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0606/13

May/June 2016

2 hours

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

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

The total number of marks for this paper is 80.

This document consists of **15** printed pages and **1** blank page.

Mathematical 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 Find the value of k for which the curve $y = 2x^2 - 3x + k$

(i) passes through the point $(4, -7)$, [1]

(ii) meets the x -axis at one point only. [2]

2 (a) Solve the equation $16^{3x-1} = 8^{x+2}$. [3]

(b) Given that $\frac{(a^{\frac{1}{3}}b^{-\frac{1}{2}})^3}{a^{-\frac{2}{3}}b^{\frac{1}{2}}} = a^p b^q$, find the value of each of the constants p and q . [2]

- 3 Find the equation of the normal to the curve $y = \ln(2x^2 - 7)$ at the point where the curve crosses the positive x -axis. Give your answer in the form $ax + by + c = 0$, where a , b and c are integers. [5]

- 4 (a) Given the matrices $\mathbf{A} = \begin{pmatrix} -1 & 2 \\ 3 & 0 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 3 & 0 \\ 1 & 2 \end{pmatrix}$, find $\mathbf{A}^2 - 2\mathbf{B}$. [3]

- (b) Using a matrix method, solve the equations

$$\begin{aligned} 4x + y &= 1, \\ 10x + 3y &= 1. \end{aligned} \quad [4]$$

5 Do not use a calculator in this question.

- (i) Show that $\frac{d}{dx}\left(\frac{e^{4x}}{4} - xe^{4x}\right) = pxe^{4x}$, where p is an integer to be found. [4]

- (ii) Hence find the exact value of $\int_0^{\ln 2} xe^{4x} dx$, giving your answer in the form $a\ln 2 + \frac{b}{c}$, where a , b and c are integers to be found. [4]

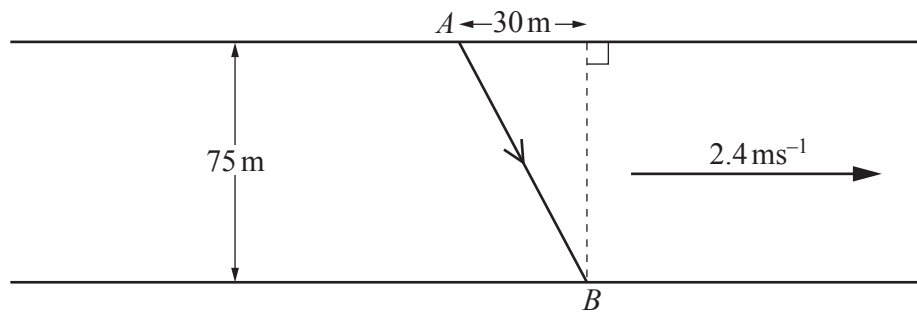
6 The function f is defined by $f(x) = 2 - \sqrt{x+5}$ for $-5 \leq x < 0$.

(i) Write down the range of f . [2]

(ii) Find $f^{-1}(x)$ and state its domain and range. [4]

The function g is defined by $g(x) = \frac{4}{x}$ for $-5 \leq x < -1$.

(iii) Solve $fg(x) = 0$. [3]



The diagram shows a river with parallel banks. The river is 75 m wide and is flowing with a speed of 2.4 ms^{-1} . A speedboat travels in a straight line from a point A on one bank to a point B on the opposite bank, 30 m downstream from A . The speedboat can travel at a speed of 4.5 ms^{-1} in still water.

- (i) Find the angle to the bank and the direction in which the speedboat is steered. [4]

- (ii) Find the time the speedboat takes to travel from A to B .

[4]

8 Solutions to this question by accurate drawing will not be accepted.

Three points have coordinates $A(-8, 6)$, $B(4, 2)$ and $C(-1, 7)$. The line through C perpendicular to AB intersects AB at the point P .

(i) Find the equation of the line AB . [2]

(ii) Find the equation of the line CP . [2]

(iii) Show that P is the midpoint of AB . [3]

(iv) Calculate the length of CP .

[1]

(v) Hence find the area of the triangle ABC .

[2]

- 9 (i) Show that $2 \cos x \cot x + 1 = \cot x + 2 \cos x$ can be written in the form $(a \cos x - b)(\cos x - \sin x) = 0$, where a and b are constants to be found. [4]

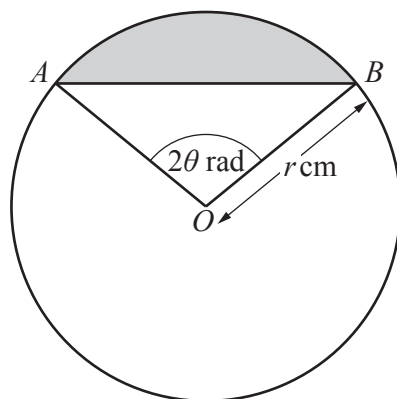
- (ii) Hence, or otherwise, solve $2 \cos x \cot x + 1 = \cot x + 2 \cos x$ for $0 < x < \pi$. [3]

- 10 (i) Given that $f(x) = 4x^3 + kx + p$ is exactly divisible by $x + 2$ and $f'(x)$ is exactly divisible by $2x - 1$, find the value of k and of p . [4]

- (ii) Using the values of k and p found in part (i), show that $f(x) = (x + 2)(ax^2 + bx + c)$, where a , b and c are integers to be found. [2]

- (iii) Hence show that $f(x) = 0$ has only one solution and state this solution. [2]

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The diagram shows a circle, centre O , radius r cm. The points A and B lie on the circle such that angle $AOB = 2\theta$ radians.

- (i) Find, in terms of r and θ , an expression for the length of the chord AB . [1]

- (ii) Given that the perimeter of the shaded region is 20 cm, show that $r = \frac{10}{\theta + \sin \theta}$. [2]

- (iii) Given that r and θ can vary, find the value of $\frac{dr}{d\theta}$ when $\theta = \frac{\pi}{6}$. [4]

- (iv) Given that r is increasing at the rate of 15 cm s^{-1} , find the corresponding rate of change of θ when $\theta = \frac{\pi}{6}$. [3]

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