A picture containing text, queen, vector graphics

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Semester One Examination, 2021

Question/Answer booklet

MATHEMATICS  
METHODS  
UNIT 1

Section Two:  
Calculator-assumed

Student’s name

Teacher’s name

|  |  |
| --- | --- |
| Number of additional answer booklets used (if applicable): |  |

## 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 | 15 | 15 | 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.

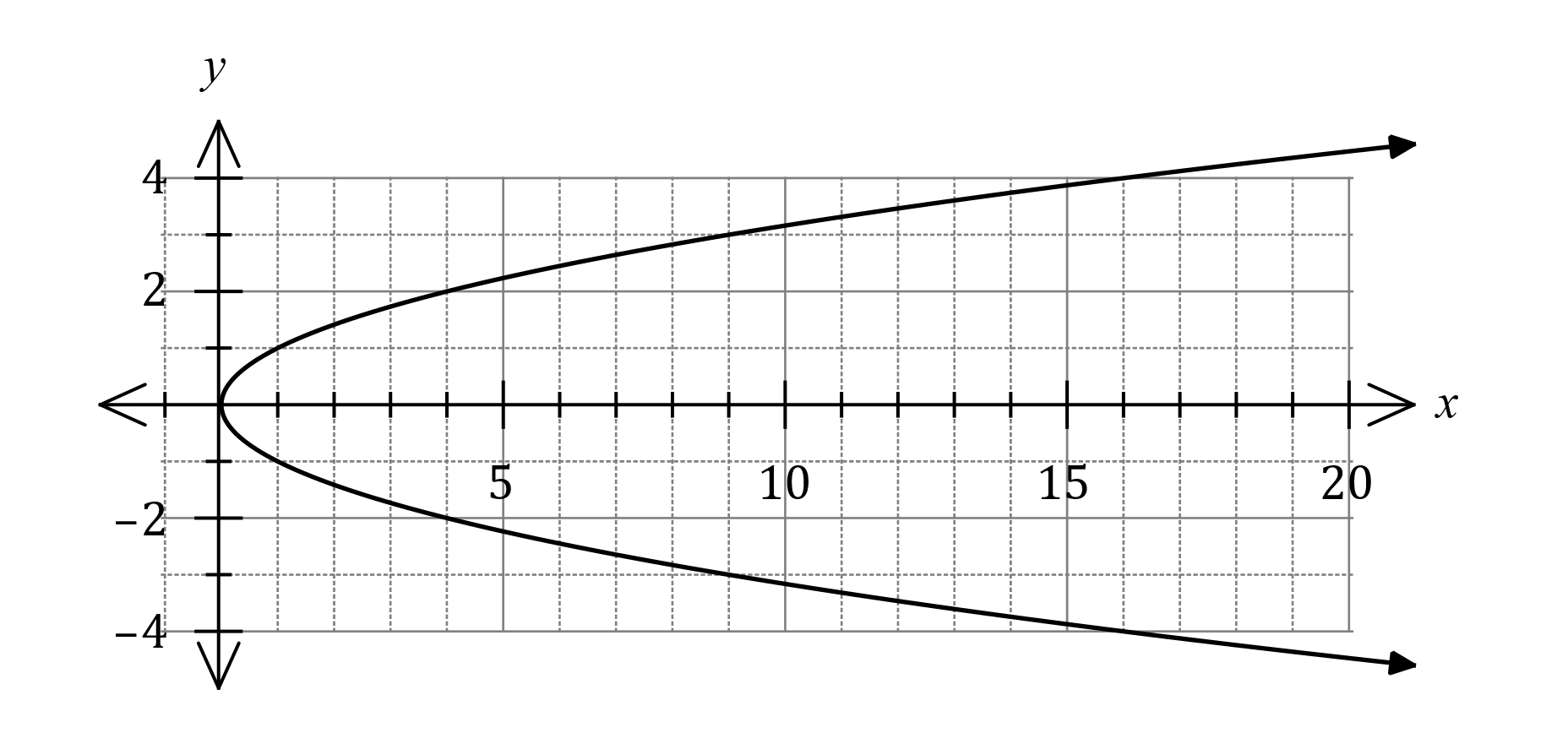
Section Two: Calculator-assumed 65% (98 Marks)

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

Working time: 100 minutes.

Question 9 (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 and . (1 mark)

(b) Points and have coordinates and respectively. Determine the equation of the circle that has diameter .

(4 marks)

Question 10 (4 marks)

The graph of is shown on the axes below.

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1. Determine the coordinates of the -intercepts of the above parabola. (1 mark)

(b) Determine the coordinates of the turning point. (1 mark)

(c) Determine the value of such that has one -intercept. (1 mark)

(d) Determine the value of such that the -intercepts of are and .

(1 mark)

Question 11 (5 marks)

The graphs of three functions are given below.

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|  |  |  |
| --- | --- | --- |
| Graph 1 | Graph 2 | Graph 3 |

(a) Match the graphs numbered above with a statement below that best describes the graph’s function.

(i) The graph whose function has a negative leading coefficient is graph \_\_\_\_\_. (1 mark)

(ii) The graph which has degree 2 is graph \_\_\_\_\_. (1 mark)

(iii) The graph where , as is graph \_\_\_\_\_. (1 mark)

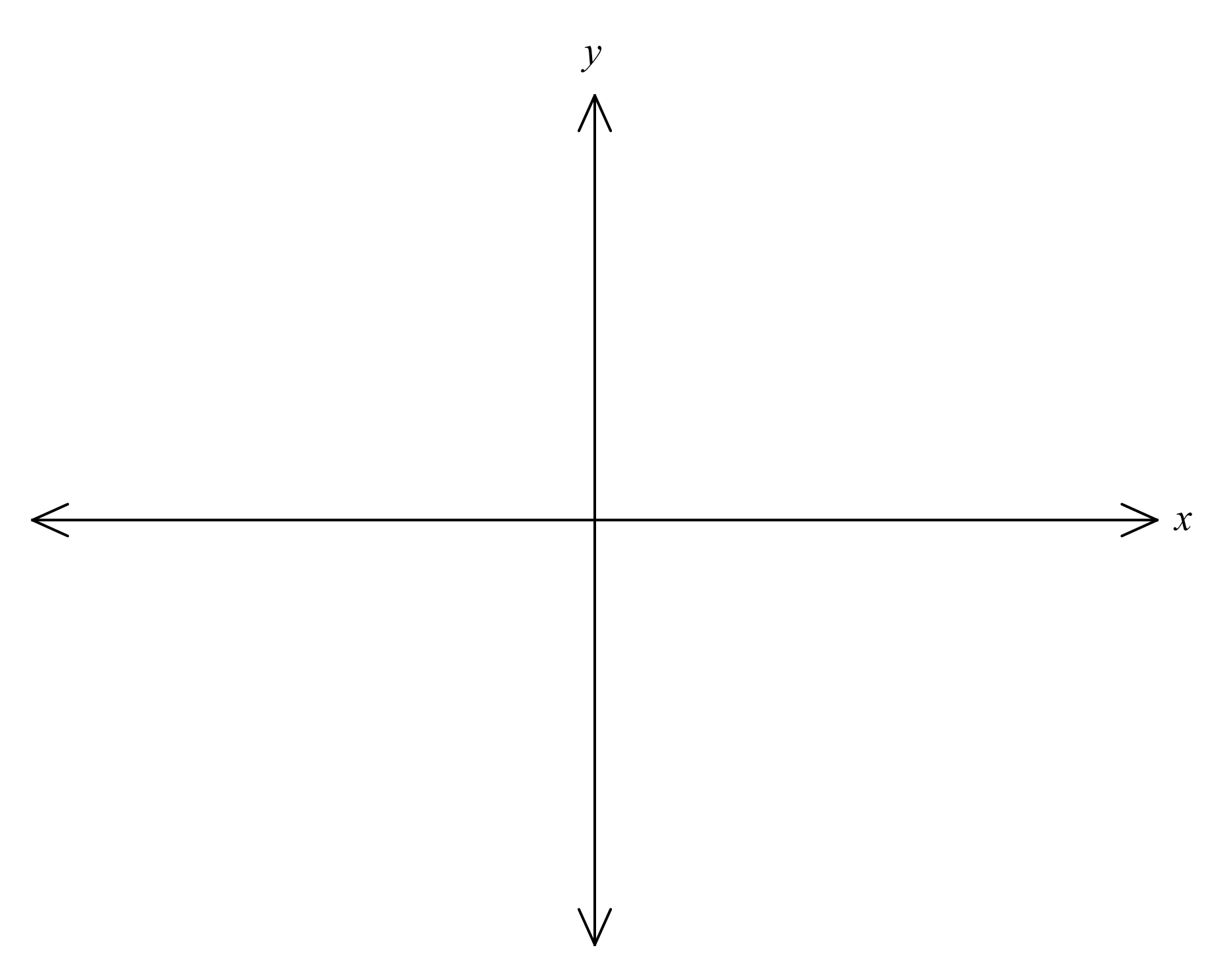
(b) A cubic can be factorised as , where . Determine the values of and if the graph has an -intercept of 2 and a -intercept of .

(2 marks)

Question 12 (8 marks)

Let .

(a) Sketch the graph of on the axes below. (4 marks)



(b) Describe the transformation(s) required to obtain the graphs of the following functions from the graph of :

(i) . (2 marks)

(ii) . (2 marks)

Question 13 (8 marks)

(a) Triangle is such that cm, cm and . Determine, with justification, the length of side . (2 marks)

1. Triangle is such that cm, cm and . Determine all possible areas of this triangle.

(6 marks)

Question 14 (8 marks)

(a) Let , where and are constants. The graph of has an axis of symmetry with equation and an axis intercept at .

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

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

(b) Let . Determine

(i) the coordinates of the turning point of the graph of . (1 mark)

(ii) the domain and range of . (2 marks)

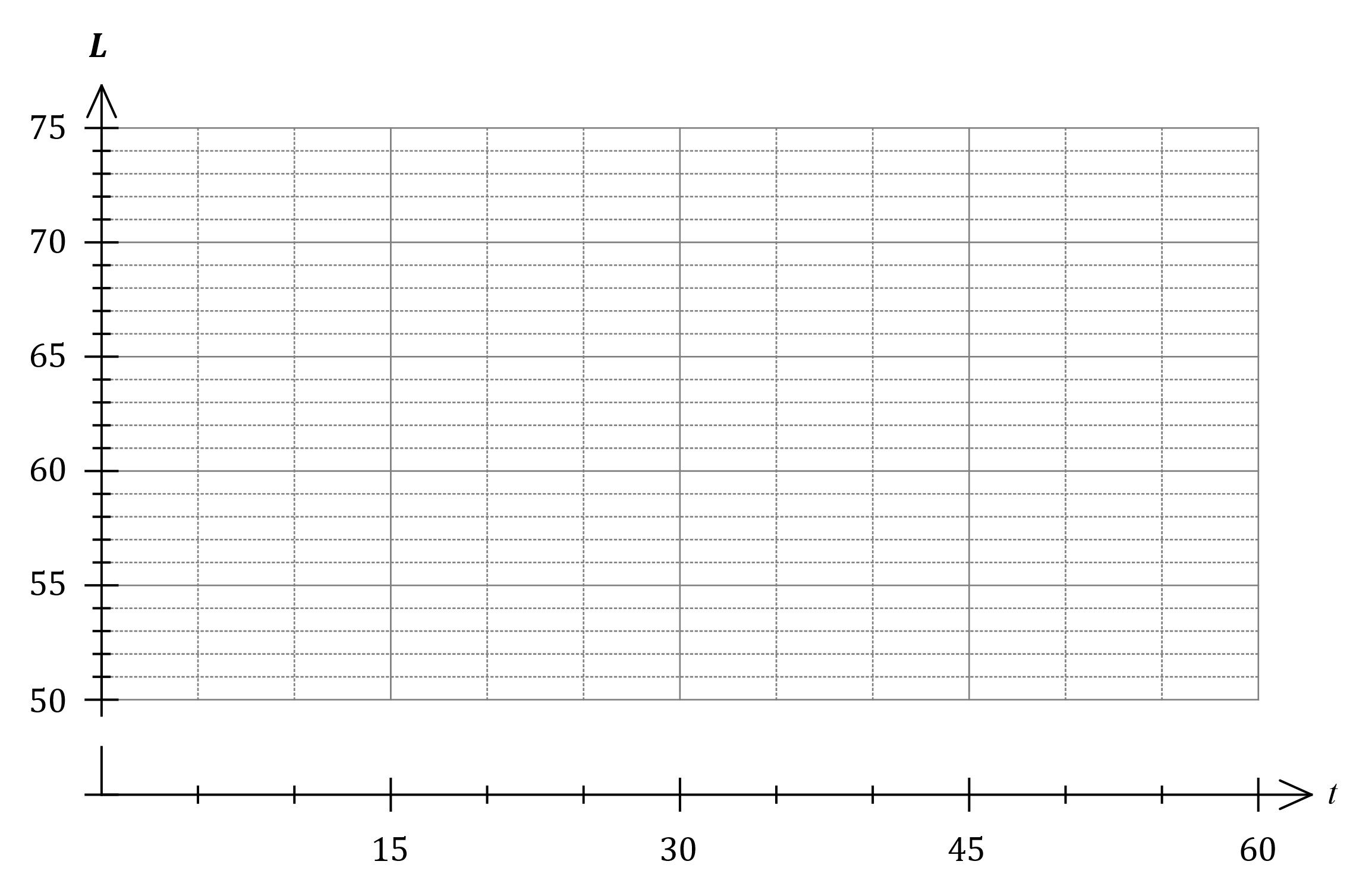
(iii) the coordinates of the turning point of the graph of . (2 marks)

Question 15 (9 marks)

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

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

(b) Draw the graph of against on the axes below for the first 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 dB for more than minutes in any hour that it is running. Determine, with justification, whether this machine could be deemed unserviceable.

(3 marks)

Question 16 (5 marks)

The diagram below shows two unit circles, A and B, with two angles, and marked in each one respectively. Both angles are in radians.

A B

|  |  |
| --- | --- |
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(a) On unit circle A, draw in angle such that sin sin , where . (1 mark)

(b) On unit circle B, draw in angle such that cos cos , where . (1 mark)

1. Use an appropriate trigonometric expansion to show cos . (3 marks)

Question 17 (5 marks)

A chess club has members, of which are beginners, are intermediate and the rest are advanced. The club has to select a group of members at random to assist with a regional tournament.

(a) Determine the number of different groups that can be selected. (2 marks)

(b) Determine the number of different groups that can be selected which contain at least intermediate members. (2 marks)

(c) The number of different groups that could be selected was decided to be calculated using the following calculation:

Describe how the group members were selected. (1 mark)

Question 18 (8 marks)

The cross section of a roof structure is shown below. All lengths are given in meters.

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1. Determine the horizontal length of the overhang, , correct to two decimal places.

(2 marks)

Two roofing companies are approached to give a quote to cover the roof in corrugated iron. The cost of the first company is shown on the graph below, where is the cost in dollars.

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1. (i) Give a reason why the graph on the previous page, demonstrates that the cost of

roofing, , is directly proportional to the roof area, .

(1 mark)

(ii) Determine a rule for the cost of roofing, , in terms of the roof area, . (1 mark)

A second company quotes $40 per square metre, with a delivery and installation charge of $750.

1. (i) On the axes opposite, draw a graph representing the cost quoted by the second company.

(2 marks)

(ii) Explain why the cost, , quoted by the second company is not directly proportional to the roof area, .

(1 mark)

A black and white photo of a traffic light

Description automatically generated with low confidenceDuring hot weather the interior of corrugated iron roofs heat up.

Whirlybirds, as shown, are used to extract hot air.

Whirlybirds are installed on the roof on the opposite page.

It is calculated that for this roof, one whirlybird working at

maximum efficiency would extract 150 m3 of hot air an hour.

However, as more whirlybirds are added, each one becomes

less effective. The amount of hot air each whirlybird extracts

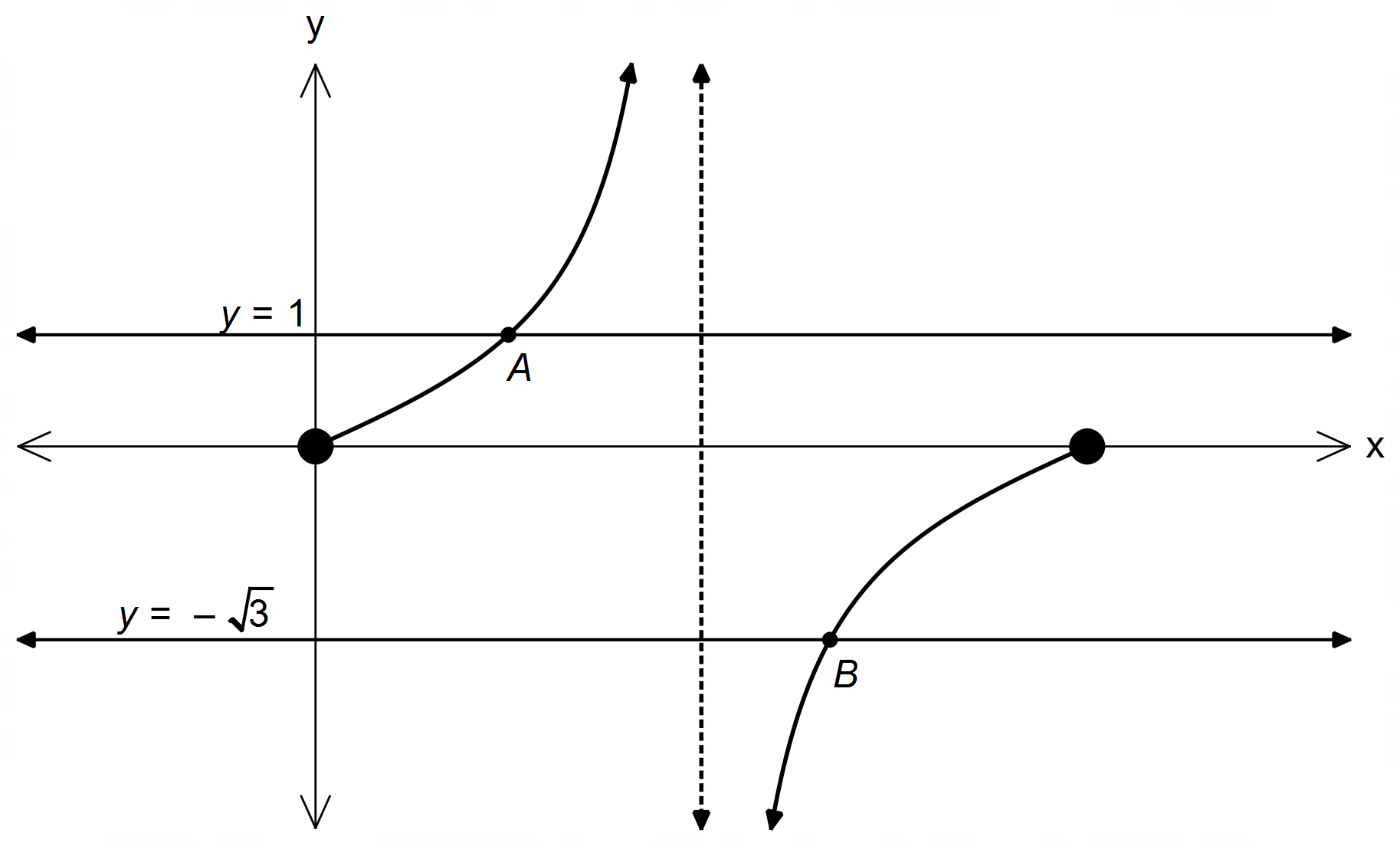
is inversely proportional to the number of whirlybirds.

1. Determine a rule for the amount of hot air extracted by each whirlybird, m3 per hour, in terms of the number of whirlybirds installed, .

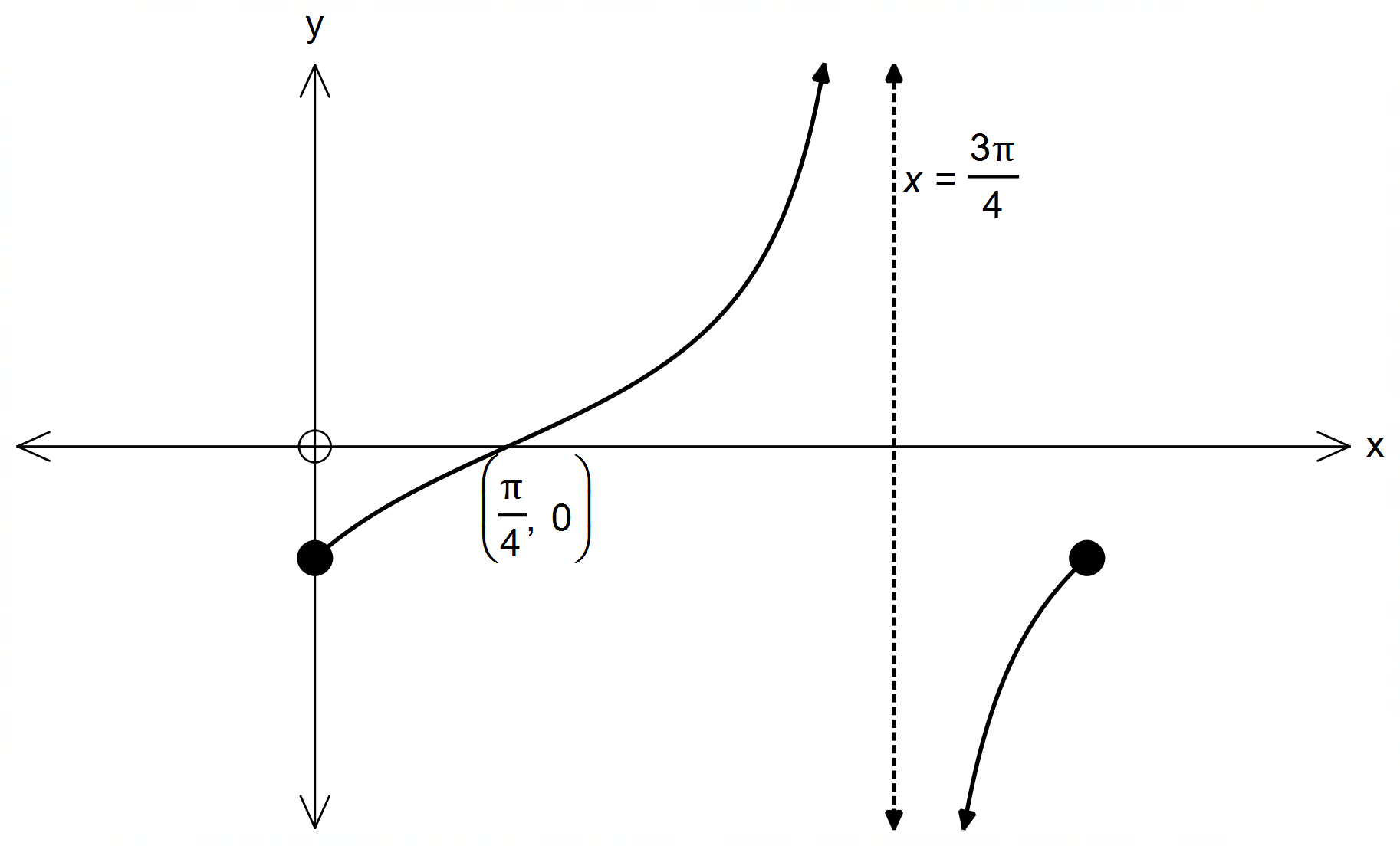
(1 mark)

Question 19 (6 marks)

The diagram below, represents the graph of , where .



1. State the equation for the asymptote in this interval. (1 mark)
2. Determine the exact coordinates of point A and point B. (3 marks)
3. Consider the graph below, where has undergone a transformation.



1. State the phase change where . (1 mark)
2. State the period of . (1 mark)

Question 20 (6 marks)

1. Solve (1 mark)
2. Using the Pythagorean identity, , determine a simplified expression for in terms of powers of and a constant term.

(2 marks)

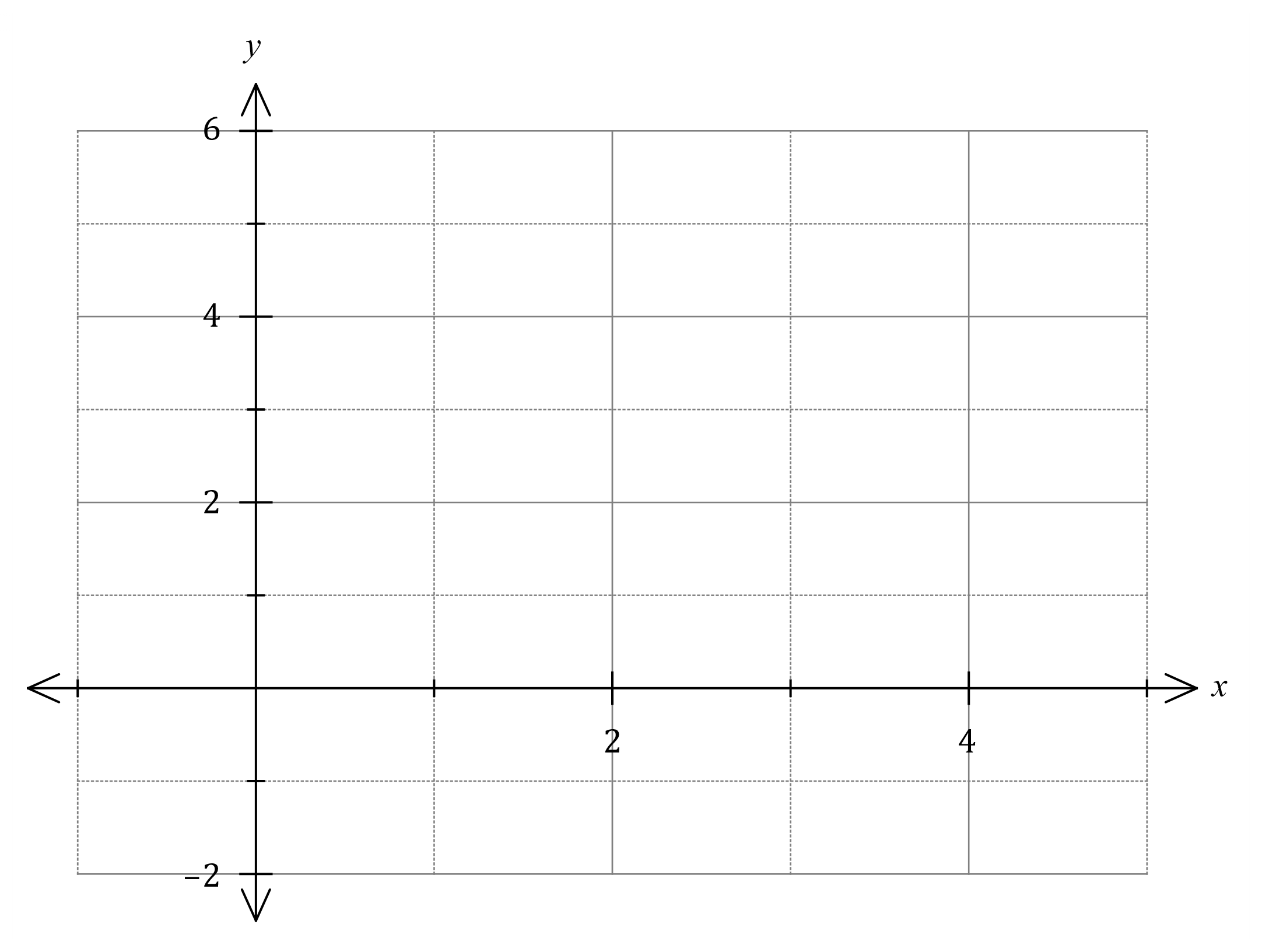
1. Using your response to parts (a) and (b), or otherwise, solve the following equation over the given domain.

for (3 marks)

Question 21 (7 marks)

The equation of a parabola is .

(a) Sketch the parabola on the axes below. (3 marks)

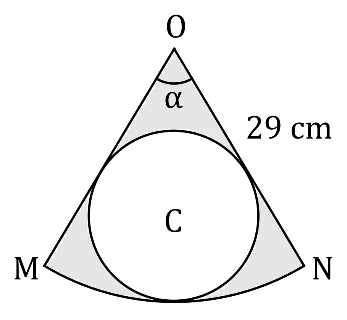


All parabolas have a focal point and a directrix. For a parabola with equation , the focal point is at and the equation of the directrix is , where and are constants.

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

(4 marks)

Question 22 (7 marks)

The diagram shows sector of a circle  
centre of radius cm and .

Circle is inside the sector and just  
touches and arc .

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

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

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

(2 marks)

Question 23 (6 marks)

The equation has two solutions, where and and are constants.

The graph of cuts the -axis at , , and at one other point.

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

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
| Markers use only | | | |
| Marker | Question | Maximum | Mark |
| Mrs Kalotay | 9 | 6 |  |
| 10 | 4 |  |
| 11 | 5 |  |
| 12 | 8 |  |
| 13 | 8 |  |
| 14 | 8 |  |
| Mrs Scoles | 15 | 9 |  |
| 16 | 5 |  |
| 17 | 5 |  |
| 18 | 8 |  |
| 19 | 6 |  |
| 20 | 6 |  |
| Mr Whiteley | 21 | 7 |  |
| 22 | 7 |  |
| 23 | 6 |  |
|  | S2 Total | 98 |  |

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