2002 National Mu Alpha Theta Convention
Mu Division Ciphering

1. Find the sum of all values of x such that $0 \leq x < 2\pi$ and $\tan x = -1$.

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2. Evaluate $\lim\limits_{x \to -2} \frac{3x^2-12}{\sqrt{2x+4}}$.

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3. What is the minimum value of the function

$$f(x) = x^4 - 2x^2 - 24x + 28$$

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4. Find the product of all values of z for which $z^6 = 64$ and $\text{Im}(z) \neq 0$, where $\text{Im}(a + bi) = b$.

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5. A particle is traveling on the curve described by

$$\frac{xy^3}{1 + y^2} = 1.$$

If $\frac{dy}{dt} = 2$ when the particle is at $(2, 1)$, what is $\frac{dx}{dt}$ at that point?

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6. Find the volume of tetrahedron $ABCD$ in cubic units if $AB = AC = AD = BD = 10$, $BC = 6$, and $CD = 8$.

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7. Given points $A = (1,0)$, $B = (3,4)$, and $C = (-1,2)$, find the area of the triangle that results from applying the transformation $\begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix}$ to triangle ABC.

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8. Evaluate:
$$\int_{-\sqrt[3]{2\pi}}^{\sqrt[3]{\pi}} x^2 \sin x^3 \, dx.$$

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9. How many positive integers less than 2002 leave a remainder of 2 when divided by 7 and a remainder of 5 when divided by 10?

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10. A jar has 500 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 nine times. It comes up heads each time. What is the probability that the coin is one of the 499 fair coins?

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

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12. Find the length of median AD of triangle ABC if $AB = 9$, $BC = 41$, and $AC = 40$.