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0606/12

February/March 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 $\triangle ABC$

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

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

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

- 1 (a) Given that $\mathcal{E} = \{x : 1 < x < 20\}$,
 $A = \{\text{multiples of } 3\}$,
 $B = \{\text{multiples of } 4\}$,

find

(i) $n(A)$, [1]

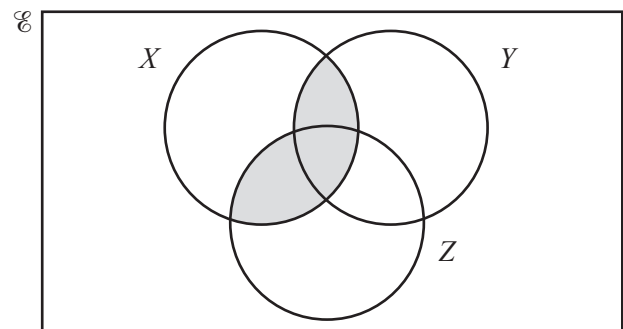
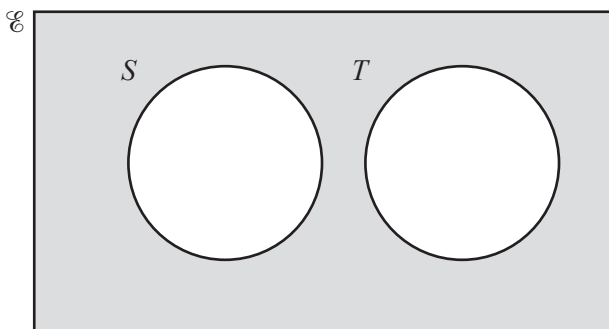
(ii) $n(A \cap B)$. [1]

- (b) On the Venn diagram below, draw the sets P , Q and R such that $P \subset Q$ and $Q \cap R = \emptyset$.



[2]

- (c) Using set notation, describe the shaded areas shown in the Venn diagrams below.



.....

.....

[2]

- 2 On the axes below, sketch the graph of the curve $y = |2x^2 - 5x - 3|$, stating the coordinates of any points where the curve meets the coordinate axes.



[4]

- 3 (i) Find the first 3 terms in the expansion, in ascending powers of x , of $\left(3 - \frac{x}{9}\right)^6$. Give the terms in their simplest form. [3]

- (ii) Hence find the term independent of x in the expansion of $\left(3 - \frac{x}{9}\right)^6 \left(x - \frac{2}{x}\right)^2$. [3]

- 4 The polynomial $p(x) = 2x^3 + ax^2 + bx - 49$, where a and b are constants. When $p'(x)$ is divided by $x + 3$ there is a remainder of -24 .

(i) Show that $6a - b = 78$. [2]

It is given that $2x - 1$ is a factor of $p(x)$.

(ii) Find the value of a and of b . [4]

(iii) Write $p(x)$ in the form $(2x - 1)Q(x)$, where $Q(x)$ is a quadratic factor. [2]

(iv) Hence factorise $p(x)$ completely. [1]

5 It is given that $\log_4 x = p$. Giving your answer in its simplest form, find, in terms of p ,

(i) $\log_4(16x)$, [2]

(ii) $\log_4\left(\frac{x^7}{256}\right)$. [2]

Using your answers to **parts (i) and (ii)**,

(iii) solve $\log_4(16x) - \log_4\left(\frac{x^7}{256}\right) = 5$, giving your answer correct to 2 decimal places. [3]

- 6 (a) Given that $\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 0 & -1 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 1 & -4 \\ 2 & 5 \\ 3 & 1 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 3 & -2 & 0 \end{pmatrix}$, write down the matrix products which are possible. You do not need to evaluate your products. [2]

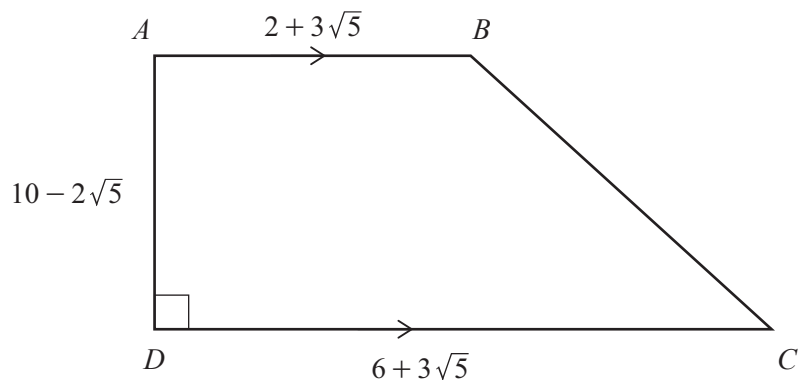
(b) It is given that $\mathbf{X} = \begin{pmatrix} 2 & -2 \\ 5 & 3 \end{pmatrix}$ and $\mathbf{Y} = \begin{pmatrix} 4 & 1 \\ 2 & 0 \end{pmatrix}$.

- (i) Find $\mathbf{X}^{-1}$. [2]

- (ii) Hence find the matrix $\mathbf{Z}$ such that $\mathbf{XZ} = \mathbf{Y}$. [3]

7 Do not use a calculator in this question.

All lengths in this question are in centimetres.

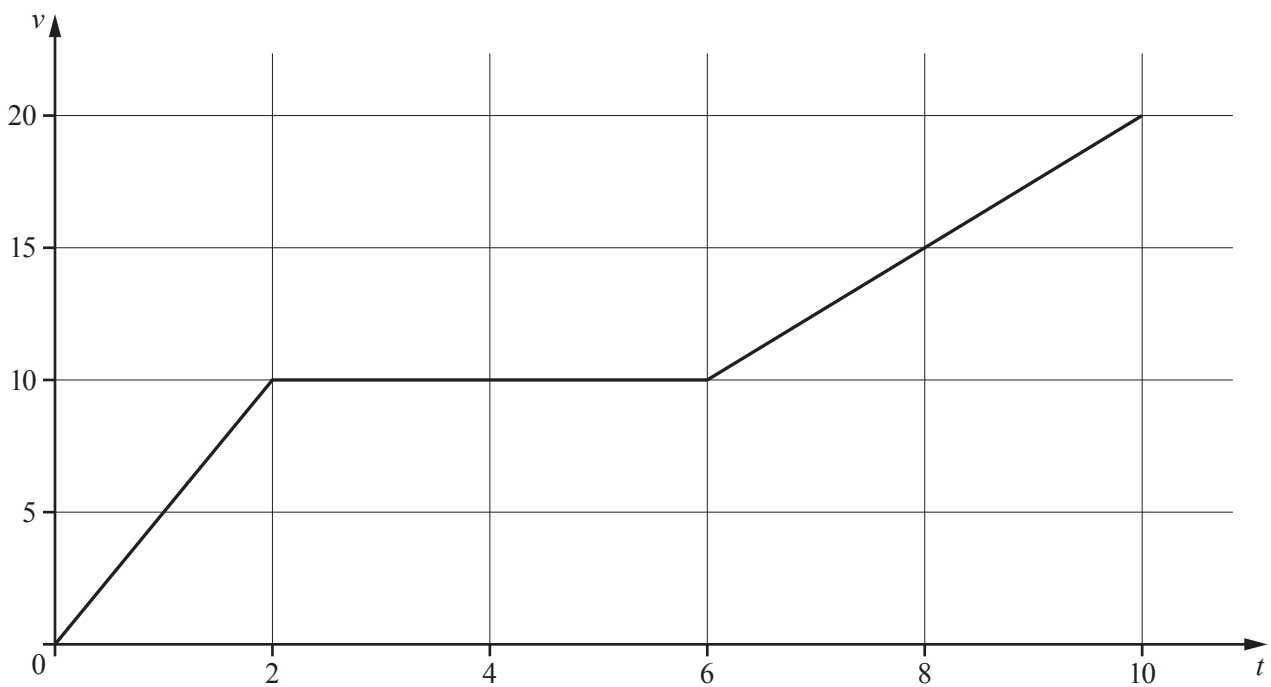


The diagram shows the trapezium $ABCD$, where $AB = 2 + 3\sqrt{5}$, $DC = 6 + 3\sqrt{5}$, $AD = 10 - 2\sqrt{5}$ and angle $ADC = 90^\circ$.

- (i) Find the area of $ABCD$, giving your answer in the form $a + b\sqrt{5}$, where a and b are integers. [3]

- (ii) Find $\cot BCD$, giving your answer in the form $c + d\sqrt{5}$, where c and d are fractions in their simplest form. [3]

8 (a)



The diagram shows the velocity-time graph of a particle P moving in a straight line with velocity $v \text{ ms}^{-1}$ at time t seconds after leaving a fixed point.

(i) Write down the value of the acceleration of P when $t = 5$. [1]

(ii) Find the distance travelled by the particle P between $t = 0$ and $t = 10$. [2]

(b) A particle Q moves such that its velocity, $v \text{ ms}^{-1}$, t seconds after leaving a fixed point, is given by $v = 3 \sin 2t - 1$.

(i) Find the speed of Q when $t = \frac{7\pi}{12}$. [2]

(ii) Find the least value of t for which the acceleration of Q is zero. [3]

9 The area of a sector of a circle of radius r cm is 36 cm^2 .

(i) Show that the perimeter, P cm, of the sector is such that $P = 2r + \frac{72}{r}$. [3]

(ii) Hence, given that r can vary, find the stationary value of P and determine its nature. [4]

10 A curve is such that when $x = 0$, both $y = -5$ and $\frac{dy}{dx} = 10$. Given that $\frac{d^2y}{dx^2} = 4e^{2x} + 3$, find

(i) the equation of the curve,

[7]

(ii) the equation of the normal to the curve at the point where $x = \frac{1}{4}$.

[3]

11 (a) Solve $\sin x \cos x = \frac{1}{2} \tan x$ for $0^\circ \leq x \leq 180^\circ$.

[3]

(b) (i) Show that $\sec \theta - \frac{\sin \theta}{\cot \theta} = \cos \theta$. [3]

(ii) Hence solve $\sec 3\theta - \frac{\sin 3\theta}{\cot 3\theta} = \frac{1}{2}$ for $-\frac{2\pi}{3} \leq \theta \leq \frac{2\pi}{3}$, where θ is in radians. [4]

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