

2002 National Mu Alpha Theta Convention
Alpha Division Ciphering

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2. Find the determinant of A^{-1} if

$$A = \begin{bmatrix} 2 & 1 \\ 7 & -3 \end{bmatrix}.$$

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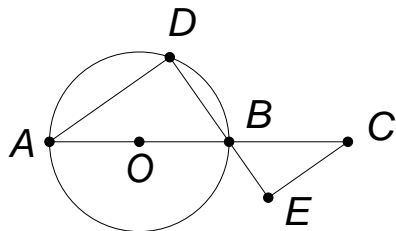
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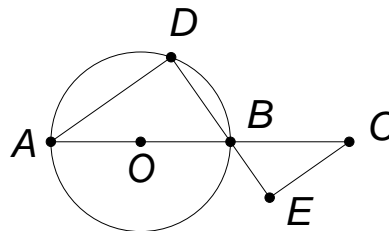
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3. Extend diameter AB of circle O to C . Extend chord DB to E such that $DE \perp CE$. If $AD = 4$, $BC = 6$, and $AB = 8$, find BE .



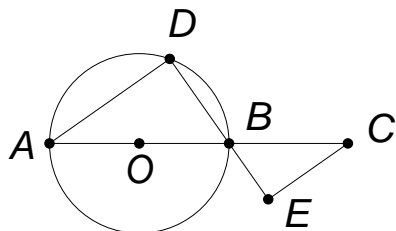
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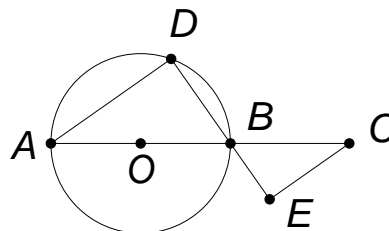
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4. A 30 question multiple-choice test is scored as follows: Each question left blank is worth two points; each question answered correctly is worth five points, and each question answered incorrectly is worth zero points. How many different scores are possible on the test?

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5. Find the area of the intersection of

$$x^2 + y^2 - 6x - 8y \leq 11$$

and

$$x - y \geq -7$$

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6. For how many pairs of positive integers (a, b) , such that $a, b < 6$, is

$$\sum_{i=0}^{\infty} \left(\frac{a}{b}\right)^i \leq 2$$

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7. A jar has 125 coins. One has heads on both sides while the rest are fair, having heads on one side and tails on the other. A coin is chosen randomly from the jar and flipped seven times. It comes up heads each time. What is the probability that the coin is one of the 124 fair coins?

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7. A jar has 125 coins. One has heads on both sides while the rest are fair, having heads on one side and tails on the other. A coin is chosen randomly from the jar and flipped seven times. It comes up heads each time. What is the probability that the coin is one of the 124 fair coins?

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9. Find A if

$$\frac{x+5}{x^3+3x^2-4x-12} = \frac{A}{x+2} + \frac{B}{x-2} + \frac{C}{x+3},$$

where A , B , and C are constants.

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9. Find A if

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10. We write $m \equiv r \pmod{n}$ (where m and r are integers and n is a positive integer) if $m = qn + r$ for some integer q . You can also think of this as m divided by n leaves a remainder of r . How many integers k such that $0 \leq k \leq 100$ satisfy

$$4k^2 \equiv 2 \pmod{7}?$$

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11. Given that $\sin x = \frac{\sqrt{3}}{7}$, find $\cot^2 x$.

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12. Find n if the sum of the first 10 terms of the arithmetic series

$$(n - 1) + 0 + (1 - n) + (2 - 2n) + (3 - 3n) + \dots$$

is 70.

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