Y12: EXCELLENCE LEVEL B .

ALGEBRA.

1. Find the value of the constant "c" so that the line y = 3x + c is a tangent to the

curve
$$y = -\frac{12}{x}$$

 x
 $3x^{2} + cx = -12/x$
 $3x^{2} + cx = -12$
 $3x^{2} + cx + 12 = 0$
If tangent then discrim $) = 0$
 $c^{2} - 4.3.12 = 0$
 $c^{2} = 144$
 $c = \pm 12$

2. A Biological researcher found that the number of bacteria in a culture could be calculated at some future time using a formula of the form $N = A \times b^t$

Where N = the number of bacteria at *t* hours. *A* and *b* are unknown constants. She estimated that at t = 4 hours, *N* was 5,600 and at t = 7 hours, *N* was 59,700. Use this information to calculate the constants *A* and *b* then use your formula to estimate the number of bacteria at t = 12 hours.

Subs
$$5600 = A.b^4$$
 and $59700 = A.b^7$
 $59700 = A.b^7$ so $b^3 = 59700$ so $b = 2.2$ sub $5600 = A 2.2^4$
 $5600 A.b^4 5600 A = 239$
 $N = 239 \times 2.2^{12} = 3072345$
CALCULUS

2. A 40 cm piece of wire is cut into two pieces.

The first piece is shaped into a circle of area A, and the second piece into a square of area B.

Find the minimum value of the total area A + B.
Lengths are x and 40 - x if circumf = x then
$$2\pi r = x$$
 so $r = x/(2\pi)$
Area A + B = $\pi r^2 + (40 - x)^2$
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AREA = $\frac{\pi x^2}{4\pi^2} + \frac{1600 - 80x + x^2}{16} = \frac{x^2}{4\pi} + 100 - 5x + \frac{x^2}{16}$
 $\frac{40 - x}{4}$
 $\frac{40 - x}{4}$
 $\frac{40 - x}{4}$
 $x(\frac{1}{2\pi} + \frac{1}{8}) = 5$

 $x \times 0.28415 = 5$ x = 17.6 cm so r = 2.8So Min Area = $\pi \times 2.8^2 + 5.6^2 = 56 \text{ cm}^2$