

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.

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Important note to Candidates

Special items: drawing instruments, templates, ruler, highlighters and up to three calculators approved for use in this examination

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

Formula sheet (retained from Section One)

This Question/Answer booklet

To be provided by the supervisor

Materials required/recommended for this section

Number of additional answer books used

Working time: ten minutes
Reading time before commencing work: one hundred minutes
(if applicable):

Your name

Question/Answer booklet

Semester Two Examination, 2020



MATHEMATICS
METHODS
UNITS 1&2
Section Two:
Calculator-assumed

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 | 5 | |
| 10 | 6 | |
| 11 | 7 | |
| 12 | 8 | |
| 13 | 7 | |
| 14 | 6 | |
| 15 | 7 | |
| 16 | 8 | |
| 17 | 13 | |
| 18 | 9 | |
| 19 | 8 | |
| 20 | 7 | |
| 21 | 7 | |
| S2 Total | 98 | |
| S2 Wt ($\times 0.6633$) | 65% | |

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Supplementary page

Question number: _____

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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.

For the events A and B, $P(A) = 0.52$ and $P(B) = 0.25$.

Determine $P(A \cup B)$ when

(a) A and B are mutually exclusive.

(b) $P(A \cap B) = 0.19$.

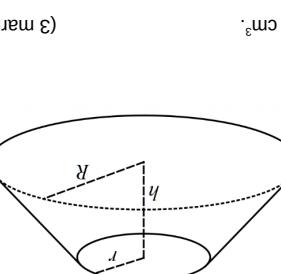
(c) $P(\bar{A} \cap \bar{B}) = 0.33$.

(1 mark)

(2 marks)

(d) A and B are independent.

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(7 marks)

CALCULATOR-ASSUMED

18

METHODS UNITS 1&2

The frustum shown at right is a truncated right cone.

The volume of such a solid is $V = \frac{\pi}{3}(r^2 + R^2 + rR)h$, where r is the radius of the smaller circle, R is the radius of the larger circle and h is the perpendicular distance between the two parallel circles.

Consider frustum F where $r = x$ cm, $R = 3x$ cm and $h = 36$ cm.

Show that the volume of frustum F is $156\pi x^3 - 13\pi x^3$ cm³. (3 marks)

(d) Use a calculus method to determine the value of x that maximises the volume of frustum F and state this maximum volume, rounding your answer to the nearest cm³. (4 marks)

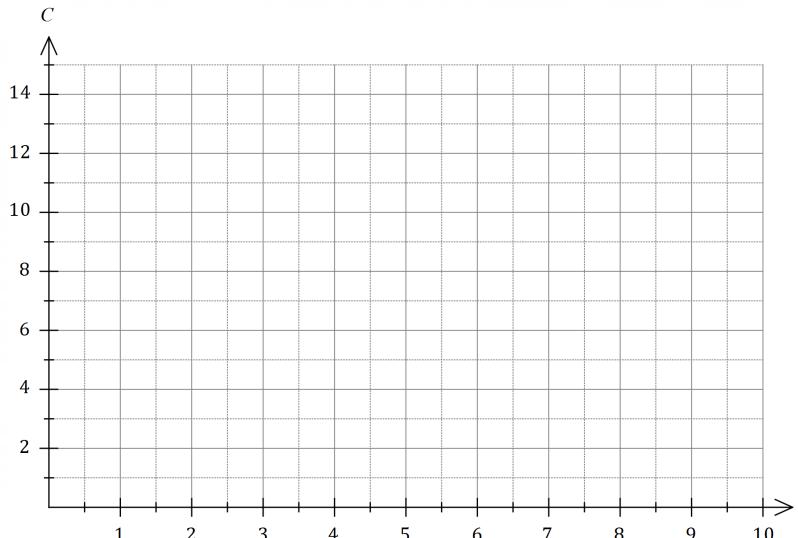
Question 10

(6 marks)

The cost, C dollars, for a gigabyte of computer memory between the end of year 2006 ($t=0$) and the end of year 2016 ($t=10$) can be modelled by the equation $C=14.5(0.84)^t$.

- (a) Calculate C at the end of year 2010. (1 mark)

- (b) Draw the graph of C against t on the axes below. (3 marks)



- (c) Assuming that the model continues to be valid, during which year will the cost of computer memory fall below \$1 per gigabyte? (2 marks)

Question 20

(7 marks)

A reader bought 14 different novels, planning to read a selection of them when on holiday.

- (a) Determine the number of different combinations of novels the reader could choose from if they select

- (i) six novels. (1 mark)

- (ii) five or six novels. (2 marks)

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Four of the 14 different novels are by the author Harper.

- (b) The reader makes a random selection of six novels. Determine the probability that

- (i) none of the novels selected are by Harper. (2 marks)

- (ii) one of the novels selected is by Harper. (2 marks)

Question 11

(1 mark)

(1 mark)

- (ii) the number of years until the machine has no value.

- (i) the value of the machine after 5 years.

(a) Determine

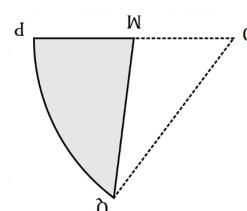
In flat rate depreciation, the value V_n of an asset is depreciated by a fixed amount each year. Using the flat rate model, the value V_0 of a machine in dollars after n years is given by $V_{n+1} = V_n - 275$, $V_0 = 3850$.

Question 12
CALCULATOR-ASSUMED

- (c) Given that both machines begin to depreciate at the same time, determine the number of years until the machines have the same value and state what this value is. (2 marks)

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- (c) The edge of the canvas is to be reinforced with thin wire. Determine the length of wire required.



- (b) Determine the area of the canvas awning. (3 marks)

- (a) Determine the area of sector OPQ. (1 mark)

The size of $\angle QOP$ is 1.1 radians.

OM is a straight line from O to M , the midpoint of OP .

The shaded region MPQ in the diagram is a canvas awning and is part of a sector of circle OPQ with centre O and radius 3.8 m.

QM is a straight line from Q to M , the midpoint of OP .

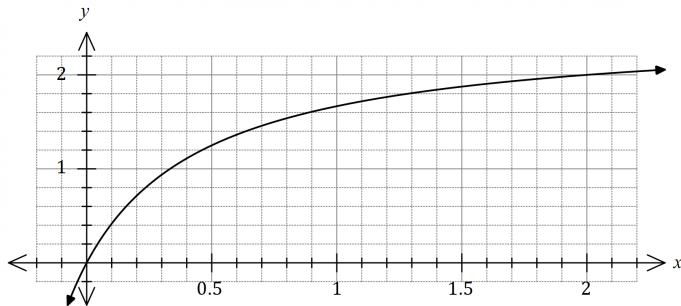
The size of $\angle QOP$ is 1.1 radians.

- Question 13**
CALCULATOR-ASSUMED

(8 marks)

Question 12

Part of the graph of $y=f(x)$ is shown below, where $f(x)=\frac{5x}{2x+1}$.



Points A and B lie on the curve and have x-coordinates of 0.5 and 2 respectively.

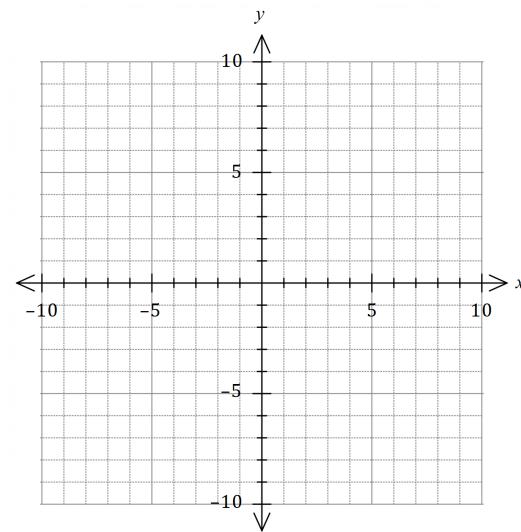
- (a) Draw the chord to the curve between A and B on the axes above and determine the gradient of this chord. (3 marks)

Point C, with an x-coordinate of $0.5+h$, lies on the curve between A and B. The gradient of the chord AC is m_{AC} .

- (b) Calculate m_{AC} for the values of h shown in the table below, recording the gradients to 3 decimal places. (3 marks)

| h | 1 | 0.5 | 0.1 | 0.05 | 0.01 |
|----------|-------|-----|-----|------|------|
| m_{AC} | 0.625 | | | | |

- (ii) Draw the graph of $y=1+\frac{a}{x+b}$ on the axes below, clearly indicating any asymptotes. (3 marks)



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- (a) Point A(11, -5) lies on the circumference of a circle with centre (-4, 3). Determine the equation of the circle.
 (2 marks)

Question 18
METHODS UNITS 1&2

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 METHODS UNITS 1&2

(a) Point A(11, -5) lies on the circumference of a circle with centre (-4, 3). Determine the equation of the circle.
 (3 marks)

- (c) Determine a limiting value for m^c as h becomes very close to 0 and state what feature of the graph of $y = f(x)$ this value represents.
 (2 marks)

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- (b) The graph of $y = 1 + \frac{x+b}{a}$ passes through the points (1, -2) and (3, 4).
 (3 marks)

(3 marks)

(3 marks)

(7 marks)

Question 13

A set of 175 undergraduates were asked to choose their electives for the following year.
 85 chose calculus, 58 chose statistics and 67 chose neither calculus nor statistics.

- (a) Determine how many of the undergraduates chose both calculus and statistics. (2 marks)

- (b) Determine the probability that a randomly chosen undergraduate from the set chose

(i) statistics. (1 mark)

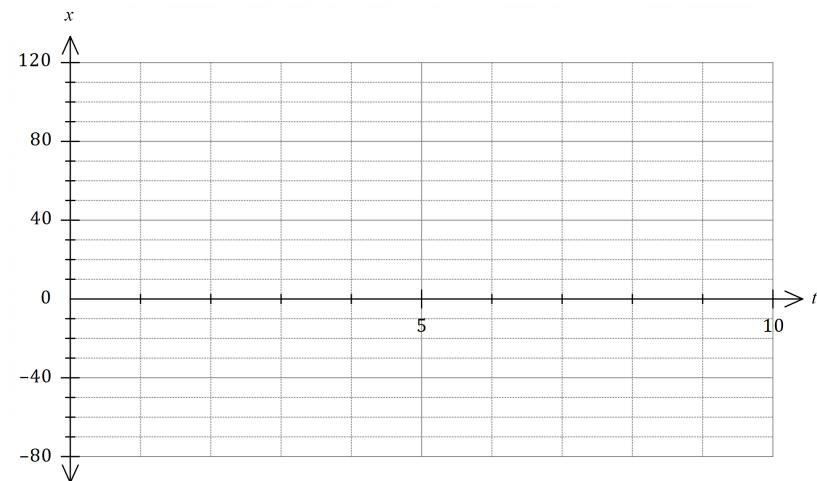
(ii) statistics but not calculus. (1 mark)

(iii) statistics given that they chose calculus. (1 mark)

- (c) Use your answers above to explain whether the choice of statistics and calculus electives is independent for these undergraduates. (2 marks)

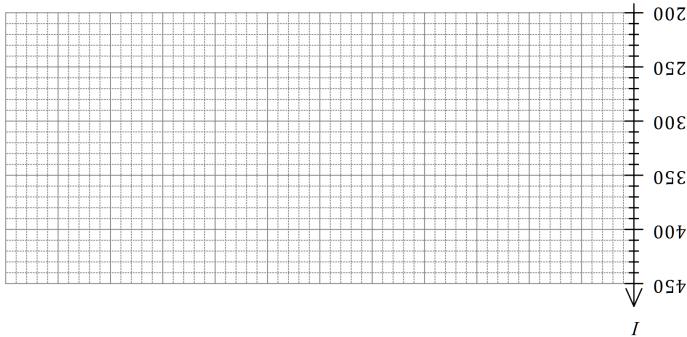
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- (c) Use the axes below to sketch the displacement of the body over the given domain. (3 marks)



- (d) State the number of times the body passed through O and determine the minimum speed and maximum speed of the body as it passed through this point. (3 marks)

(a)

Draw the graph of I against t on the axes below for $0 \leq t \leq 60$. (3 marks)

$$I = 320 + 80 \sin\left(\frac{\pi t}{10}\right).$$

Question 14

METHODS UNITS 1&2

(a)

Obtain an expression for the velocity of the body in the form $v(t) = (at+b)(ct+d)$, where a , b , c and d are integer constants. (3 marks)

(a) Obtain an expression for the velocity of the body in the form $v(t) = (at+b)(ct+d)$, where a , b , c and d are integer constants.

$$x(t) = 2t^3 - 28t^2 + 98t - 72, 0 \leq t \leq 10.$$

A small body is moving in a straight line. Relative to a fixed point O , it has a displacement of x cm at time t seconds given by

(13 marks)

METHODS UNITS 1&2

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CALCULATOR-ASSUMED

(1 mark)

(b) State the period of I .

(3 marks)

(iii)

the displacement of the body at the instant(s) that it is stationary.

(1 mark)

(i)

the initial velocity of the body.

(b)

Determine

(3 marks)

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See next page

(2 marks)

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See next page

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(c) Determine the percentage of each cycle that the intensity of light exceeds 375 lumens.

Question 15

(7 marks)

A farmer was treating a large area of land for an invasive weed. The area treated on the first day was 275 m^2 . Over the following months more resources were utilised so that the area treated each day was 7.5% more than the previous day.

- (a) Determine the area treated on the 28th day. (2 marks)

The cost of the treatment was 35.8 cents per square metre.

- (b) On which day did the cost of the days treatment first exceed \$10 000? (2 marks)

- (c) Determine, to the nearest ten dollars, the total cost of the first 15 days of treatment. (3 marks)

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Question 16

(8 marks)

A farm grows two varieties of apples - Fuji and Gala. 42% of all apples are grown in orchard A, 36% in orchard B and the remainder in orchard C. The proportion of Fiji apples that are grown in orchards A, B and C are 25%, 30% and 35% respectively. After harvesting, the farm stores all the apples together in a large silo before using them to make apple juice.

- (a) Determine the probability that an apple chosen at random from the silo is

- (i) a Fuji grown in orchard C. (2 marks)

- (ii) a Gala. (3 marks)

- (b) Given that an apple selected at random is a Fuji, determine the probability that it was grown in orchard A. (3 marks)