EQUATIONS WORKSHEET

7X

NAME _____

FACTORIAL – II (EM only)

PRINCIPLE

The **factorial** variation works in combination with other variations.

Factorial in Combination with Other Variations

(a) Sideways ↷! is not defined. However, (↷ x 8)! = 4! = 4 x 3 x 2 = 24

(b) Upside down ↷! is undefined. However, (↷ + 6)! = 4! = 24

(c) Multiple ops. Only *two* ! may be used in a Solution since ! is not on the cubes and therefore cannot appear in Required or Permitted to be used multiple times.

(d) Percent 5!_^20 = 120% of 20 = 1.20 x 20 = 24

(e) Decimal pt. * as decimal point takes precedence over all other operations. So 4*3! may *not* be interpreted as 4.(3!) or 4.6. (4*3! has no defined interpretation.)

(f) # factors x(6!) is not allowed since 6! is bigger than 200. However x(5!) = x120 = x(2^3 x 3^1 x 5^1) = 4 x 2 x 2 = 16.

(g) Small. prime x(6!) is not allowed since 6! is bigger than 200. However x(5!) = x120 = 127.

(h) E: 2-dig.num. In the Goal or a Solution, 12! ÷ (10!) =

$$\frac{12 \times 11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1} = \frac{12 \times 11 \times \cancel{10} \times \cancel{9} \times \cancel{8} \times \cancel{7} \times \cancel{6} \times \cancel{5} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times \cancel{1}}{\cancel{10} \times \cancel{9} \times \cancel{8} \times \cancel{7} \times \cancel{6} \times \cancel{5} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times \cancel{1}} = 12 \times 11 = 132$$

(i) EI: 3-op. Sol. Each ! sign in a Solution counts as an operation *sign*. So the Solution 6! ÷ 2! contains three operations.

(j) EI: LCM 6! √ (5!) = 720 √ 120 = 720. In general, if $m > n$ (m and n whole numbers), then $m!$ √ $n!$ = $m!$

(k) EI: GCF 6! * (5!) = 720 * 120 = 120. In general, if $m > n$ (m and n whole numbers), then $m!$ √ $n!$ = $n!$

(l) Mid: Mult.of *k* If $k = 6$, then 3!, 4!, 5!, and so on, all equal 0 since each of these factorials contains factors of 2 and 3. If $k = 7$, 7!, 8!, 9!, and so on equal 0 since each contains 7 as a factor. In general, $k!$, $(k+1)!$, $(k+2)!$, and so on, all equal 0. However, for non-prime values of k, factorials smaller than $k!$ may also be 0.

(m) Mid: Red ex. A Goal of 23 (red 3) may be interpreted as $2^{3!}$ or 2^6. In a Solution write $2^{(3!)}$ to prevent an opponent from interpreting the expression as $(2^3)!$

EXERCISES

Give the value of each interpretation of each expression. Assume factorial is in effect along with the variation listed.

1.	sideways	(6 x ↷)!	**2.**	upside-down	(4 – ↷)!
3.	decimal pt.	4! x 1*5	**4.**	# factors	x(4!)
5.	# factors	x3!	**6.**	small. prime	x(4!)
7.	small. prime	x3!	**8.**	average	3! + (5!)
9.	E: 2-dig.num.	11! ÷ (8!)	**10.**	E: LCM	5! √ (4!)
11.	E: GCF	4! * (6!)	**12.**	M: base 8	12! ÷ (10!)
13.	M: base 9	11! ÷ [(5 + 4)!]	**14.**	M: red exp.	$3^{3!}$

Middle: *Give the smallest non-negative value of each factorial for the given multiple of* k.

15. k = 8, 9! _____ **16.** k = 9, 6! _____ **17.** k = 7, 7! _____

18. k = 10, 5! _____ **19.** k = 11, 43! _____ **20.** k = 12, 4! _____