

**Time: 2 hours**

### **Instructions to candidates**

Write your name, centre number and candidate number in the spaces on the Answer Booklet provided.

There are **12 questions** in this paper. Answer **all** questions.

Write your answers in the Answer Booklet provided.

If you use more than one Answer Booklet, fasten the Answer Booklets together.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

### **Information for candidates**

The number of marks is shown in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 80.

**The use of a non programmable electronic calculator is expected, where appropriate.**

**Cell phones should not be brought in the examination room.**

You are reminded of the need for clear presentation in your answers.

**Check the formulae overleaf.**

## MATHEMATICS FORMULAE

### 1 ALGEBRA

Quadratic Equation

For the equation  $ax^2 + bx + c = 0$ ,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

*Binomial Theorem*

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n,$$

where  $n$  is a positive integer and  $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

### 2 TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for  $\triangle ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

- 1** Solve the simultaneous equations  
 $x - 2y = 6,$   
 $x(y - 2) = 12.$  [5]
- 2** The coordinates of **P** and **Q** are  $(-2, -4)$  and  $(6, 4)$  respectively. A perpendicular line to line **PQ** passes through **Q** and meets the  $y$ -axis at **R**. Find the coordinates of **R**. [4]
- 3** Functions  $f$  and  $g$  are defined by  
 $f: x \rightarrow 1 - 2x,$   
 $g: x \rightarrow \frac{x}{3 - 4x}, x \neq \frac{3}{4}.$   
 Find  
 (a)  $g^{-1}(x),$  [2]  
 (b)  $gf(x),$  [2]  
 (c) the value of  $x$  for which  $gf(x)$  is undefined. [2]
- 4** Find the range of values of  $k$  for which the line  $y = kx + 3$  meets the curve  $y = x^2 + 12$  at two distinct points. [4]
- 5** (a) In the expansion of  $(1 + 3x)^{10}$ , the coefficient of  $x^4$  is  $k$  times the coefficient of  $x^2$ . Find the value of  $k$ . [3]  
 (b) Determine the coefficient of  $x^2$  in the expansion of  $(1 - x + 2x^2)(1 - 3x)^6$ . [6]
- 6** Prove the identity  
 $\cot^2 \theta \sec^2 \theta \equiv 1 + \cot^2 \theta.$  [4]
- 7** On the same diagram, sketch the graphs of  $y = -3\cos x$  and  $y = \frac{x}{\pi}$  for the domain  $0 \leq x \leq 2\pi$ . Hence state the number of solutions of the equation  $-3\pi\cos x = x$  for  $0 \leq x \leq 2\pi$ . [5]
- 8** The perimeter of a sector of a circle is 16cm and its area is  $16\text{cm}^2$ .  
 Find  
 (a) the angle of the sector, [4]  
 (b) the length of its arc. [3]

- 9 P, Q and R are points with position vectors  $\underline{a} - 2\underline{b}$ ,  $4\underline{a} + \underline{b}$  and  $3\underline{a} - \underline{b}$  respectively, relative to an origin O. S is a point on OP produced, such that  $\vec{OS} = k\vec{OP}$  and  $RS = m\vec{RQ}$ .

(a) Express  $\vec{OS}$  in terms of

(i)  $\underline{a}$ ,  $\underline{b}$  and  $k$ , [1]

(ii)  $\underline{a}$ ,  $\underline{b}$  and  $m$ . [2]

(b) Hence or otherwise, find the values of  $k$  and  $m$ . [4]

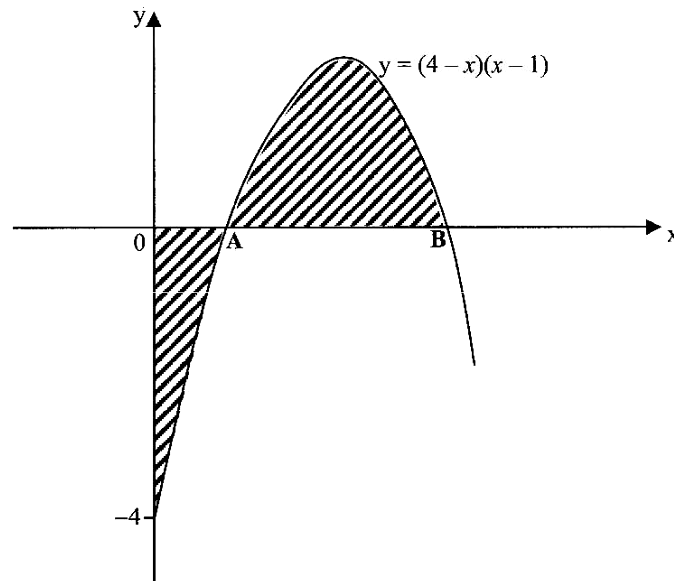
- 10 (a) Given that the gradient of  $y = (2x + 3)^n$  at  $x = -1$  is 4, find the value of  $n$ . [3]

(b) Two variables,  $x$  and  $y$  are related by the equation  $y = \frac{2}{(x^2 - 1)^3}$ .

Obtain an expression for  $\frac{dy}{dx}$  and find in terms of  $p$ , the approximate change in  $y$  as  $x$  increases from 2 to  $2 + p$ . [6]

- 11 (a) Find  $\int (5x - 1)^4 dx$ . [3]

(b) The diagram below shows part of the curve  $y = (4 - x)(x - 1)$  intersecting the x-axis at A and B, and meets the y-axis at  $(0, -4)$ .



Find

(i) the coordinates of A and B, [1]

(ii) the area of the shaded region. [6]

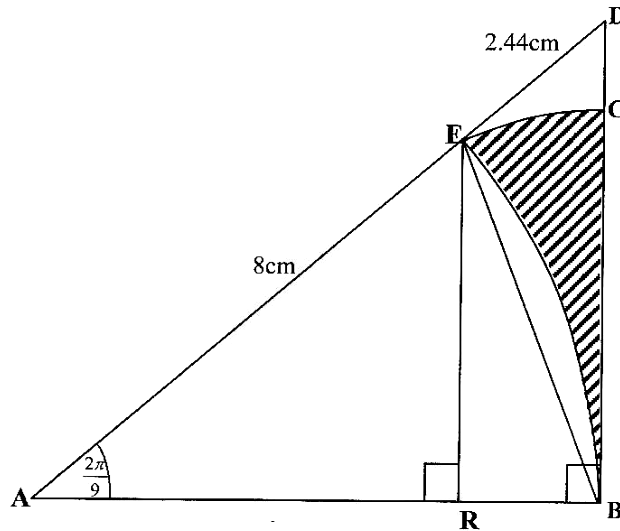
12 Answer only one of the following alternatives:

Either

In the diagram below,  $\text{ABE}$  and  $\text{BCE}$  are sectors of circles with centres at  $A$  and  $B$

respectively. The radius of sector  $\text{ABE}$  is 8cm and  $\widehat{\text{BAD}} = \frac{2\pi}{9}$  radians.

$\widehat{\text{ABD}} = \widehat{\text{ARE}} = 90^\circ$  and  $\text{ED} = 2.44\text{cm}$ .



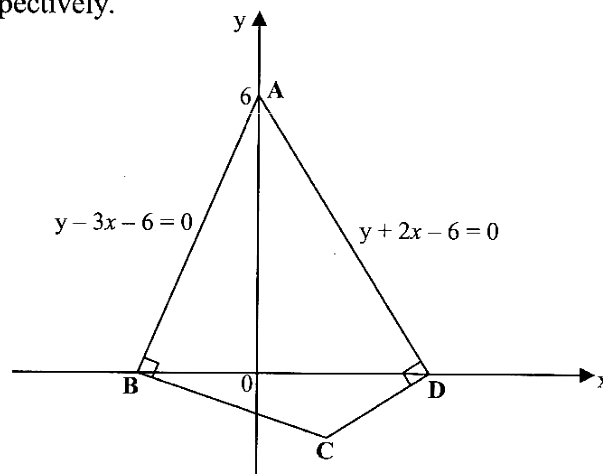
Calculate the area of the shaded region.

[10]

Or

The diagram below shows a quadrilateral  $\text{ABCD}$  in which point  $A$  is  $(0, 6)$  and

$\widehat{\text{ABC}} = \widehat{\text{ADC}} = 90^\circ$ . The equations of lines  $\text{AB}$  and  $\text{AD}$  are  $y - 3x - 6 = 0$  and  $y + 2x - 6 = 0$  respectively.



Find

- (a) the coordinates of  $B$  and  $D$ , [4]
- (b) the equations of  $\text{BC}$  and  $\text{CD}$ , [4]
- (c) the coordinates of  $C$ . [2]