

A-Level Further Mathematics

Name: \_\_\_\_\_ Score: \_\_\_\_\_

1. For  $x^2 - 5x + 6 = 0$ , what is the sum of the roots  $\alpha + \beta = -b/a$ ?  
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2. For a reduced rational function with a non-zero remainder, a sloping straight-line asymptote occurs when the numerator degree is:
  - ☐ exactly one more than the denominator degree
  - ☐ lower than the bottom
  - ☐ always zero
  - ☐ equal to the bottom
3. Using  $\Sigma r = \frac{1}{2}n(n+1)$ , what is the sum of the first 5 integers?  
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4. What is the determinant of the matrix  $\begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$  ( $ad - bc$ )?  
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5. In polar coordinates, the x-coordinate is given by:
  - ☐  $r \sin \theta$
  - ☐  $r \tan \theta$
  - ☐  $r \cos \theta$
  - ☐  $r / \theta$
6. For two non-parallel non-zero vectors  $a$  and  $b$ , their vector product  $a \times b$  is:
  - ☐ equal to  $a + b$
  - ☐ a scalar
  - ☐ perpendicular to both  $a$  and  $b$
  - ☐ parallel to  $a$
7. The two steps of proof by induction are the base case and the:
  - ☐ inductive step (assume  $n = k$ , prove  $n = k + 1$ )
  - ☐ substitution
  - ☐ differentiation step
  - ☐ final check at  $n = 100$

8. For  $x^2 - 5x + 6 = 0$ , what is the product  $\alpha\beta = c/a$ ?

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9. You find an oblique asymptote by:

☐ differentiating

☐ taking the modulus

☐ setting  $x = 0$

☐ dividing the top polynomial by the bottom

10. Using  $\Sigma r^2 = (1/6)n(n+1)(2n+1)$ , what is the sum of the first 3 squares?

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## 1. 5

$$\alpha + \beta = -b/a = -(-5)/1 = 5.$$

## 2. exactly one more than the denominator degree

When the numerator's degree exceeds the denominator's, dividing out leaves a slant line the curve approaches.

## 3. 15

$$\frac{1}{2} \times 5 \times 6 = 15 \quad (= 1+2+3+4+5).$$

## 4. 10

$$\det = 3 \times 4 - 1 \times 2 = 12 - 2 = 10.$$

5.  $r \cos \theta$ 

$$x = r \cos \theta \text{ and } y = r \sin \theta.$$

6. perpendicular to both  $\mathbf{a}$  and  $\mathbf{b}$ 

$\mathbf{a} \times \mathbf{b}$  is perpendicular to both vectors; its length is  $|\mathbf{a}||\mathbf{b}|\sin \theta$ .

7. inductive step (assume  $n = k$ , prove  $n = k + 1$ )

Induction needs a base case plus an inductive step from  $k$  to  $k+1$ .

## 8. 6

$$\alpha\beta = c/a = 6/1 = 6.$$

## 9. dividing the top polynomial by the bottom

Polynomial division gives the straight-line part the curve approaches far from the origin.

## 10. 14

$$(1/6)(3)(4)(7) = 84/6 = 14 \quad (= 1+4+9).$$