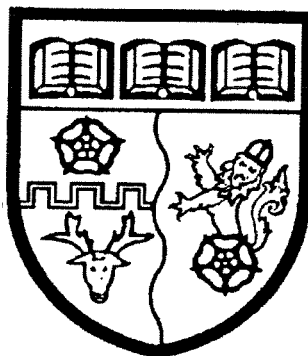


**FORTROSE ACADEMY**

**MATHEMATICS DEPARTMENT**

Established 1791



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**Mathematics**

**Higher Mini-Prelim Examination 2011/2012**

**Assessing Unit 3 + revision from Units 1 & 2**

**Paper 1**

**Time allowed - 50 minutes**

**NATIONAL  
QUALIFICATIONS**

**Read carefully**

**Calculators may NOT be used in this paper.**

**Section A - Questions 1 - 10 (20 marks)**

Instructions for the completion of **Section A** are given on the next page.

For this section of the examination you should use an **HB pencil**.

**Section B (19 marks)**

1. Full credit will be given only where the solution contains appropriate working.
2. Answers obtained by readings from scale drawings will not receive any credit.



## FORMULAE LIST

### Circle:

The equation  $x^2 + y^2 + 2gx + 2fy + c = 0$  represents a circle centre  $(-g, -f)$  and radius  $\sqrt{g^2 + f^2 - c}$ .

The equation  $(x - a)^2 + (y - b)^2 = r^2$  represents a circle centre  $(a, b)$  and radius  $r$ .

### Trigonometric formulae:

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$= 2 \cos^2 A - 1$$

$$= 1 - 2 \sin^2 A$$

**Scalar Product:**  $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos \theta$ , where  $\theta$  is the angle between  $\mathbf{a}$  and  $\mathbf{b}$ .

or

$$\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3 \text{ where } \mathbf{a} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$$

### Table of standard derivatives:

$f(x)$	$f'(x)$
$\sin ax$	$a \cos ax$
$\cos ax$	$-a \sin ax$

### Table of standard integrals:

$f(x)$	$\int f(x) dx$
$\sin ax$	$-\frac{1}{a} \cos ax + C$
$\cos ax$	$\frac{1}{a} \sin ax + C$

## SECTION A

In this section the correct answer to each question is given by one of the alternatives **A**, **B**, **C** or **D**. Indicate the correct answer by writing **A**, **B**, **C** or **D** opposite the number of the question on your answer paper.

Rough working may be done on the paper provided. 2 marks will be given for each correct answer.

1. If  $k$  is a constant of integration then  $\int \sqrt{4x+1} \, dx$  is
- A**  $2(4x+1)^{-\frac{1}{2}} + k$
- B**  $\frac{2}{3}(4x+1)^{\frac{3}{2}} + k$
- C**  $\frac{1}{4}(4x+1)^{\frac{3}{2}} + k$
- D**  $\frac{1}{6}(4x+1)^{\frac{3}{2}} + k$
2. If  $a = 2i - j + 3k$  and  $b = 8i - 2j - 6k$ . The value of  $a \cdot b$  is
- A** 4
- B** 0
- C** -4
- D** unknown without further information
3. The graph of  $y = \log_2 4x$  crosses the  $x$ -axis at the point where  $x$  equals
- A** 2
- B** 0.25
- C** 4
- D** 0.5
4. Given that  $x + 2$  is a factor of  $x^3 - 2x^2 - 3x + c$ , then the value of  $c$  is
- A** 10
- B** -10
- C** 6
- D** -6
5. Given that  $|a| = 2$ ,  $|b| = 3$  and  $a \cdot b = 4$ , the value of  $(2a - b) \cdot (a + b)$  is
- A** 3
- B** -1
- C** 5
- D** 0

6. Given that  $f(x) = \frac{1}{(2x-5)^3}$ , then  $f'(x)$  equals

A  $\frac{-6}{(2x-5)^2}$

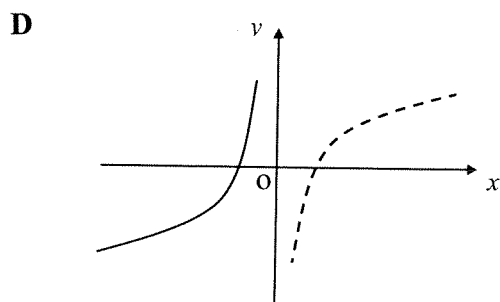
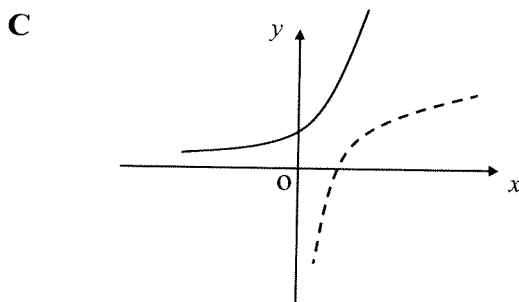
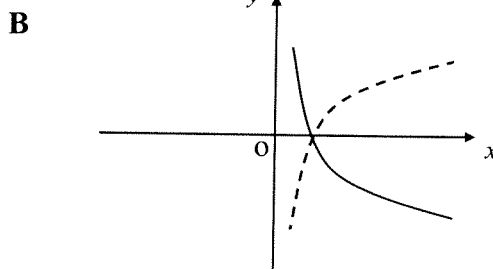
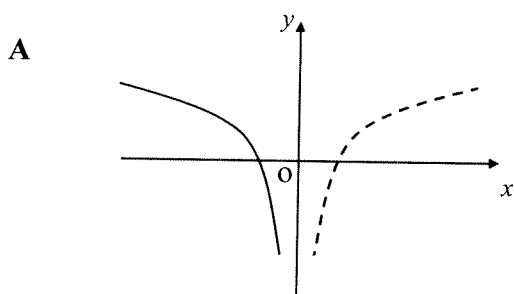
B  $\frac{1}{6(2x-5)^4}$

C  $\frac{-6}{(2x-5)^4}$

D  $\frac{-3}{(2x-5)^4}$

7. Part of the graph of  $y = \log_{10} x$  is shown in each diagram below as a broken line.

Which diagram is most likely to show as an unbroken line part of the graph of  $y = \log_{10} \frac{1}{x}$ ?



8.  $\int_0^{\frac{\pi}{2}} \cos 2x \, dx$  is equal to

A 0

B -1

C  $\frac{1}{2}$

D 1

9. Two functions are defined as follows:  $g(x) = x + 5$  and  $f(x) = x^2 - 1$ .  
Find an expression for  $f(g(x)) - g(f(x))$ .

- A  $x^2 - 10$
- B 8
- C  $-10x - 20$
- D  $10x + 20$

10. A circle has the equation  $x^2 + y^2 - 8x + 6y + 9 = 0$ . Its centre is C.  
The line joining C to the origin, OC cuts the circle at B, where B lies between O and C.  
Calculate the length of OB.

- A 5 Units
- B 1 Unit
- C 4 Units
- D 6 Units

[ END OF SECTION A ]

## SECTION B

ALL questions should be attempted

11. A function is defined on a suitable domain as  $h(x) = 2\sin 2x - \sqrt{3}\cos^2 x$ .

Calculate the rate of change of this function at the point where  $x = \frac{\pi}{3}$ .

5

12. Given that  $\log_3(x+1) + 2\log_3 2 = 2$ , find the value of  $x$ .

3

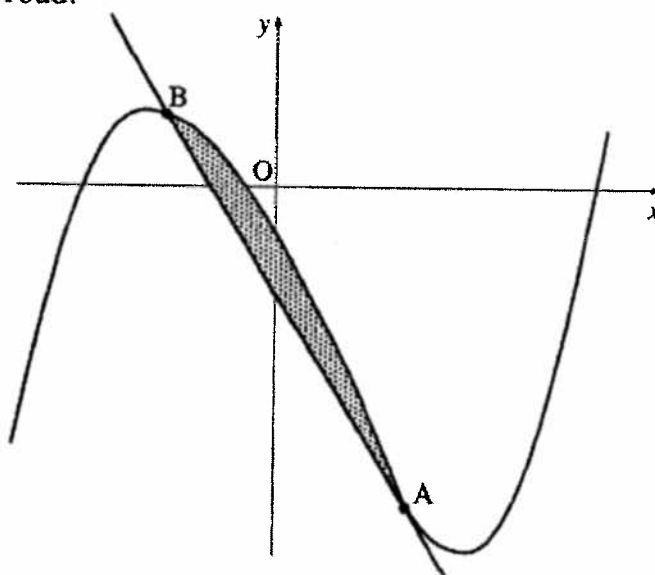
13. In the diagram below a winding river has been modelled by the curve  $y = x^3 - x^2 - 6x - 2$  and a road has been modelled by the straight line AB. The road is a tangent to the river at the point A(1, -8).

(a) Find the equation of the tangent at A and hence find the coordinates of B.

(8)

(b) Find the area of the shaded part which represents the land bounded by the river and the road.

(3)



[ END OF SECTION B ]

[ END OF QUESTION PAPER ]

