}{a}$

(D) Product of the roots = $\frac{c}{a}$

(7) If $ax^3 + bx^2 + cx + d = 0$, then

(A) Sum of the roots = $-\frac{b}{a}$

(B) Product of the roots = $-\frac{d}{a}$

(C) Sum of the product of the roots taken two at a time = $\frac{c}{a}$

(8) $(a + b)^2 = a^2 + 2ab + b^2$; $(a - b)^2 = a^2 - 2ab + b^2$

(9) $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

(10) $(a - b)^3 = = a^3 - 3a^2b + 3ab^2 - b^3$

(11) Given points (x_1, y_1) and (x_2, y_2)

(A) Slope = m = $\frac{y_2 - y_1}{x_2 - x_1}$

(B) Midpoint : $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

(C) Distance = d = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

(12) Probability = $\frac{Favorable}{TotalOutcomes}$; Odds = $\frac{Favorable}{Unfavorable}$

(13) If Tom can do a job in A hours and Jane can do the same job in B hours, how long will it take them to do the job together?

$$\frac{Both}{A(alone)} + \frac{Both}{B(alone)} = 1$$

(14) The sum of the coefficients of $(Ax + By)^n = (A + B)^n$

(15) A tangent and a secant intersect in a point in the exterior of a circle.

$$\frac{ExternalSegment}{Tangent} = \frac{Tangent}{Secant}$$

(16) Orthocenter : The point where the altitudes of a triangle intersect

(17) Centroid : The point where the medians of a triangle intersect.

(18) Circumcenter : The point where the perpendicular bisectors of the sides of a triangle intersect.

(19) Incenter : The point where the angle bisectors of a triangle intersect.

(20) Supplementary angles : two angles the sum of whose measures is 180°

(21) Complementary angles : two angles the sum of whose measures is 90

(22) Arithmetic sequence

(A) $t_n = a + (n - 1)d$

(23) Arithmetic series

(A) $S_n = \frac{n}{2}(a + t_n) = \frac{n}{2}[2a+(n-1)d]$

(24) Geometric Sequence

(A) $t_n = ar^{n-1}$

(25) Geometric Series

(A) $S_n = \frac{a(1-r^{n+1})}{1-r}$

(26) Infinite Geometric Series

(A) $S = \frac{a}{1-r}$

(27) Circle : $(x - h)^2 + (y - k)^2 = r^2$

(A) Center : (h, k) (B) radius = r

(28) Parabola : $(x - h)^2 = 4p(y - k)$

(A) Length of latus rectum = |4p|

(B) Vertex : (h, k)

(29) sin2A = 2sinAcosA

(30) $\sin^2 A + \cos^2 A = 1$

(31) $\text{TanA} = \frac{SineA}{CosA}$; $\text{CotA} = \frac{CosA}{SinA}$; $\text{SecA} = \frac{1}{CosA}$; $\text{CscA} = \frac{1}{SinA}$

(32) Angle of Inclination, B, of line with slope m.

(A) TanB = m

(33) The distance between a point (x_1, y_1) and a line, Ax + By + C = 0

(A) $d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$

(34) In a 45°-45°-90° triangle

(A) hypotenuse = $\text{leg}\sqrt{2}$

(35) In a 30°-60°-90° triangle

(A) hypotenuse = 2(short leg)

(B) long leg = (short leg)$\sqrt{3}$

(36) Lucas numbers : 1, 3, 4, 7, 11, 18. 29. 47. 76. 123. 199, 322, 521 ...

(A) $L_n = \left[\left(\frac{1+\sqrt{5}}{2}\right)^n\right]$; Note : The "nint" function is the "nearest integer function" and is denoted by [x] which means the nearest integer to the number x. The Golden Mean is equal to $\frac{1+\sqrt{5}}{2}$ which is approximately equal to 1.618.

(37) Fibonacci numbers : 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, ...

(A) $F_n = \left[\frac{\left(\frac{1+\sqrt{5}}{2}\right)^n}{\sqrt{5}}\right]$ Note : The "nint" function is the "nearest integer function" and is denoted by [x] which means the nearest integer to the number x.

(38) Deficient number : If the sum of the positive integral divisors of a number is less than twice the number, the number is a deficient number (Examples : 1, 2, 3, 4, 5, 8, 9, 10, 11, 13, 14, 15, 16,...)

(39) Perfect number : If the sum of the positive integral divisors of a number is equal to twice the number, the number is a perfect number (Examples : 6, 28, 496, ...)

(40) Abundant number : If the sum of the positive integral divisors of a number is greater than twice the number, the number is an abundant number (Examples : 12, 18, 20, 24, ...)

(41) Factorials

(A) 0! = 0 ; 1! = 1 ; 2! = 2 3! = 6 4! = 24 ; 5! = 120

6! = 720

(42) Permutations

(A) Permutation of n things taken r at a time = $\frac{n!}{(n-r)!}$

(43) Combinations

(A) Combination of n things taken r at a time = $\frac{n!}{r!(n-r)!}$

(44) Laws of Exponents

(A) $\left(a^m\right)\left(a^n\right) = a^{m+n}$

(B) $\frac{a^m}{a^n} = a^{m-n}$

(D) $(a^m)^n = a^{mn}$

(45) Laws of Logarithms

(A) $\text{Log}_b M + \text{Log}_b N = \text{Log}_b MN$

(B) $\text{Log}_b M - \text{Log}_b N = \text{Log}_b \frac{M}{N}$

(C) $\text{Log}_b M^p = p\text{Log}_b M$

(D) Change of base : $\text{Log}_b M = \frac{LogM}{Logb}$

(46) $\text{Lim}_{x\to\infty} \frac{ax^n + bx^{n-1} + \ldots}{cx^n + dx^{n-1} + \ldots} = \frac{a}{c}$

(47) Interest = Principal x Rate x Time

(48) Distance = Rate x Time

(49) Cevian : A line segment joining the vertex of a triangle to any point on the opposite side.

(50) General equation of a conic section is $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$

(A) If θ is the angle of rotation, then $\cot 2\theta = \frac{A-C}{B}$

(B) If $B^2 - 4AC < 0$, the conic is either an ellipse or a circle.

(C) If $B^2 - 4AC = 0$, the conic is a parabola.

(D) If $B^2 - 4AC > 0$, the conic is hyperbola.

(51) $r_1(\cos\theta_1 + i\sin\theta_1) \bullet r_2(\cos\theta_2 + i\sin\theta_2) = r_1 r_2[\cos(\theta_1 + \theta_2) + i\sin(\theta_1 + \theta_2)$

(52) $\frac{r_1(\cos\theta_1 + i\sin\theta_1)}{r_2(\cos\theta_2 + i\sin\theta_2)} = \frac{r_1}{r_2}[\cos(\theta_1 - \theta_2) + i\sin(\theta_1 - \theta_2)]$

(53) $(\text{rcis}\,\theta)^n = r^n \text{cisn}\,\theta$

(54) Although the cross product of two vectors can be solved by a formula, it is solved more easily if set up as a 3 x 3 determinant. If $v = (x_1, y_1, z_1)$ and $w = (x_2, y_2, z_2)$, the v x w =

$$\begin{vmatrix} i & j & k \\ x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \end{vmatrix} = ai + bj + ck \; ; \; \text{Answer : (a, b, c)}$$

(55) Euler Polyhedron Formula : V - E + F = 2 for all convex polyhedrons, where V = number of vertices, E = number of edges, and F = number of faces.

(56) The distance between the center and the directrix of an ellipse = $\frac{a}{e}$, where e = $\frac{c}{a}$ (e = eccentricity of the ellipse).

(57) The radius of a circle that circumscribes a triangle with sides a ,b, and c is equal to $\frac{abc}{4K}$, where K is the area of the triangle (K = $\sqrt{s(s-a)(s-b)(s-c)}$)

(58) The critical points of a function are located where the first derivative is equal to 0 or where the first derivative is undefined.

(59) How many ways can n candies be placed in a bag if there are r colors of candy?

(60) The absolute maximum or absolute minimum of f(x) in the interval [a, b] are located at f(a), f(b), or where the first derivative is equal to 0.