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0606/21

May/June 2013

**2 hours**

Additional Materials: Electronic calculator

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 **16** printed pages.

**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  $\triangle ABC$* 

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

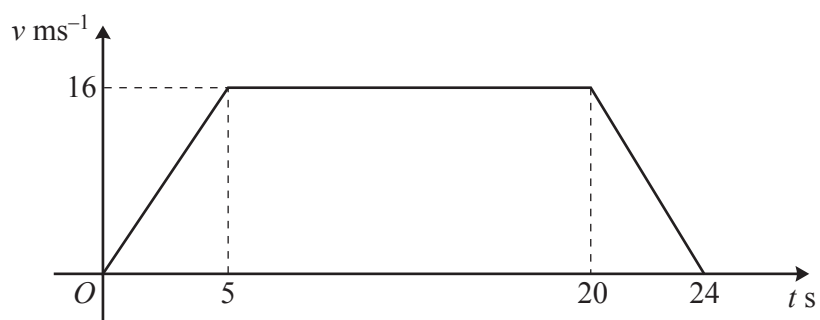
$$a^2 = b^2 + c^2 - 2bc \cos A$$

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

1 Prove that  $\left(\frac{1 + \sin \theta}{\cos \theta}\right)^2 + \left(\frac{1 - \sin \theta}{\cos \theta}\right)^2 = 2 + 4 \tan^2 \theta$ .

[4]

*For  
Examiner's  
Use*



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

(i) Find the acceleration during the first 5 seconds. [1]

(ii) Find the length of time for which the particle is travelling with constant velocity. [1]

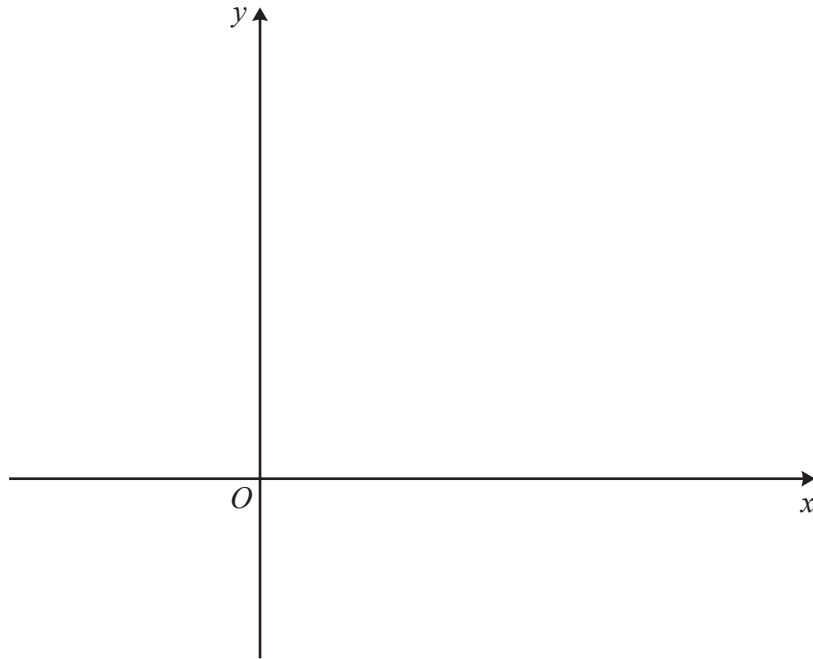
(iii) Find the total distance travelled by the particle. [3]

- 3 Variables  $x$  and  $y$  are related by the equation  $y = 10 - 4 \sin^2 x$ , where  $0 \leq x \leq \frac{\pi}{2}$ . Given that  $x$  is increasing at a rate of 0.2 radians per second, find the corresponding rate of change of  $y$  when  $y = 8$ . [6]

For  
Examiner's  
Use

- 4 (i) Sketch the graph of  $y = |4x - 2|$  on the axes below, showing the coordinates of the points where the graph meets the axes. [3]

For  
Examiner's  
Use



- (ii) Solve the equation  $|4x - 2| = x$ . [3]

5

For  
Examiner's  
Use

A piece of wire of length 96 cm is formed into the rectangular shape  $PQRSTU$  shown in the diagram. It is given that  $PQ = TU = SR = x$  cm. It may be assumed that  $PQ$  and  $TU$  coincide and that  $TS$  and  $QR$  have the same length.

(i) Show that the area,  $A \text{ cm}^2$ , enclosed by the wire is given by  $A = \frac{96x - 3x^2}{2}$ . [2]

(ii) Given that  $x$  can vary, find the stationary value of  $A$  and determine the nature of this stationary value. [4]

- 6 Find the equation of the normal to the curve  $y = \frac{x^2 + 8}{x - 2}$  at the point on the curve where  $x = 4$ .  
[6]

For  
Examiner's  
Use

- 7 (i) Find the first four terms in the expansion of  $(2 + x)^6$  in ascending powers of  $x$ .

[3]

For  
Examiner's  
Use

- (ii) Hence find the coefficient of  $x^3$  in the expansion of  $(1 + 3x)(1 - x)(2 + x)^6$ .

[4]

- 8 The line  $y = 2x - 8$  cuts the curve  $2x^2 + y^2 - 5xy + 32 = 0$  at the points  $A$  and  $B$ . Find the length of the line  $AB$ . [7]

For  
Examiner's  
Use

- 9 It is given that  $x \in \mathbb{R}$  and that
- $$\mathcal{C} = \{x : -5 < x < 12\},$$
- $$S = \{x : 5x + 24 > x^2\},$$
- $$T = \{x : 2x + 7 > 15\}.$$

For  
Examiner's  
Use

Find the values of  $x$  such that

(i)  $x \in S,$  [3]

(ii)  $x \in S \cup T,$  [2]

(iii)  $x \in (S \cap T)'.$  [3]

- 10 A plane, whose speed in still air is  $240 \text{ kmh}^{-1}$ , flies directly from  $A$  to  $B$ , where  $B$  is  $500 \text{ km}$  from  $A$  on a bearing of  $032^\circ$ . There is a constant wind of  $50 \text{ kmh}^{-1}$  blowing from the west.

For  
Examiner's  
Use

- (i) Find the bearing on which the plane is steered.

[4]

- (ii) Find, to the nearest minute, the time taken for the flight.

[4]

*For  
Examiner's  
Use*

**11** A one-one function  $f$  is defined by  $f(x) = (x - 1)^2 - 5$  for  $x \geq k$ .

**(i)** State the least value that  $k$  can take.

[1]

For  
Examiner's  
Use

For this least value of  $k$

**(ii)** write down the range of  $f$ ,

[1]

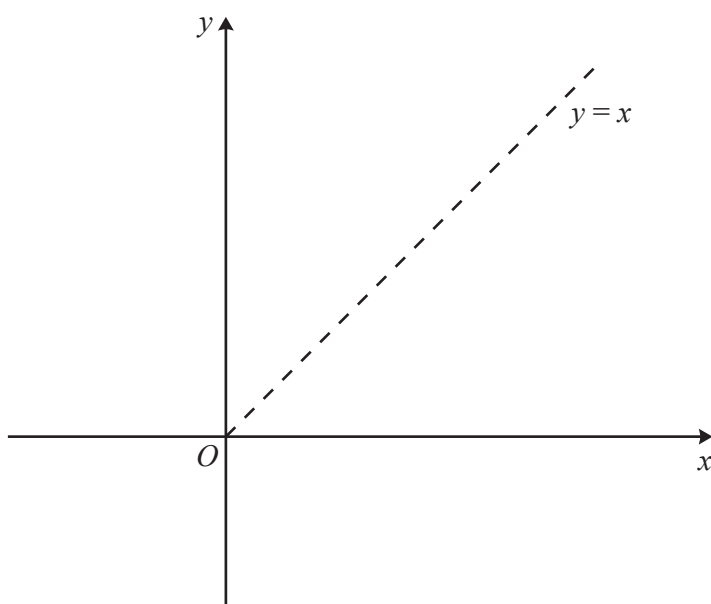
**(iii)** find  $f^{-1}(x)$ ,

[2]

- (iv) sketch and label, on the axes below, the graph of  $y = f(x)$  and of  $y = f^{-1}(x)$ ,

[2]

For  
Examiner's  
Use



- (v) find the value of  $x$  for which  $f(x) = f^{-1}(x)$ .

[2]

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**Question 12 is printed on the next page.**

- 12 The function  $f(x) = x^3 + x^2 + ax + b$  is divisible by  $x - 3$  and leaves a remainder of 20 when divided by  $x + 1$ .

(i) Show that  $b = 6$  and find the value of  $a$ .

[4]

- (ii) Using your value of  $a$  and taking  $b$  as 6, find the non-integer roots of the equation  $f(x) = 0$  in the form  $p \pm \sqrt{q}$ , where  $p$  and  $q$  are integers.

[5]

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