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0606/21

May/June 2019

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 ΔABC

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

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

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

- 1 Find the values of x for which $x(6x + 7) \geq 20$.

[3]

- 2 Two variables x and y are such that $y = \frac{\ln x}{x^3}$ for $x > 0$.

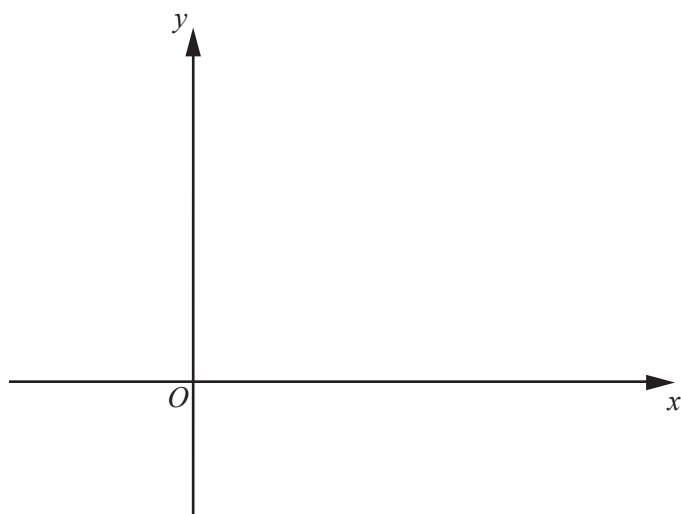
(i) Show that $\frac{dy}{dx} = \frac{1 - 3 \ln x}{x^4}$.

[3]

- (ii) Hence find the approximate change in y as x increases from e to $e + h$, where h is small.

[2]

- 3 (i) Sketch the graph of $y = |5x - 3|$ on the axes below, showing the coordinates of the points where the graph meets the coordinate axes.



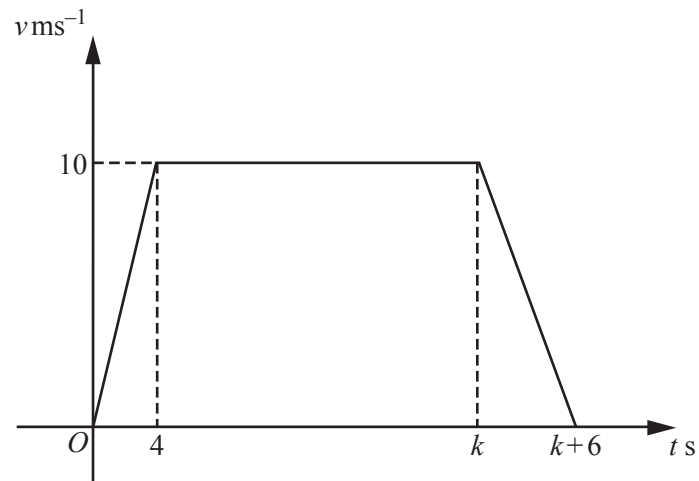
[3]

- (ii) Solve the equation $|5x - 3| = 2 - x$.

[3]

- 4 Without using a calculator, express $\frac{(\sqrt{5} - 3)^2}{\sqrt{5} + 1}$ in the form $p\sqrt{5} + q$, where p and q are integers. [4]

5



The velocity-time graph represents the motion of a particle travelling in a straight line.

- (i) Find the acceleration during the last 6 seconds of the motion. [1]
- (ii) The particle travels with constant velocity for 23 seconds. Find the value of k . [1]
- (iii) Using your answer to **part (ii)**, find the total distance travelled by the particle. [3]

6 (a) $\mathbf{A} = \begin{pmatrix} x+3 & -x \\ 2x & x-3 \end{pmatrix}$

Given that $\mathbf{A}$ does not have an inverse, find the exact values of x .

[3]

(b) $\mathbf{B} = \begin{pmatrix} 0 & 3 \\ -4 & 1 \\ 5 & 2 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 0 & 1 & 2 \\ 3 & -4 & 5 \end{pmatrix}$

(i) Write down the order of matrix $\mathbf{B}$.

[1]

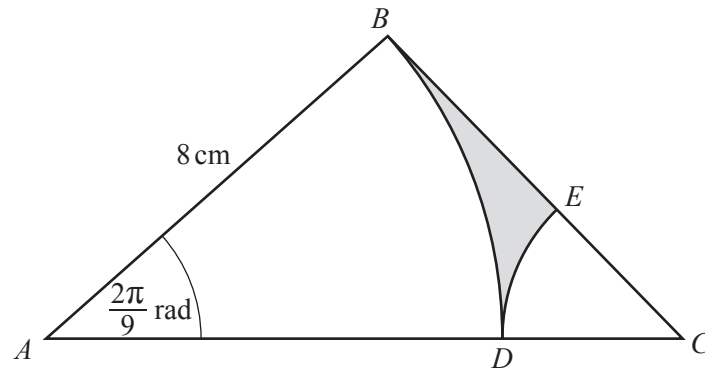
(ii) The matrix $\mathbf{BC} = \begin{pmatrix} 9 & -12 & 15 \\ 3 & -8 & -3 \\ 6 & -3 & 20 \end{pmatrix}$. Explain why $\mathbf{CB} \neq \mathbf{BC}$.

[2]

7 The variables x, y and u are such that $y = \tan u$ and $x = u^3 + 1$.

(i) State the rate of change of y with respect to u . [1]

(ii) Hence find the rate of change of y with respect to x , giving your answer in terms of x . [4]



The diagram shows a right-angled triangle ABC with $AB = 8$ cm and angle $ABC = \frac{\pi}{2}$ radians. The points D and E lie on AC and BC respectively. BAD and ECD are sectors of the circles with centres A and C respectively. Angle $BAD = \frac{2\pi}{9}$ radians.

- (i) Find the area of the shaded region.

[6]

(ii) Find the perimeter of the shaded region.

[3]

9 (a) Eleven different television sets are to be displayed in a line in a large shop.

(i) Find the number of different ways the televisions can be arranged. [1]

Of these television sets, 6 are made by company A and 5 are made by company B .

(ii) Find the number of different ways the televisions can be arranged so that no two sets made by company A are next to each other. [2]

(b) A group of people is to be selected from 5 women and 3 men.

(i) Calculate the number of different groups of 4 people that have exactly 3 women. [2]

(ii) Calculate the number of different groups of at most 4 people where the number of women is the same as the number of men. [2]

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

The points A and B have coordinates $(p, 3)$ and $(1, 4)$ respectively and the line L has equation $3x + y = 2$.

(i) Given that the gradient of AB is $\frac{1}{3}$, find the value of p . [2]

(ii) Show that L is the perpendicular bisector of AB . [3]

(iii) Given that $C(q, -10)$ lies on L , find the value of q . [1]

(iv) Find the area of triangle ABC . [2]

11 (a) (i) Show that $\frac{\operatorname{cosec} \theta - \cot \theta}{\sin \theta} = \frac{1}{1 + \cos \theta}$. [4]

(ii) Hence solve $\frac{\operatorname{cosec} \theta - \cot \theta}{\sin \theta} = \frac{5}{2}$ for $180^\circ < \theta < 360^\circ$. [2]

(b) Solve $\tan(3\phi - 4) = -\frac{1}{2}$ for $0 \leq \phi \leq \frac{\pi}{2}$ radians.

[3]

- 12 (a)** Given that $\int_0^a e^{2x} dx = 50$, find the exact value of a . You must show all your working. [4]

(b) A curve is such that $\frac{dy}{dx} = 3 - 2 \cos 5x$. The curve passes through the point $\left(\frac{\pi}{5}, \frac{8\pi}{5}\right)$.

(i) Find the equation of the curve.

[4]

(ii) Find $\int y dx$ and hence evaluate $\int_{\frac{\pi}{2}}^{\pi} y dx$.

[5]

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