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0606/22

February/March 2017

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 Solve the equation $|5 - 3x| = 10$. [3]

2 The value, V dollars, of a car aged t years is given by $V = 12\,000e^{-0.2t}$.

(i) Write down the value of the car when it was new. [1]

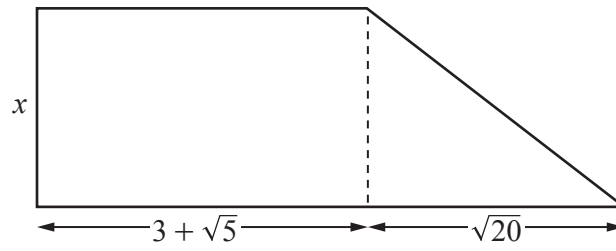
(ii) Find the time it takes for the value to decrease to $\frac{2}{3}$ of the value when it was new. [2]

3 The polynomial $p(x)$ is $x^4 - 2x^3 - 3x^2 + 8x - 4$.

(i) Show that $p(x)$ can be written as $(x - 1)(x^3 - x^2 - 4x + 4)$. [1]

(ii) Hence write $p(x)$ as a product of its linear factors, showing all your working. [4]

4 Find the set of values of k for which the line $y = 3x + k$ and the curve $y = 2x^2 - 3x + 4$ do not intersect. [4]



The diagram shows a trapezium made from a rectangle and a right-angled triangle. The dimensions, in centimetres, of the rectangle and triangle are shown. The area, in square centimetres, of the trapezium is $13 + 5\sqrt{5}$. **Without using a calculator**, find the value of x in the form $p + q\sqrt{5}$, where p and q are integers. [5]

6 (a) (i) Express $(\sqrt[3]{-8x^9})(\sqrt[6]{x^{-3}})$ in the form ax^b , where a and b are constants to be found. [2]

(ii) Hence solve the equation $(\sqrt[3]{-8x^9})(\sqrt[6]{x^{-3}}) = -6250$. [2]

(b) It is given that $y = \log_a(ax) + 2\log_a(4x - 3) - 1$, where a is a positive integer.

(i) Explain why x must be greater than 0.75. [1]

(ii) Show that y can be written as $\log_a(16x^3 - 24x^2 + 9x)$. [3]

(iii) Find the value of x for which $y = \log_a(9x)$. [2]

- 7 (a) Calculate the magnitude and bearing of the resultant velocity of 10 ms^{-1} on a bearing of 240° and 5 ms^{-1} due south. [5]

- (b) A car travelling east along a road at a velocity of 38 kmh^{-1} passes a lorry travelling west on the same road at a velocity of 56 kmh^{-1} . Write down the velocity of the lorry relative to the car. [2]

- 8 The points $A(3, 7)$ and $B(8, 4)$ lie on the line L . The line through the point $C(6, -4)$ with gradient $\frac{1}{6}$ meets the line L at the point D . Calculate

(i) the coordinates of D , [6]

(ii) the equation of the line through D perpendicular to the line $3y - 2x = 10$. [2]

9 (a) Find $\int e^{2x+1} dx$. [2]

(b) (i) Given that $y = \frac{x}{\ln x}$, find $\frac{dy}{dx}$. [3]

(ii) Hence find $\int \left(\frac{1}{\ln x} - \frac{1}{(\ln x)^2} + \frac{1}{x^2} \right) dx$. [3]

10 Solve, for $0^\circ \leq x \leq 360^\circ$, the equation

(i) $\cot(2x - 10^\circ) = \frac{3}{4}$, [4]

(ii) $\sin^2 x - \cos^2 x = \cos x$. [5]

11 The functions f and g are defined by

$$f(x) = \frac{x^2 - 2}{x} \text{ for } x \geq 2,$$

$$g(x) = \frac{x^2 - 1}{2} \text{ for } x \geq 0.$$

(i) State the range of g . [1]

(ii) Explain why $fg(1)$ does not exist. [2]

(iii) Show that $gf(x) = ax^2 + b + \frac{c}{x^2}$, where a , b and c are constants to be found. [3]

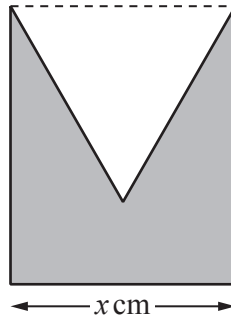
(iv) State the domain of gf .

[1]

(v) Show that $f^{-1}(x) = \frac{x + \sqrt{x^2 + 8}}{2}$.

[4]

- 12 The diagram shows a shape made by cutting an equilateral triangle out of a rectangle of width x cm.



The perimeter of the shape is 20 cm.

- (i) Show that the area, A cm², of the shape is given by

$$A = 10x - \left(\frac{6 + \sqrt{3}}{4} \right) x^2. \quad [3]$$

- (ii) Given that x can vary, find the value of x which produces the maximum area and calculate this maximum area. Give your answers to 2 significant figures. [4]

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