Example 10. If for positive integers a and b, $\langle ab\rangle = ab - a - b$, find the value of $a + b$ in the equation $\langle ab\rangle = 6$.

(A) 9 (B) 10 (C) 8 (D) 15 (E) 12

Example 13. 10. Subfactorials, $!n$, are defined by the formula:

$$!n = n!\left(1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\cdots+(-1)^n\frac{1}{n!}\right)$$

Express the following where for $x=6$: $\dfrac{!x}{!(x-1)}$.

(A) $\dfrac{265}{44}$ (B) $\dfrac{11}{30}$ (C) $\dfrac{53}{24}$ (D) $\dfrac{53}{144}$ (E) 6.

☆**Example 36.** For real numbers a and b, define $a\Diamond b = \sqrt{a^2 + b^2}$. What is the value of $(8\Diamond 15)\Diamond((-15)\Diamond(-8))$?

(A) 0 (B) 13/2 (C) 15 (D) $17\sqrt{2}$ (E) 26

Example 37. Let $\triangledown$ be defined as $\triangledown(a, b) = \sqrt{a^2 + b^2}$, for all real numbers a and b. Find $\triangledown$ ($\triangledown$ ($\triangledown(12, 5), 84), 132$).

(A) 97 (B) 117 (C) 137 (D) 157 (E) 187

Problem 16. If 4! means $4 \cdot 3 \cdot 2 \cdot 1$, express $\frac{8!}{6!2!2!}$ in simplest form.

(A) 40320 (B) 56 (C) 28 (D) 14 (E) 120

Problem 36. If $a \clubsuit b = (\frac{1}{a})^b + (\frac{1}{b})^a$, find $2 \clubsuit 3$.

(A) $\frac{17}{72}$ (B) $\frac{2}{17}$ (C) $1\frac{1}{9}$ (D) $\frac{1}{8}$ (E) $\frac{5}{6}$

Problem 39. Given $a \star b = \sqrt{a^2 + b^2}$, find $((13 \star 84) \star (36 \star 77))$.

(A) 85 (B) $85\sqrt{2}$ (C) $83\sqrt{2}$ (D) 135 (E) $58\sqrt{2}$

Problem 41. The symbols ✦ and * represent different operations, either +, −, ×, or ÷, and x is a positive integer. Find x if $17 \spadesuit x = 54 * x$.

(A) 4 (B) 3 (C) 6 (D) 5 (E) 7