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1988 Q11

11. $\sqrt{164}$ is

A) 42 B) less than 10 C) between 10 and 11

D) between 11 and 12 E) between 12 and 13

11. E $10^2 = 100$, $11^2 = 121$, $12^2 = 144$, $13^2 = 169$ so (E) is correct.

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1991 Q13

13. How many zeros are at the end of the product

$$25 \times 25 \times 25 \times 25 \times 25 \times 25 \times 25 \times 8 \times 8 \times 8?$$

(A) 3 (B) 6 (C) 9 (D) 10 (E) 12

13. **(C)** Since $2 \times 5 = 10$, each zero at the end of the product comes from a product of 2 and 5 in the prime factorization of the number. Since $25 = 5 \times 5$ and $8 = 2 \times 2 \times 2$, it follows that there are fourteen factors of 5 and 9 factors of 2. This yields 9 pairs of 2×5 and results in 9 zeros at the end of the product.

OR

Multiplying the given numbers using a calculator gives an answer equivalent to 3.125×10^{12} which equals $3,125,000,000,000$. This results in 9 zeros at the end of the product.

OR

Factoring each number yields

$$\overbrace{2 \times 2 \times 2}^{8} \times \overbrace{2 \times 2 \times 2}^{8} \times \overbrace{2 \times 2 \times 2}^{8} \times \underbrace{5 \times 5}_{25} \times \underbrace{5 \times 5}_{25} \times \underbrace{5 \times 5}_{25} \times \underbrace{5 \times 5}_{25} \times \underbrace{5 \times 5}_{25} \times \underbrace{5 \times 5}_{25} \times \underbrace{5 \times 5}_{25}.$$

Pairing each factor of 2 with a factor of 5 yields $(2 \times 5)^9 \times 5^5 = 10^9 \times$ (an odd number). Thus the product ends in nine zeros.

OR

Since $25 \times 25 \times 8 = 25 \times 200 = 5000$, regrouping yields

$$(25 \times 25 \times 8) \times (25 \times 25 \times 8) \times (25 \times 25 \times 8) \times 25$$
$$= 5000 \times 5000 \times 5000 \times 25 = 125,000,000,000 \times 25 = 3,125,000,000,000.$$

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1996 Q15

15. The remainder when the product $1492 \cdot 1776 \cdot 1812 \cdot 1996$ is divided by 5 is

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** 4