



Christ Church Grammar School

Semester One Examination, 2021 Question/Answer booklet

MATHEMATICS METHODS UNIT 1

Section One: Calculator-free

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

WA student number: In figures

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In words _____

Your name _____

Time allowed for this section

Reading time before commencing work: five minutes
Working time: fifty 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

To be provided by the candidate

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

Special items: nil

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	96	65
Total					100

Instructions to candidates

1. The rules for the conduct of CCGS assessments are detailed in the Reporting and Assessment policy. 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.

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Section One: Calculator-free**35% (52 Marks)**

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

Supplementary pages for planning/continuing your answers to questions are provided at the end of the 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.

Working time: 50 minutes.

Question 1**(7 marks)**

Solve the following equations for x .

(a) $(3x - 1)(x + 2) = 0.$ (2 marks)

(b) $x^2 - 6x - 7 = 0.$ (2 marks)

(c) $(x - 11)^2 - 81 = 0.$ (3 marks)

Question 2**(8 marks)**

The straight line L has equation $4x + 2y = 1$.

- (a) Write the equation of L in the form $y = mx + c$ to show that its gradient is -2 . (2 marks)

Line L_1 is perpendicular to L and passes through the point $(2, 6)$.

Line L_2 is parallel to L and passes through the point $(1, -7)$.

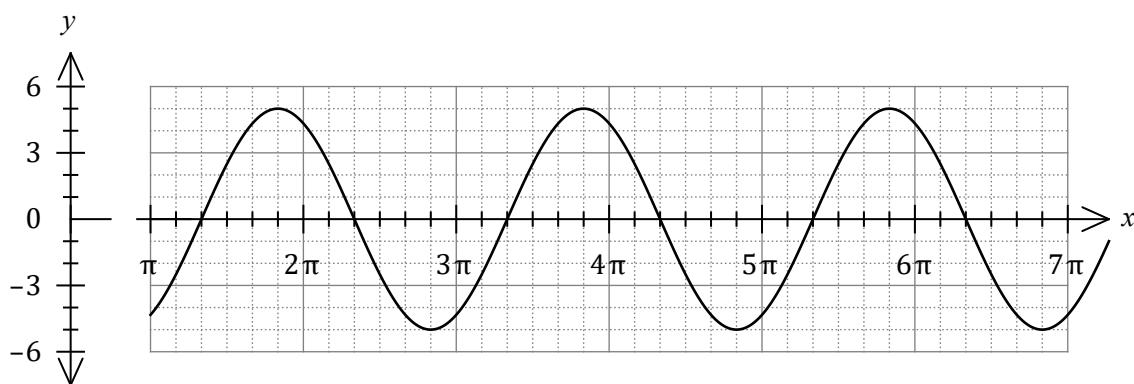
- (b) Determine the point of intersection of L_1 and L_2 . (6 marks)

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Question 3

(4 marks)

- (a) The graph of $y = a \sin(x + b)$ is shown below, where a and b are positive constants.



Determine the value of a and the least value of b .

(2 marks)

- (b) Let $g(x) = 3 + \cos\left(\frac{x}{2}\right)$.

Determine the coordinates of the minimum of the graph of $y = g(x)$ for $0 \leq x \leq 4\pi$.

(2 marks)

Question 4

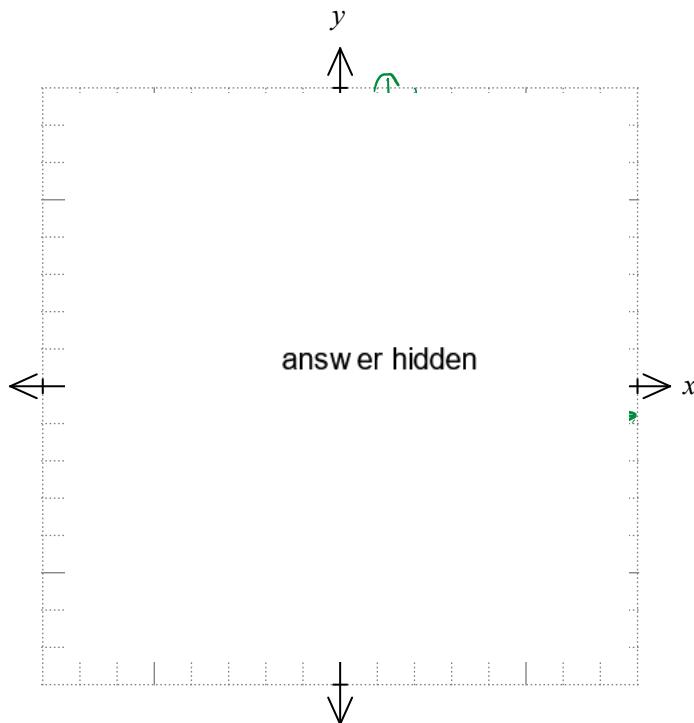
(7 marks)

Consider the function $f(x) = \frac{p}{x+q}$, where p and q are constants. The graph of $y = f(x)$ has an asymptote with equation $x = 2$ and passes through the point $(6, -1)$.

- (a) Determine the value of p and the value of q . (3 marks)

- (b) State the equation of the other asymptote of the graph of $y = f(x)$. (1 mark)

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



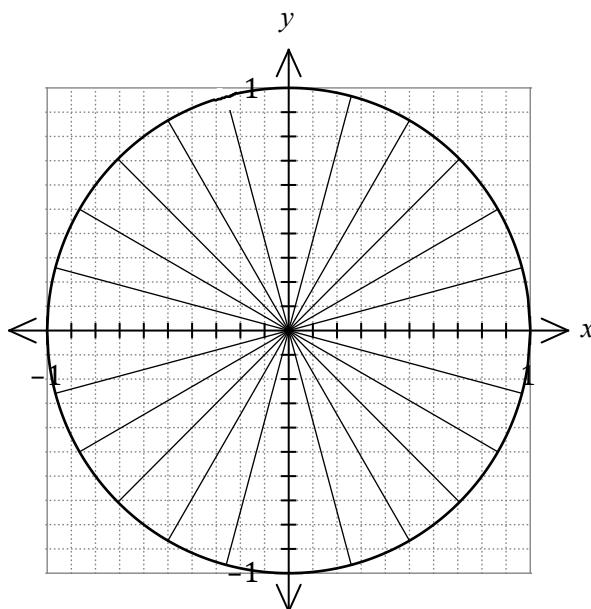
Question 5

(5 marks)

- (a) A unit circle is shown.

Mark on the circumference of the circle the point P so that a ray drawn from the origin to point P will make an anticlockwise angle of $\frac{7\pi}{12}$ from the positive x -axis.

Hence estimate the value of $\cos\left(\frac{7\pi}{12}\right)$.



(2 marks)

- (b) Solve the equation $2 \tan(3x - 75^\circ) + 2 = 0$ for $0^\circ \leq x \leq 90^\circ$.

(3 marks)

Question 6**(7 marks)**

- (a) Determine the number of possible combinations when four students must be chosen from a small class of six. (2 marks)

- (b) Determine the coefficient of the x^2 term in the expansion of

(i) $(x + 4)^3$. (2 marks)

(ii) $(5x - 2)^6$. (3 marks)

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Question 7**(7 marks)**

Two polynomial functions are defined by $f(x) = (3x - 2)(x + 4)$ and $g(x) = x^3 - x^2 + 3x + 2$.

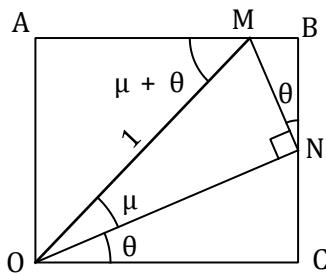
Determine the coordinates of the point(s) of intersection of $f(x)$ and $g(x)$.

Question 8

(7 marks)

Consider rectangle $OABC$ that contains the right triangle OMN as shown.

Let the length of $OM = 1$,
 $\angle NOC = \angle MNB = \theta$,
 $\angle MON = \mu$ and
 $\angle AMO = \mu + \theta$.



- (a) Explain why $OC = \cos \mu \cos \theta$.

(2 marks)

- (b) Determine expressions for the lengths of BM and AM and hence prove the angle sum identity $\cos(\mu + \theta) = \cos \mu \cos \theta - \sin \mu \sin \theta$.

(3 marks)

- (c) Use the identity from part (b) to show that $\cos\left(x + \frac{\pi}{2}\right) = -\sin x$. (2 marks)

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Christ Church Grammar School

Semester One Examination, 2021 Question/Answer booklet

MATHEMATICS METHODS UNIT 1

Section Two: Calculator-assumed

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

WA student number: In figures

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In words _____

Your name _____

Time allowed for this section

Reading time before commencing work: ten minutes

Number of additional answer booklets used (if applicable):

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

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Section Two: Calculator-assumed**65% (93 Marks)**

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

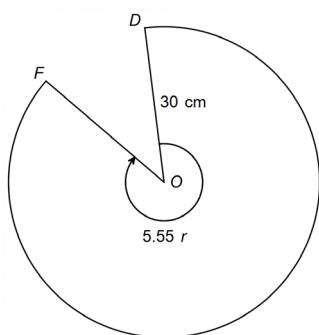
Supplementary pages for planning/continuing your answers to questions are provided at the end of the Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Working time: 100 minutes.

Question 9**(5 marks)**

- (a) The diagram below shows a sector of a circle with centre O. The radius of the circle is 30 cm and $\angle DOF = 5.55$ radians. Calculate the length of the major arc DF

(2 marks)



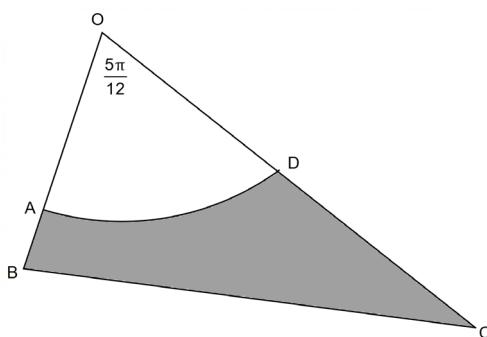
- (b) In the diagram below AOD is a sector of the circle with centre O. BOC is a triangle.

In sector AOD, the radius is 30 cm and angle AOD is $\frac{5\pi}{12}$ radians.

In triangle BOC, OB = 38 cm and OC = 55 cm.

Calculate the shaded area of the shape with the vertices of ABCD rounded to 3 dp.

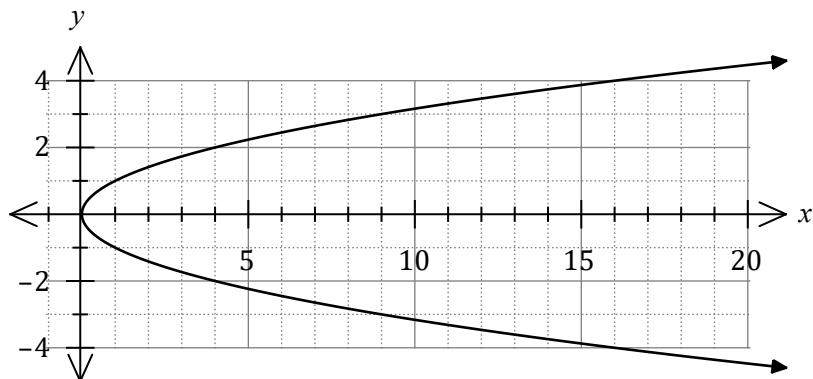
(3 marks)



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 $(5, 4)$ respectively. Determine the equation of the circle that has diameter AB . (4 marks)

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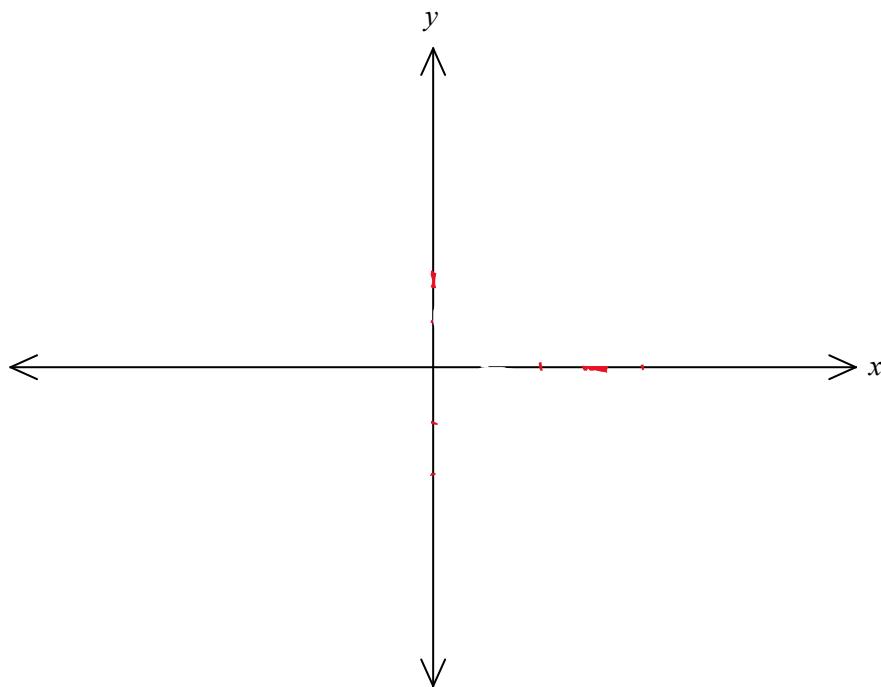
Question 11

(8 marks)

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

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

(3 marks)



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

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

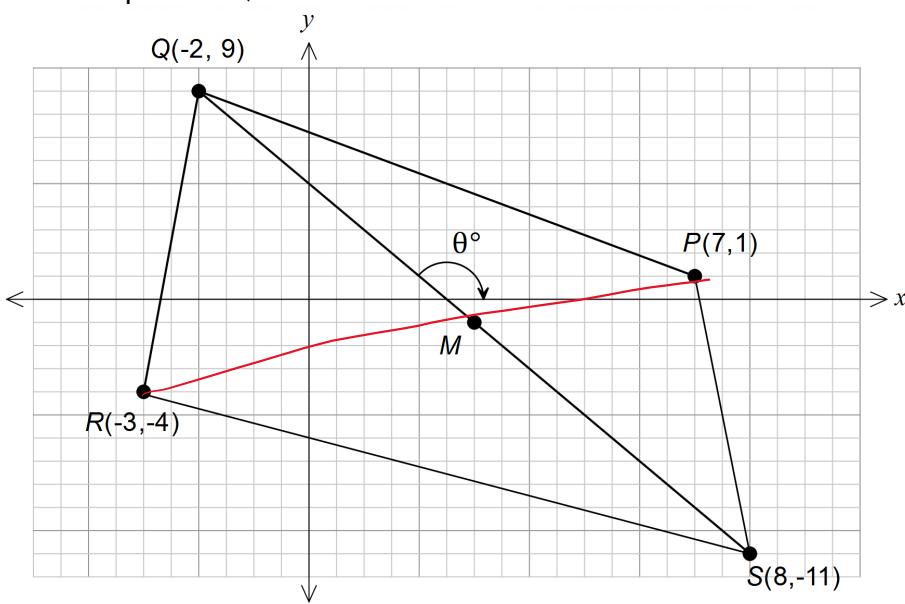
(2 marks)

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

(3 marks)

Question 12**(9 marks)**

In the diagram $PQRS$ is a quadrilateral having vertices $P(7, 1)$, $Q(-2, 9)$, $R(-3, -4)$ and $S(8, -11)$. M is the midpoint of QS .



- (a) A line is drawn from P to R , determine the equation of the line PR . (2 marks)

- (b) Determine whether M lies on the line PR . (3 marks)

Question 12 continued

(c) Show that QS is Perpendicular to PR . (2 marks)

(d) Calculate θ , the angle of inclination of QS , as shown in the diagram. (2 marks)

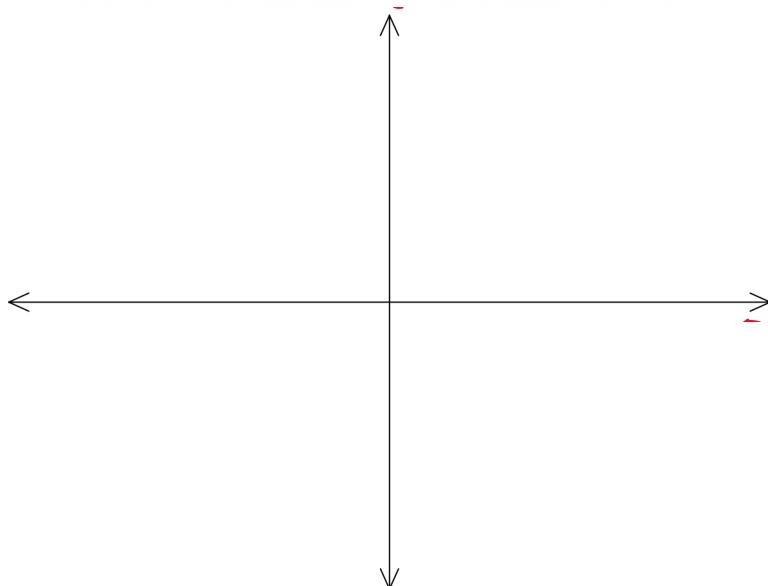
Question 13**(6 marks)**

A netball team collected money to go on a tour. They decided to sell cans of soft drinks at their home games. At the first game they sold 100 cans at \$4 per can. They collected data and found that if they increased the price of the soft drinks, the sales would decrease. This is the data they collected:

Price per can	\$4	\$4.50	\$5
Number of supporters willing to buy at the given price	100	88	79

One of the players claimed that the data suggested an inverse relation with the equation $n = \frac{296}{p}$ where n is the number of cans they can sell at $\$p$ per can.

- (a) Comment on the validity of the player's claim. (2 marks)
- (b) According to the given model, state the number of cans which would be sold if the price of a can was \$5.50. (2 marks)
- (c) Draw a sketch of the graph of this model labelling the axes appropriately. (2 marks)



Question 14**(9 marks)**

- (a) Triangle ABC is such that $b = 22$ cm, $c = 13$ cm and $\angle A = 134^\circ$. Determine, with justification, the length of side a . (3 marks)
- (b) Triangle PQR is such that $p = 46.5$ cm, $r = 38.5$ cm and $\angle R = 38^\circ$. Determine all possible areas of this triangle. (6 marks)

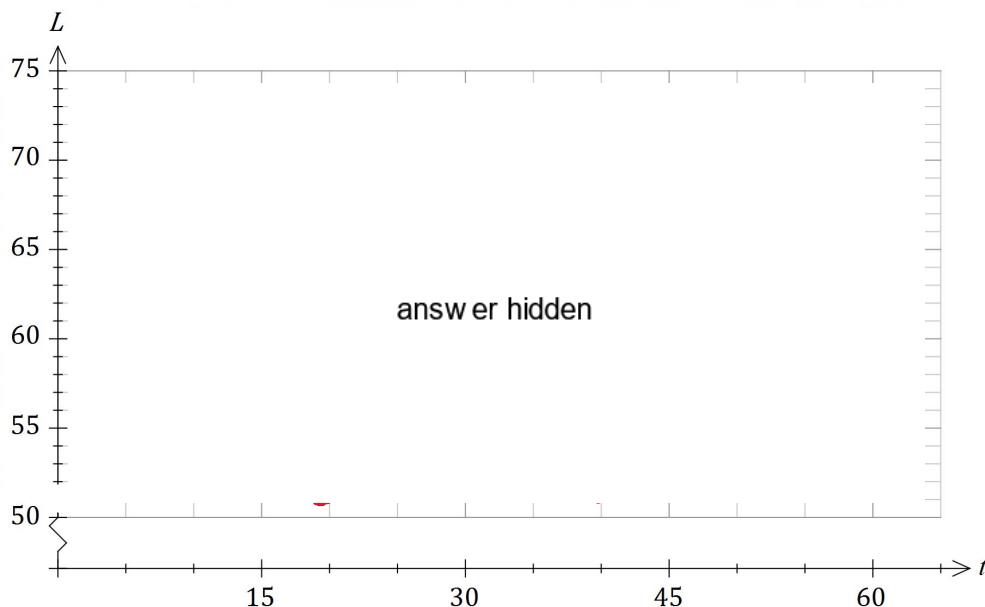
Question 15**(10 marks)**

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

$$L = 62 - 11 \cos\left(\frac{\pi t}{10}\right)$$

- (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 60 minutes. (4 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 unsafe if the loudness it emits exceeds 70 dB for more than 15 minutes in any hour that it is running. Determine, with justification, whether this machine could be deemed unsafe. (3 marks)

Question 16**(9 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 $x = 4$ and an axis intercept at $(0, 6)$.

(i) State the value of the constant c . (1 mark)

(ii) Determine the value of the constant b . (2 marks)

- (b) Let $g(x) = -(x + 3)^2 + 5$. Determine

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

(ii) the domain and range of $g(x)$. (3 marks)

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

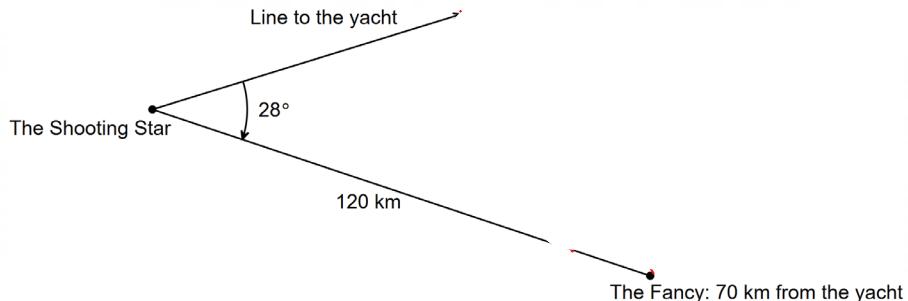
Question 17**(8 marks)**

- (a) A ferry and a trawler receive a request for help from a stranded yacht. The ferry is 7.2 km from the yacht. The trawler is 5.6 km from the yacht. The ferry is 10.3 km from the trawler and is on a bearing of 240° from the trawler. Draw a diagram and hence calculate the bearing of the yacht from the trawler. (4 marks)

DO NO

Question 17 continued

- (b) Two cargo ships, The Shooting Star and The Fancy, are 120 km apart when they pick up the distress call from the stranded yacht from (a). The captain of The Fancy estimates that the yacht is 70 km away and that the angle between the line from The Fancy to The Shooting Star and the line from The Shooting Star to the yacht is 28° . What are two possible distances, to the nearest tenth of a km, from The Shooting Star to the yacht? (4 marks)



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Question 18**(8 marks)**

- (a) A row of Pascal's Triangle is shown below in combination notation.

$${}^5C_0 \quad {}^5C_1 \quad {}^5C_2 \quad {}^5C_3 \quad {}^5C_4 \quad {}^5C_5$$

(i) State the natural numbers in the row above this row. (1 mark)

(ii) Expand and simplify $(p + q)^4$. (2 marks)

(b) (i) State the degree of the polynomial $(3 - 2x)^5$. (1 mark)

(ii) Without expanding, show clearly that the co-efficient of x^3 in the binomial expansion of $(3 - 2x)^5$ is -720 . (3 marks)

(c) From a squad of 9 basketball players, a coach needs to select a team of 5 to play during a match.

How many different teams are possible? (1 mark)

Question 19**(7 marks)**

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

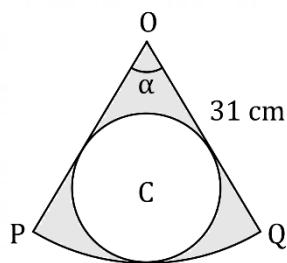
Determine the value(s) of the constant k , rounded to 2 decimal places. Explain your reasoning.

Question 20

(8 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 .

(3 marks)

Supplementary page

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