CORPUS CHRISTI COLLEGE

SEQUERE DOMINUM

Semester One Examination, 2022

Question/Answer booklet

MATHEMATICS METHODS UNIT 1

If required by your examination administrator, please place your student identification label in this box

Section Two: Calculator-assumed

WA student number: In figures

In words

Your name

Time allowed for this section

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

Number of additional answer booklets used (if applicable):

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	7	7	50	52	35
Section Two: Calculator-assumed	12	12	100	98	65
				Total	100

Instructions to candidates

1. 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.
2. Write your answers in this Question/Answer booklet preferably using a blue/black pen.
   Do not use erasable or gel pens.
3. 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.
4. 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.
5. It is recommended that you do not use pencil, except in diagrams.
6. 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.
7. The Formula sheet is not to be handed in with your Question/Answer booklet.

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

See next page

Section Two: Calculator-assumed **65% (98 Marks)**

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

Working time: 100 minutes.

Question 8 **(8 marks)**

(a) The variables V and t are linearly related so that when $t = 4, V = 52$ and when $t = 5, V = 65$. State, with reasoning, whether the relationship between V and t is an example of direct proportion. (2 marks)

(b) Four points have coordinates $A(6, 5), B(-10, 6), C(2, -3)$ and $D(p, q)$.

(i) If C is the midpoint of B and D, determine the value of the constant p and the value of the constant q. (2 marks)

(ii) Determine the equation of the line that is perpendicular to BC and that passes through A in the form $ax + by + c = 0$, where a, b and c are integers and $a > 0$. (4 marks)

Question 9 **(8 marks)**

Triangle ABC has sides $a = 15.3$ cm, $b = 16.5$ cm and an area of 65 cm^2.

(a) Determine all possible values for the size of angle C. (3 marks)

(b) Determine, showing use of trigonometry, the largest possible perimeter of triangle ABC. (3 marks)

(c) Determine, showing use of trigonometry, the size of angle B when triangle ABC has the largest possible perimeter. (2 marks)

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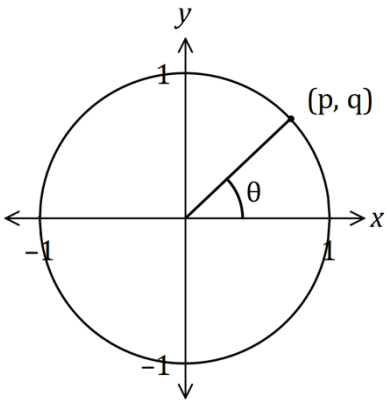
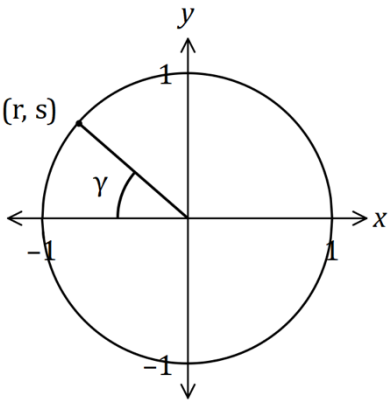
Question 10 **(8 marks)**

Consider the points with coordinates (p, q) and (r, s) that lie in the first and second quadrants respectively of the unit circles shown below, where θ and γ are acute angles.





Determine the following in terms of p, q, r and s, simplifying your answers where possible.

(a) $\tan\theta$. (1 mark)

(b) $\sin(180° - \theta)$. (1 mark)

(c) $\cos\gamma$. (2 marks)

(d) $\sin(\pi + \gamma)$. (1 mark)

(e) $\cos(\gamma - \theta)$. (3 marks)

See next page

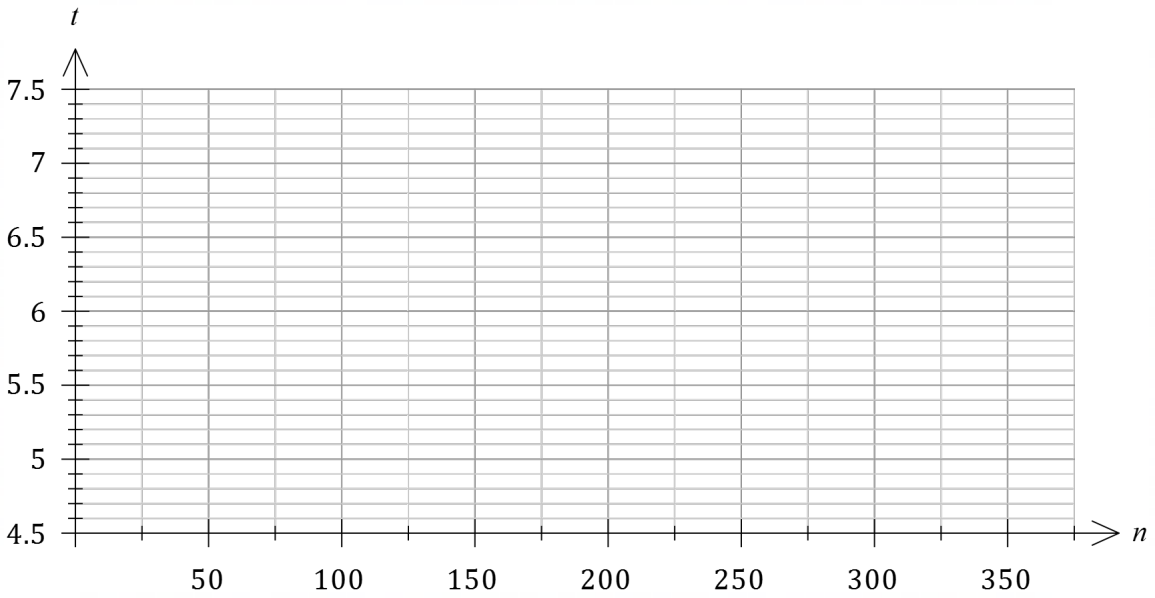
Question 11 **(9 marks)**

The time of sunrise, t hours after midnight, on the n^{th} day of the year in Bunbury is closely modelled by

$$t = 6.18 - 1.17\sin(0.0172n + 2.032).$$

(a) Use the model to calculate, in hours and minutes, the time of sunrise on 11 February. (2 marks)

(b) Graph t as a function of n on the axes below for $0 \leq n \leq 365$. (4 marks)



(c) Jack lives in Bunbury and is woken by his alarm clock at $5{:}50$ am every day. How many days is will he be awake before sunrise in a year of 365 days? (3 marks)

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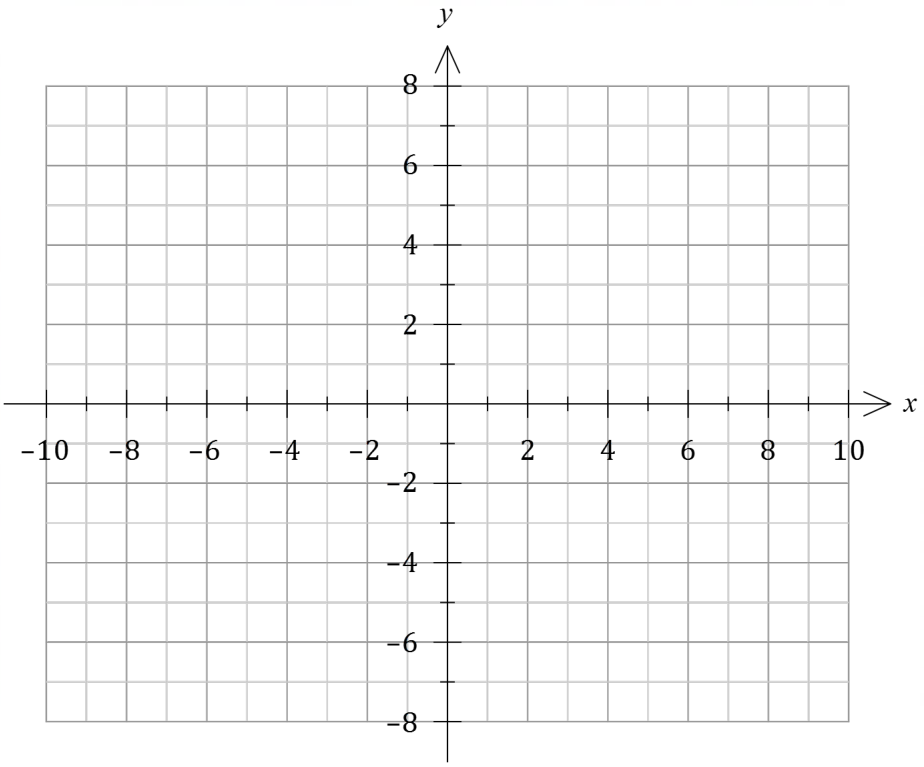
Question 12 **(7 marks)**

Let $f(x) = \sqrt{x+4} + 1$.

(a) Sketch the graph of $y = f(x)$ on the axes below. (3 marks)



(b) State the domain and range of

(i) $f(4x) + 5$. (2 marks)

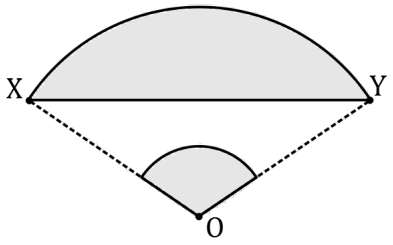
(ii) $2f(x+3)$. (2 marks)

See next page

Question 13 **(9 marks)**

The shaded regions shown in the diagram form a logo that is to be cut from a plastic sheet.

The boundaries of the shaded regions are parts of triangle XOY, where $\angle XOY = 132°$, and arcs of two concentric circles with centre O and radii of 32 cm and 82 cm.



(a) Express $132°$ exactly in radians. (1 mark)

(b) Determine the total length of the two curved and three straight cuts that must be made by the cutting machine, giving your answer to the nearest centimetre. (4 marks)

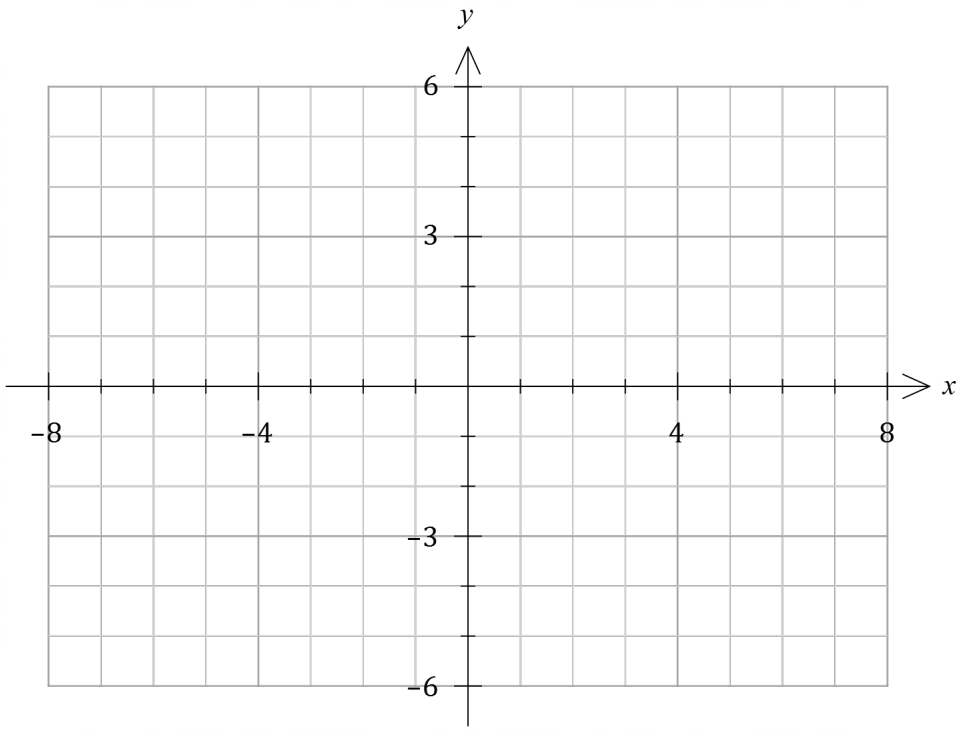
(c) Determine the area of logo, giving your answer to the nearest square centimetre. (4 marks)

Question 14 **(9 marks)**

A function defined by $f(x) = \frac{a}{x+b}$, where a and b are constants, passes through the points $(-8, 0.2)$ and $(2, -0.6)$.

(a) Determine the value of a and the value of b. (3 marks)

(b) Draw the graph of $y = f(x)$ on the axes below, clearly indicating the coordinates of all axes intercepts and equations of any asymptotes. (4 marks)



(c) State the equations of all asymptotes of the graph of $y = f(2x) - 3$. (2 marks)

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Question 15 **(7 marks)**

A block of land $ABCD$ is bounded by four straight sides, with C the most easterly corner. The lengths of sides AD and BC are 145 m and 175 m respectively and B lies 241 m due north of D. Diagonal AC makes an angle of $50°$ with AD and $33°$ with CD.

(a) Sketch a diagram of the block, showing all the above information. (2 marks)

(b) Determine the length of side CD. (2 marks)

(c) Determine the bearing of C from B. (3 marks)

Question 16 **(10 marks)**

(a) Use your classpad in standard mode to

(i) determine the exact value of $\cos 36°$. (1 mark)

(ii) determine the exact value of $\sin 105°$. (1 mark)

(iii) solve $\cos(x + 60°) = \sin x$ for $-270° \leq x \leq 270°$. (3 marks)

(b) Using suitable exact values of acute angles, and the expression given below, justify your above value of $\sin 105°$. (5 marks)

$$\sin(A \pm B) = sinAcosB \pm cosAsinB$$

Question 17 **(8 marks)**

(a) The graph of the quadratic function $y = f(x)$ has roots at $x = -3$ and $x = 7$ and the range of $f(x)$ is $y \leq 75$. Use an algebraic method to determine $f(0)$. (4 marks)

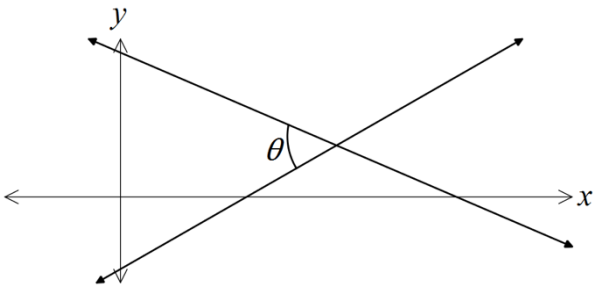
(b) The area of square B is 819 cm^2 greater than four times the area of square A, and the difference in the perimeters of the two squares is 102 cm. Determine the least possible area of square A, the smaller of the squares. (4 marks)

See next page

Question 18 **(6 marks)**

(a) Show how to establish that the exact value of $\cos 135°$ is $-\frac{1}{\sqrt{2}}$. (3 marks)

(b) The graphs of $x + 2y = 4$ and $2x - 3y = 3$ are shown below. Determine, to the nearest degree, the size of the angle θ. (3 marks)



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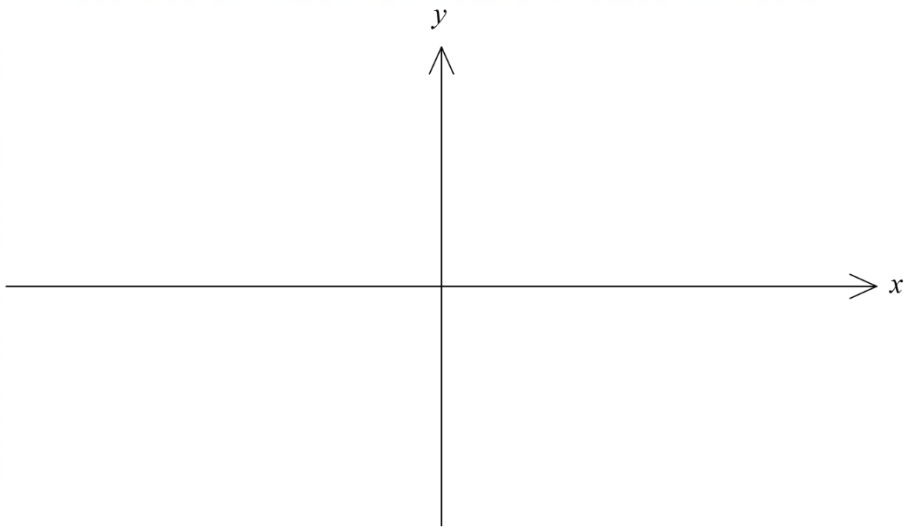
Question 19 **(9 marks)**

The graph of the cubic polynomial $y = f(x)$ passes through the points $(3, 0)$, $(0, -3)$ and has a local maximum at $(-1, 0)$.

(a) Use the above information to sketch the graph of $y = f(x)$ on the axes below. (3 marks)



Let $f(x) = x^3 + bx^2 + cx + d$, where b, c and d are constants.

(b) Determine the value of each of the constants b, c and d. (3 marks)

(c) Another cubic polynomial is defined by $g(x) = x^3 + x^2 + ax + 5$. Determine the value(s) of the constant a so that the graphs of $y = f(x)$ and $y = g(x)$ do not intersect. (3 marks)

End of questions

Supplementary page

Question number: _____