

### Section one

NO CALCULATORS PERMITTED FOR THIS SECTION

Working time: 50 minutes

Available marks 40 marks

#### Question 1 [4 marks]

(a) Solve:  $|2x - 3| = 4$

$$2x - 3 = \pm 4$$

$$2x = 3 \pm 4$$

$$2x = 7 \quad \text{or} \quad 2x = -1$$

$$x = \frac{7}{2}$$

$$\text{or} \quad x = -\frac{1}{2}$$

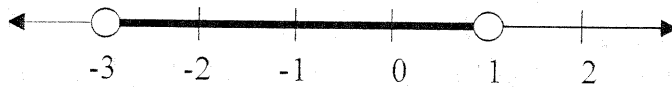
[2]

(-1)

for any error

- (b) The number line shown represents the solution to  $|x - a| < k$ . Find the values of  $a$  and  $k$ .

[2]



$$\frac{-3 + 1}{2} = -1$$

$$\therefore a = -1$$

$$-3 < x < 1$$

$$-2 < x + 1 < 2$$

$$\therefore k = 2$$

Question 2 [6 marks]

(a) Demonstrate a non graphical method to solve  $|2x+1| = |-x+3|$  [2]

$$2x+1 = \pm (-x+3) \quad \checkmark$$

$$2x+1 = -x+3$$

$$\text{(or)} \quad 2x+1 = x-3$$

$$\therefore x = -4$$

-1  
for any error

$$3x = 2$$

$$\therefore x = \frac{2}{3}$$

$$x = \frac{2}{3} \text{ or } x = -4 \quad \checkmark$$

(b) Use your result from part (a) to find the solution to:  $|2x+1| \leq |-x+3|$  [3]  
Show all working.

$$x < -4$$

$$-4 < x < \frac{2}{3}$$

$$x > \frac{2}{3}$$

$$x = -5$$

$$x = 0$$

$$x = 1$$

$$|-10+1| \leq |8|$$

$$|1| \leq |3|$$

$$|3| \leq |2|$$

$$|-9| \leq |8|$$

$$1 \leq 3$$

$$3 \leq 2$$

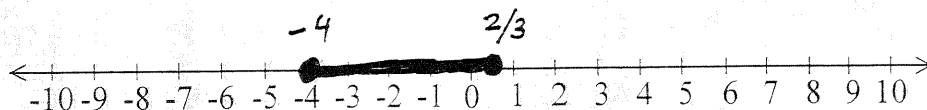
$$9 \leq 8$$

True

False

False

(c) Graph your solution on the provided number line. [1]



Question 3.

[8marks]

(a) Rewrite

$2\log x - \log x^3 + \log y$  as the logarithm of a single term. [2]

$$= \log \frac{x^2 y}{x^3} \quad \checkmark$$

$$= \log \frac{y}{x} \quad \checkmark$$

(b) Find N if  $\log_3 9 - 2\log 5 = \log N$  [3]

$$\log_3 9^2 - \log 5^2 = \log N$$

$$2 \log_3 9 - \log 25 = \log N$$

$$\boxed{N=4} \quad \checkmark$$

$$2 - \log 25 = \log N$$

$$2 = \log_{10} 25N \quad \checkmark$$

$$25N = 100 \quad \checkmark$$

(c) Find an expression for x if:

$$5^{2-x} = 17$$

[3]

$$\log 5^{2-x} = \log 17$$

$$2 \log 5 - x \log 5 = \log 17$$

$$(2-x) \log 5 = \log 17 \quad \checkmark$$

$$x \log 5 = 2 \log 5 - \log 17$$

$$2-x = \frac{\log 17}{\log 5} \quad \checkmark$$

$$x = \frac{2 \log 5 - \log 17}{\log 5}$$

$$x = 2 - \frac{\log 17}{\log 5} \quad \checkmark$$

or  $x = \frac{\log 25 - \log 17}{\log 5}$

or

$$x = \frac{2 \log 5 - \log 17}{\log 5}$$

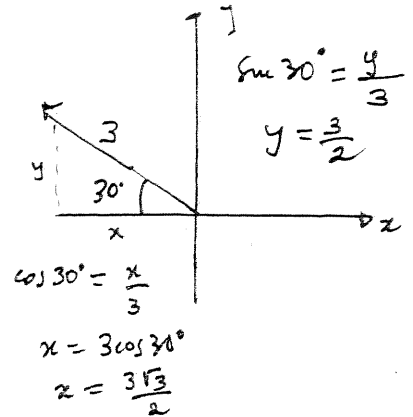
Question 4 [5 marks]

- (a) Change the polar point  $(3, \frac{5\pi}{6})$  to exact Cartesian coordinates. [2]

$$x = -\frac{3\sqrt{3}}{2} \quad \checkmark$$

$$y = \frac{3}{2} \quad \checkmark$$

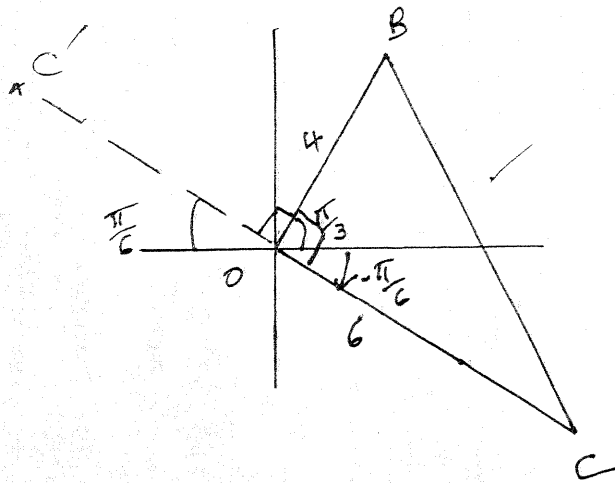
-1 for any error



- (b) Find the area of the triangle whose vertices are at the polar points

$$O: (0,0), \quad B: (4, \frac{\pi}{3}), \quad \text{and} \quad C: (6, -\frac{\pi}{6})$$

[2]



$$\frac{\pi}{3} + \frac{\pi}{6} = \frac{\pi}{2}$$

Right-angled  $\Delta$

$$A_{\Delta} = \frac{1}{2} \times 4 \times 6$$

$$A = 12 \text{ square units} \quad \checkmark$$

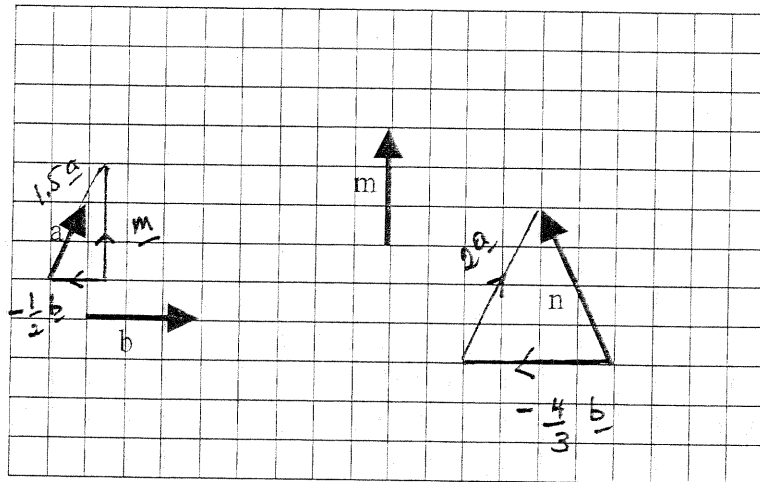
- (c) What other position might C have if the new triangle OBC has the same area as in part (b)? [1]

$$C \text{ might be at } (6, \frac{5\pi}{6}) \quad \checkmark$$

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**Question 5** [4 marks]

Write each of the vectors  $m$  and  $n$  below in terms of the given vectors  $a$  and  $b$



(a)  $m = \frac{3}{2}a - \frac{1}{2}b$

[2]

(b)  $n = 2a - \frac{4}{3}b$

[2]

**Question 6** [3 marks]

Calculate the area of the sector shown with  $OB = OA = 4\text{cm}$  and arc  $AB = 5\text{cm}$ .

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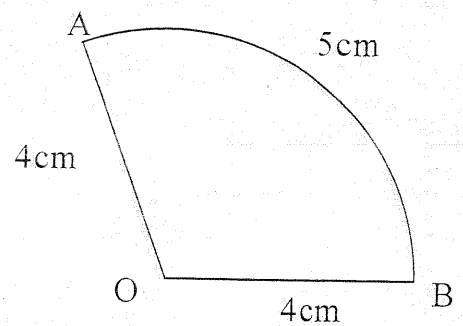
Arc length  $l = 5 = 4 \times \theta$

$\theta = \frac{5}{4}$  RADIANS ✓  
 $= 1.25$

$A = \frac{1}{2}r^2\theta$

$= \frac{1}{2} \times 16 \times \frac{5}{4}$

$A = \underline{\underline{10\text{cm}^2}}$

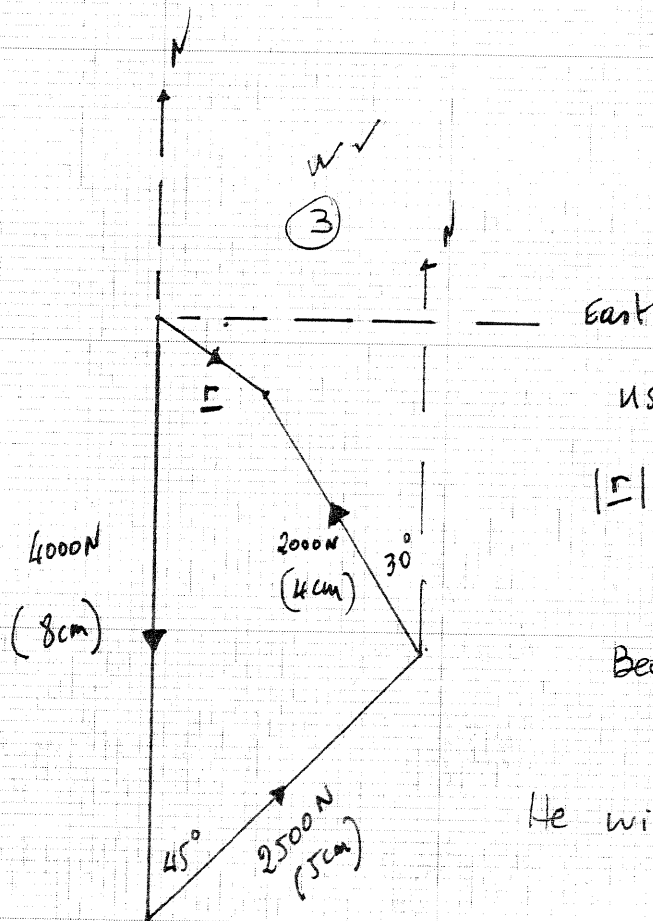


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**Question 7 [5 marks]**

A disabled boat called "Hope" is being dragged towards an East-West reef by ocean currents moving due south with a force of 4000N. Two rescue vessels, called "Hero" and "Heroine", are trying to prevent what appears to be an impending disaster by attaching rescue lines to Hope. Hero exerts a force of 2500 N to the North East and Heroine exerts a force of 2000N on a bearing of 330°.

**Make a scale drawing** using 1cm = 500N and use this scale drawing to find the resultant force on the boat "Hope" and determine whether Hope will sail another day or be broken on the reef.



Mark using their diagram.  
accept some reasonable variations

using scale

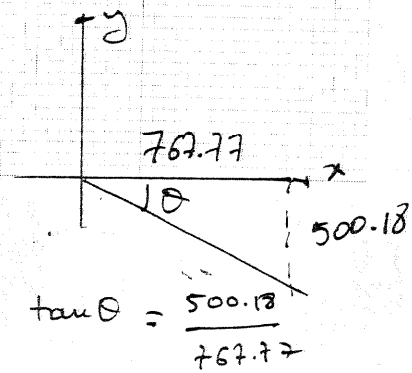
$$|R| = 1.8 \times 500 = 900N \quad \checkmark \quad (1)$$

$$\text{Bearing} \approx 125^\circ \quad \checkmark \quad (1)$$

He will sail another day.

Components (check)

$$\begin{aligned} & -4000\mathbf{j} \\ & + \frac{2500}{\sqrt{2}}\mathbf{j} + \frac{2500}{\sqrt{2}}\mathbf{i} \\ & + \frac{2000\sqrt{3}}{2}\mathbf{j} - \frac{2000 \times 1}{2}\mathbf{i} \\ \hline & = -500.18\mathbf{j} + 767.77\mathbf{i} \\ & = 767.77\mathbf{i} - 500.18\mathbf{j} \\ & |R| = \underline{916.32N} \end{aligned}$$



$$\tan \theta = \frac{500.18}{767.77}$$

$$\theta = 33.08^\circ$$

$$\text{Bearing} = \underline{123^\circ} \quad \checkmark \quad / 5$$

Question.8 [5marks]

Simplify the given expression and leave your answer as a single exponential function.

$$\frac{6^{2n} \times 3^{1-n} \times 9^2}{18^{n-1}}$$

$$= \frac{(3 \times 2)^{2n} \times 3^{1-n} \times 3^4}{(3 \times 2)^{n-1}}$$

$$= \frac{3^{2n} \times 2^{2n} \times 3^{1-n} \times 3^4}{3^{2n-2} \times 2^{n-1}}$$

$$= \frac{3^{n+5} \times 2^{2n-n+1}}{3^{2n-2}}$$

$$= 3^{7-n} \times 2^{n+1}$$

$$= \frac{2^{n+1}}{3^{n-7}}$$

$$= \frac{2^n \times 2^1}{3^n \times 3^{-7}}$$

$$= \left(\frac{2}{3}\right)^n \times 2 \times 3^7$$

$$= \left(\frac{2}{3}\right)^n \times 4374$$