



Semester One Examination, 2021

Question/Answer booklet

MATHEMATICS METHODS UNIT 1

Section Two: Calculator-assumed

Your name _____

Teacher (please circle) HILL PECK

Time allowed for this section

Reading time before commencing work: ten minutes
Working time: one hundred minutes

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer booklet
Formula sheet (retained from Section One)

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators, which can include scientific, graphic and Computer Algebra System (CAS) calculators, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	8	8	50	52	35
Section Two: Calculator-assumed	13	13	100	98	65
Total					100

Instructions to candidates

- The rules for the conduct of examinations are detailed in the school handbook. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
- You must be careful to confine your answers to the specific question asked and to follow any instructions that are specific to a particular question.
- Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.
- It is recommended that you do not use pencil, except in diagrams.
- Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.
- The Formula sheet is not to be handed in with your Question/Answer booklet.

Markers use only		
Question	Maximum	Mark
9	6	
10	6	
11	8	
12	8	
13	8	
14	8	
15	9	
16	8	
17	8	
18	7	
19	8	
20	7	
21	7	
S2 Total	98	
S2 Wt ($\times 0.6633$)	65%	

Section Two: Calculator-assumed

65% (98 Marks)

This section has **thirteen** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

Question 9

(6 marks)

- (a) The variables C and n are directly proportional to each other, so that when $n = 10$, it is known that $C = 25$. Sketch a graph of the relationship between C and n on the axes below. (3 marks)



- (b) The variables A and n are inversely proportional to each other, so that when $n = 10$, it is known that $A = 60$.
- (i) Write an equation that relates A and n . (2 marks)

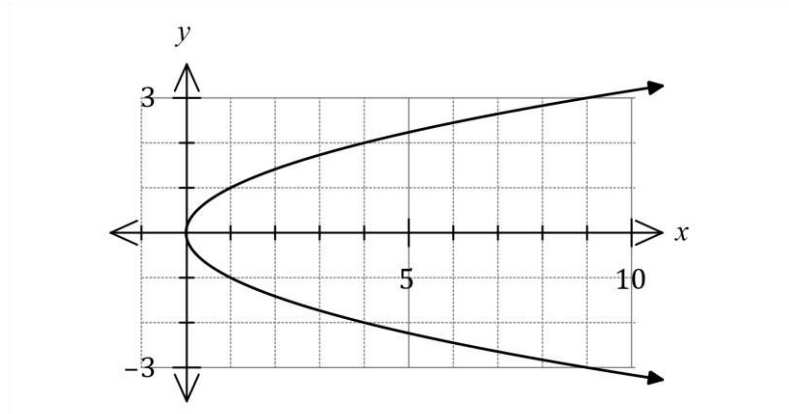
- (ii) Determine the value of n when $A = 15$. (1 mark)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 10

(6 marks)

(a) The parabolic graph of a relation is shown below.



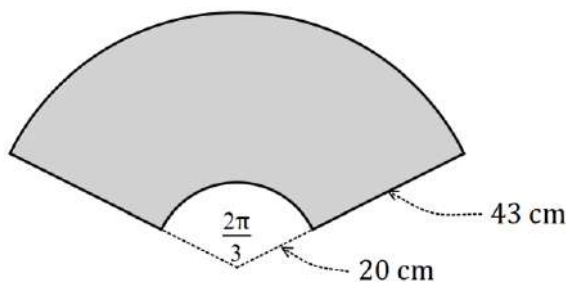
- (i) State the equation of its axis of symmetry. (1 mark)
- (ii) State the equation of the relationship between x and y . (1 mark)
- (b) Points A and B have coordinates $(7, 8)$ and $(-3, 2)$ respectively. Determine the equation of the circle that has diameter AB . (4 marks)

Question 11

(8 marks)

- (a) At 3 pm, the length of the shadow of a thin vertical pole standing on level ground is the same as the height of the pole. A while later, the angle of elevation of the sun has decreased by 12° and the length of the shadow has increased by 95 cm. Determine the height of the pole. (4 marks)

- (b) A windscreen wiper on a car is 43 cm long and rotates through one-third of a circle, as shown below. The inner and outer radii of the arcs are 20 cm and 63 cm. Determine the shaded area, rounding your answer to a reasonable degree of accuracy. (4 marks)



DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 12

(8 marks)

- (a) Triangle ABC is such that $b = 15$ cm, $c = 18$ cm and $\angle A = 125^\circ$. Determine, with justification, the length of side a . (2 marks)

- (b) Triangle PQR is such that $p = 48.1$ cm, $q = 41.5$ cm and $\angle Q = 45^\circ$. Determine all possible areas of this triangle. (6 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

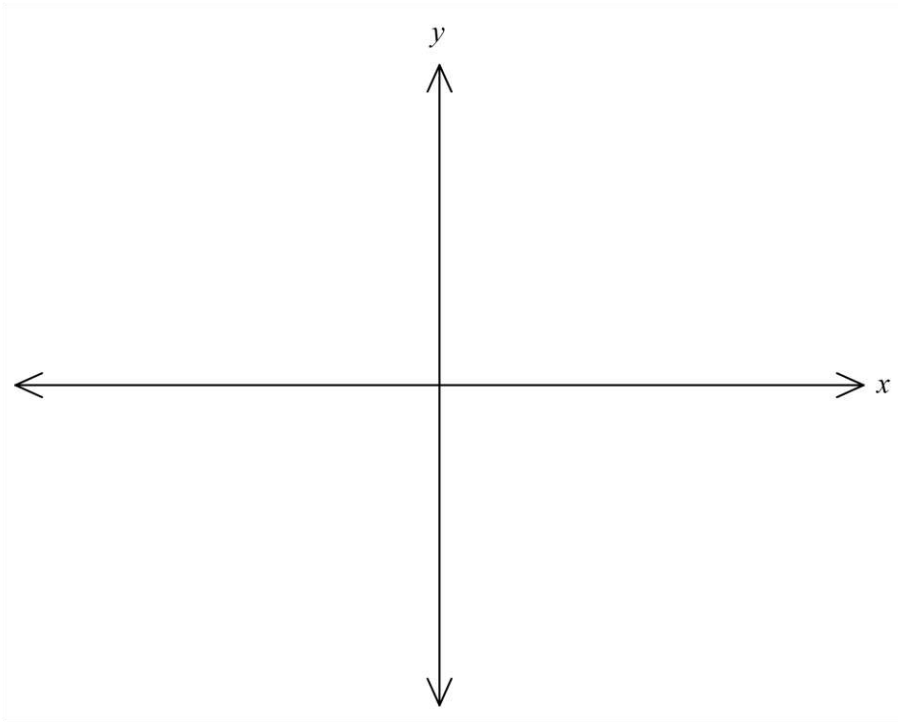
Question 13

(8 marks)

Let $f(x) = 2\sqrt{4-x} - 2$.

(a) Sketch the graph of $y = f(x)$ on the axes below.

(4 marks)



(b) Describe the transformation(s) required to obtain the graphs of the following functions from the graph of $y = f(x)$:

(i) $y = 2\sqrt{1-x} - 2$.

(2 marks)

(ii) $y = \sqrt{4-x} - 1$.

(2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 14

(8 marks)

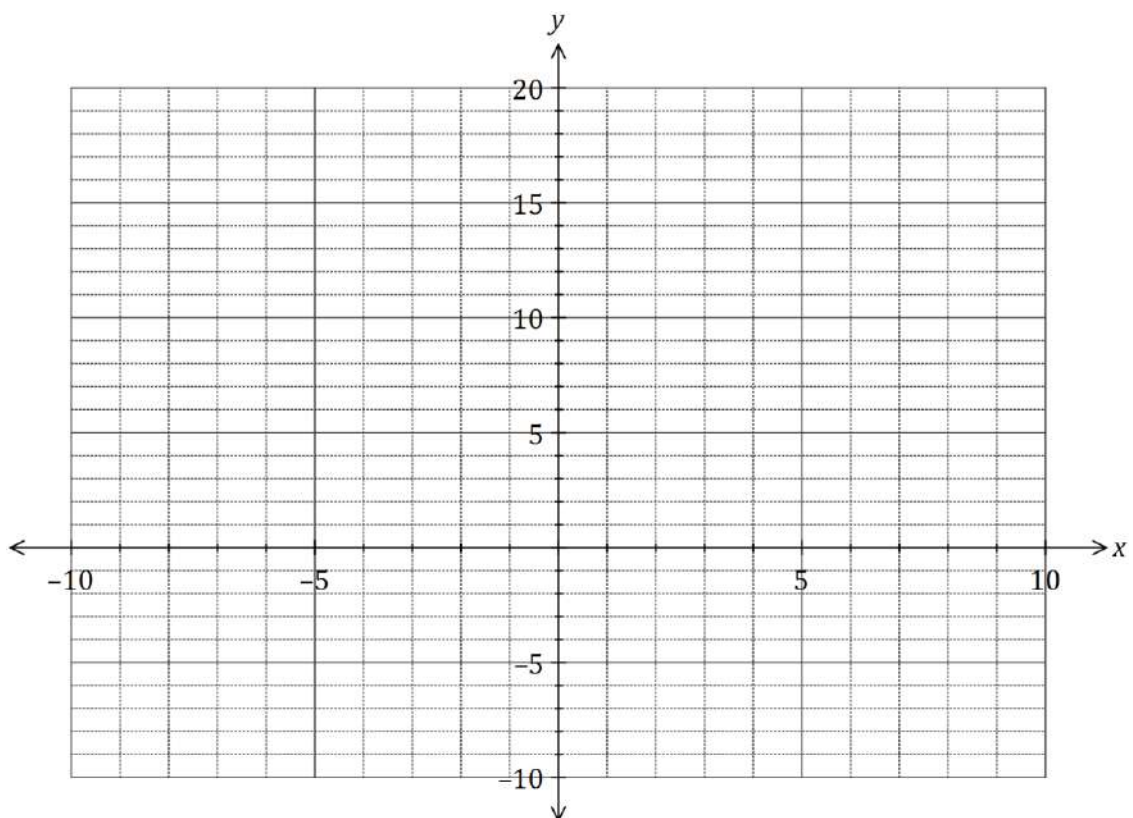
(a) The graph of $y = 2x^2 + bx + 16$ has a line of symmetry with equation $x = 3$.

(i) Determine the value of b .

(2 marks)

(ii) Draw the graph of the parabola on the axes below.

(3 marks)



- (b) One of the solutions to the equation $2x^3 + 21x^2 + cx - 495 = 0$ is $x = 5$. Determine the value of c and all other solutions. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

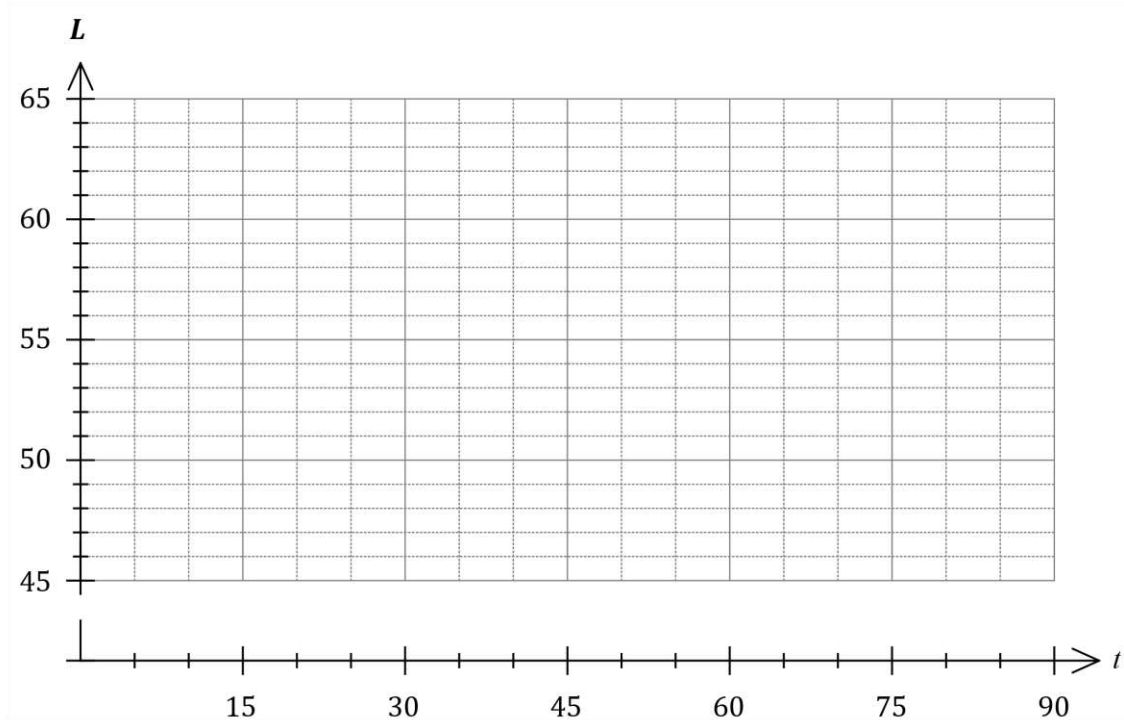
Question 15**(9 marks)**

The loudness L of sound, in decibels, emitted by a machine t minutes after it is switched on can be modelled by

$$L = 55 - 8 \cos\left(\frac{\pi t}{15}\right)$$

- (a) Determine the initial loudness emitted by the machine. (1 mark)

- (b) Draw the graph of L against t on the axes below for the first 90 minutes. (3 marks)



- (c) State the maximum loudness emitted by the machine and the time this maximum was first reached. (2 marks)

- (d) A health and safety inspector can deem a machine unserviceable if the loudness it emits exceeds 60 dB for more than 15 minutes in any hour that it is running. Determine, with justification, whether this machine could be deemed unserviceable. (3 marks)

Question 16**(8 marks)**

- (a) Let $f(x) = x^2 + bx + c$, where b and c are constants. The graph of $y = f(x)$ has an axis of symmetry with equation $x = -3$ and an axis intercept at $(0, 5)$.

Determine the value of $f(1)$.

(3 marks)

- (b) Let $g(x) = 2(x - 2)^2 - 7$. Determine

(i) the coordinates of the turning point of the graph of $y = g(x)$. (1 mark)

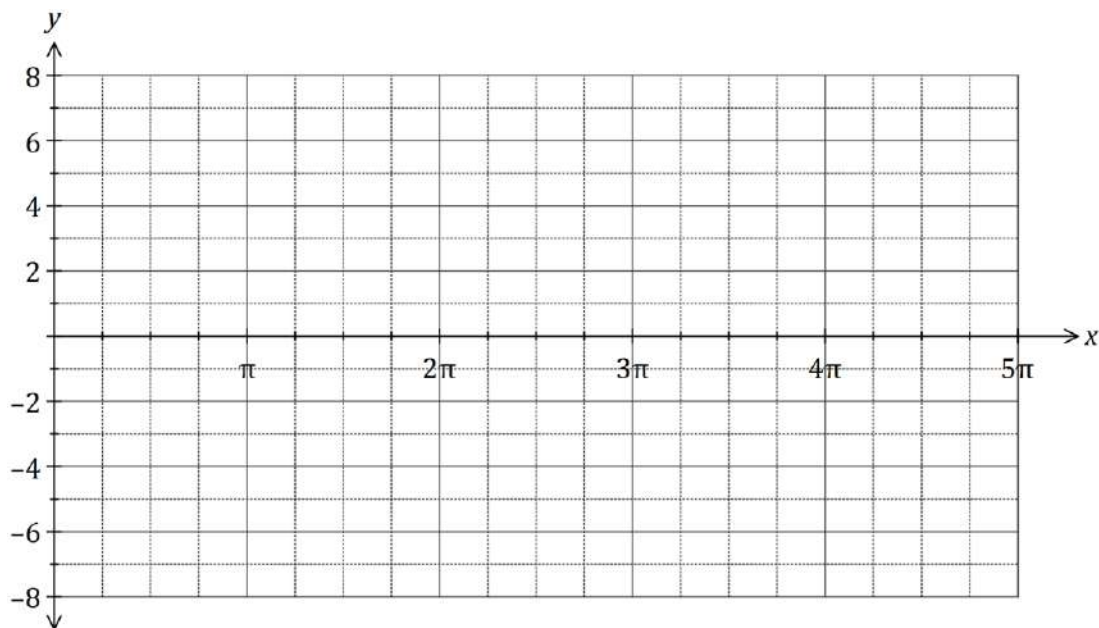
(ii) the domain and range of $g(x)$. (2 marks)

(iii) the coordinates of the turning point of the graph of $y = g(x - 3) + 2$. (2 marks)

Question 17

(8 marks)

- (a) On the axes below, draw the graph of $y = \tan\left(\frac{x}{3}\right)$ over the interval $0 \leq x \leq 5\pi$, clearly indicating the equations of any asymptotes. (3 marks)



- (b) Solve the following equations over the interval $0 \leq x \leq 5\pi$.

(i) $\tan\left(\frac{x}{3}\right) = -1$. (1 mark)

(ii) $\tan\left(\frac{x}{3}\right) - \sqrt{3} = 0$. (2 marks)

- (c) Determine the smallest positive value of α so that $\tan\left(x - \frac{5\pi}{6}\right) = \tan(x + \alpha)$. (2 marks)

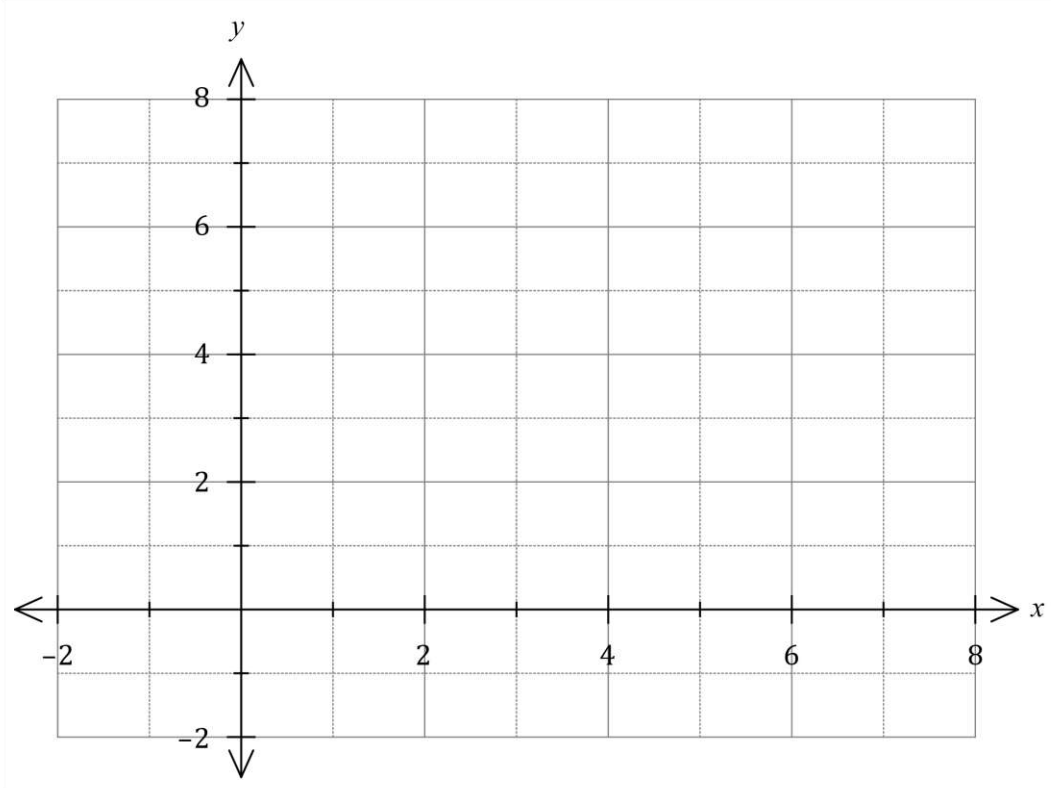
Question 18

(7 marks)

The equation of a parabola is $y = \frac{1}{4}(x^2 - 6x + 15)$.

(a) Sketch the parabola on the axes below.

(3 marks)



All parabolas have a focal point and a directrix. For a parabola with equation $y = a(x - p)^2 + q$, the focal point is at $(p, q + \frac{1}{4a})$ and the equation of the directrix is $y = q - \frac{1}{4a}$, where a, p and q are constants.

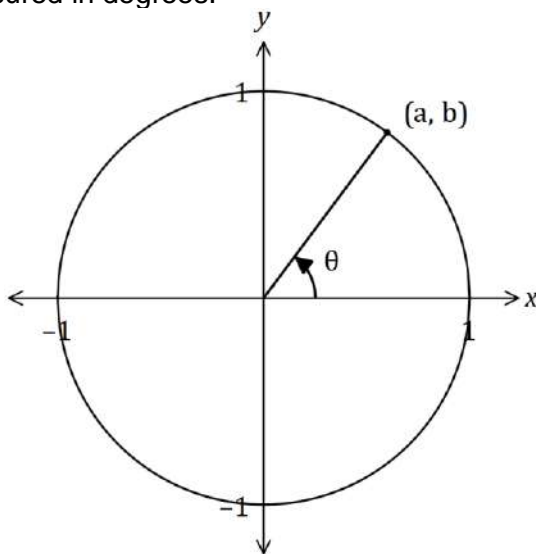
(b) Determine the focal point and directrix for this parabola and add them, with labels, to your sketch above. (4 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 19

(8 marks)

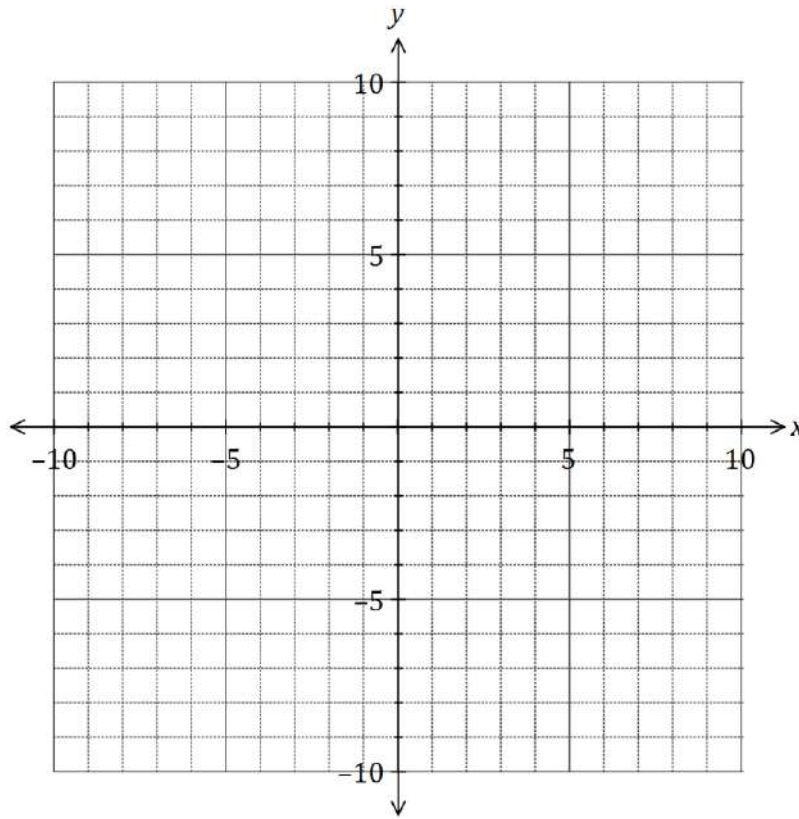
- (a) Using the unit circle shown, determine the following in terms of a and/or b , given that θ is an acute angle measured in degrees.



- (i) $\sin(\theta)$. (1 mark)
- (ii) $\cos(180 - \theta)$. (1 mark)
- (iii) $\tan(90 + \theta)$. (1 mark)
- (b) Determine x in each of the following cases, where $0 \leq x \leq \frac{\pi}{2}$.
- (i) $\sin x = \sin 17\pi$. (1 mark)
- (ii) $\cos x = \cos \frac{23\pi}{6}$. (1 mark)

(c) Draw the graph of the relation $x^2 + y^2 = 2x - 6y + 26$.

(3 marks)

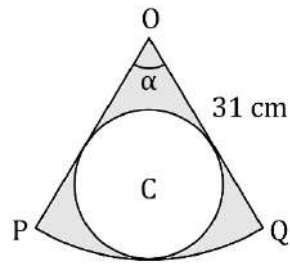


DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 20**(7 marks)**

The diagram shows sector OPQ of a circle centre O of radius 31 cm and $\alpha = 40^\circ$.

Circle C is inside the sector and just touches OP , OQ and arc PQ .



(a) Determine the area of sector OPQ . (2 marks)

(b) Show that the radius of circle C is 7.9 cm, correct to one decimal place. (3 marks)

(c) Determine the area of the shaded region, inside sector OPQ but outside circle C . (2 marks)

Question 21**(7 marks)**

The equation $f(x) = k$ has two solutions, where $f(x) = ax^3 + bx^2 - 12x + 8$ and a, b and k are constants.

The graph of $y = f(x)$ cuts the x -axis at $x = 2$, $x = -2$, and at one other point.

Determine the value(s) of the constant k , rounded to 2 decimal places. Explain your reasoning.

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

© 2021 WA Exam Papers. Kennedy Baptist College has a non-exclusive licence to copy and communicate this document for non-commercial, educational use within the school. No other copying, communication or use is permitted without the express written permission of WA Exam Papers. SN245-172-2.