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WAEP Semester One Examination, 2016

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

Student number: In figures

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In words

Your name

Time allowed for this section

Reading time before commencing work: ten minutes
Working time for section: 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 approved for use in this 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 exam
Section One: Calculator-free	7	7	50	50	35
Section Two: Calculator-assumed	13	13	100	99	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.
3. You must be careful to confine your response to the specific question asked and to follow any instructions that are specified to a particular question.
4. Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space page.
5. 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.
6. It is recommended that you do not use pencil, except in diagrams.
7. The Formula sheet is not to be handed in with your Question/Answer booklet.

Section Two: Calculator-assumed

65% (99 Marks)

This section has **thirteen (13)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time for this section is 100 minutes.

Question 8

(6 marks)

The results from a clinical study on the effect of sleep on reaction times for a group of 210 male police cadets is shown in the table below. The participants were given either 4, 6 or 8 hours' sleep, woken and immediately asked to perform a series of tasks involving reacting to various stimuli, from which the total reaction time was calculated.

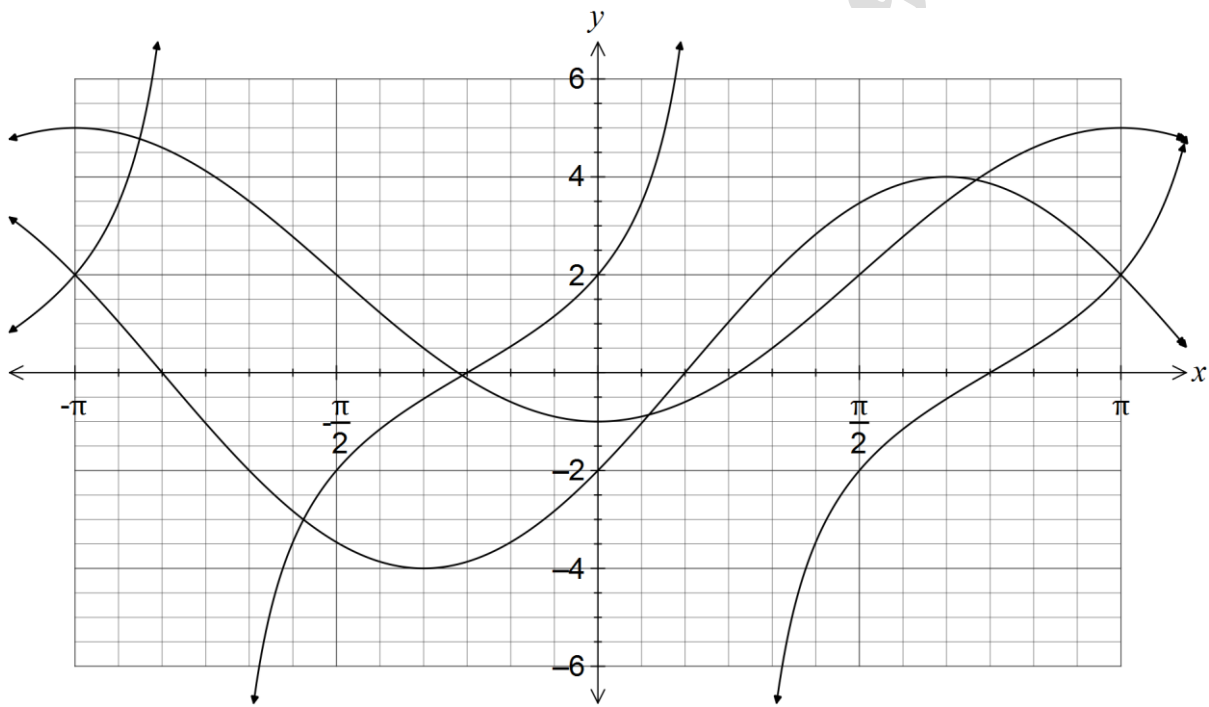
	Total reaction time less than 3 s	Total reaction time 3 s or more.
Tested after 4 h sleep	18	55
Tested after 6 h sleep	21	49
Tested after 8 h sleep	22	45

- (a) Determine the probability that a randomly chosen participant
- (i) had a total reaction time of less than 3 s. (1 mark)
 - (ii) was tested after 8 h sleep and had a total reaction time 3 s or more. (1 mark)
- (b) Determine the probability that a randomly chosen participant had a reaction time of less than 3 s given they were woken after
- (i) 4 h sleep. (1 mark)
 - (ii) 8 h sleep. (1 mark)
- (c) Does the study suggest that reaction time is independent of sleep? Explain your answer. (2 marks)

Question 9

(7 marks)

The graphs of the functions $f(x) = a - b\cos(x)$, $g(x) = c\sin(x - d)$ and $h(x) = m\tan(x + n)$ are shown below, where a , b , c , d , m and n are positive constants.



- (a) Clearly label each of the functions f , g and h on the graph. (1 mark)
- (b) Determine the values of the positive constants a , b , c , d , m and n . (6 marks)

Question 10

(7 marks)

When a box of three fragile glasses is sent through the post, the probability that none of the glasses break is $\frac{1}{2}$, that one breaks is $\frac{7}{20}$ and that two break is $\frac{3}{25}$.

(a) Determine the probability that

(i) at least one glass breaks.

(1 mark)

(ii) fewer than two glasses break.

(1 mark)

(iii) exactly three glasses break.

(1 mark)

(b) During one week, a large number of boxes were sent, resulting in 280 customers receiving a box with one broken glass. Estimate how many boxes were sent during the week.

(2 marks)

(c) After improvements were made to the packaging used, a random sample of 350 posted boxes were examined, of which just 11 contained all broken glasses. Briefly discuss whether there is any evidence that the improvements were successful.

(2 marks)

Question 11

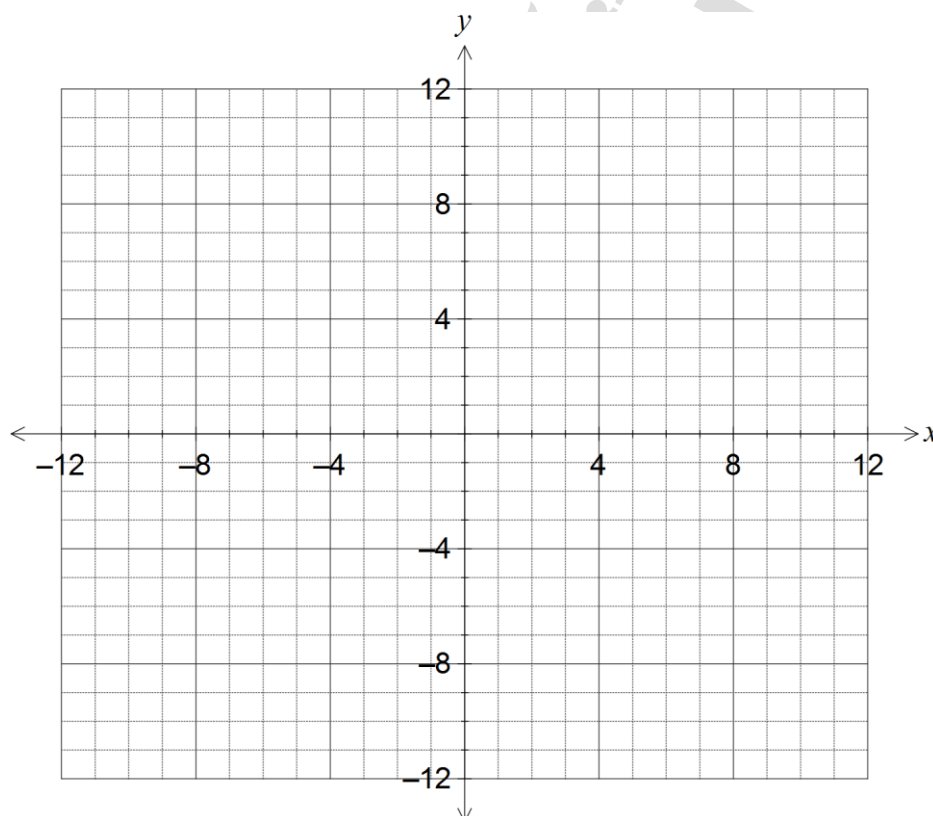
(7 marks)

A function is defined by $f(x) = \frac{6}{x-3}$.

(a) State the domain of this function.

(1 mark)

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

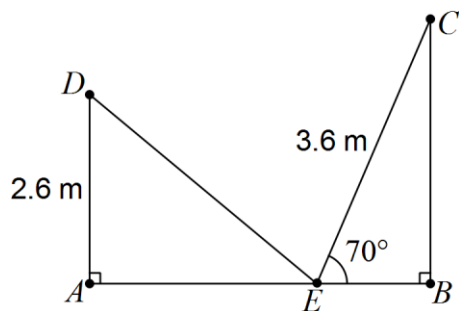


(c) The graph of $y = f(x)$ is dilated vertically by a scale factor of 4 followed by a translation of three units to the right. Determine the coordinates of the y -intercept of the transformed graph. (2 marks)

Question 12

(8 marks)

- (a) A 3.6 m long ladder first rests against a vertical wall BC , making an angle of 70° with the horizontal ground. The ladder is rotated in a vertical plane about E to rest against wall AD , reaching a point 2.6 m above the ground.



Showing use of trigonometry, determine

- (i) the angle through which the ladder was rotated. (2 marks)
 - (ii) the distance AB . (2 marks)
 - (iii) the distance DC . (2 marks)
- (b) A thin metal plate in the shape of an equilateral triangle has an area of 330 cm. Determine the side length of the triangle. (2 marks)

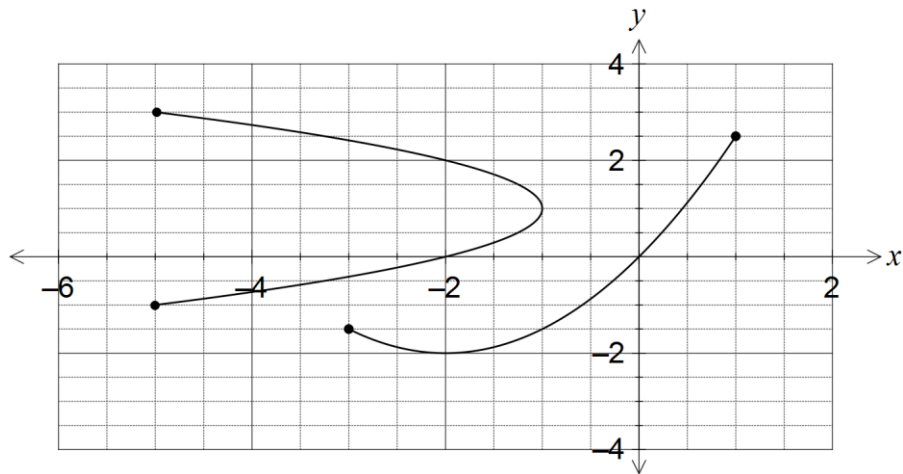
Question 13**(8 marks)**

- (a) In a group of 47 people, 6 had surnames beginning with A, 5 had first names beginning with A and 38 had neither name beginning with A. Determine the probability that a randomly chosen person from the group
- (i) has both names beginning with A. (2 marks)
- (ii) only has a first name beginning with A. (1 mark)
- (iii) only has a surname beginning with A, given that either their first name or surname begins with A. (2 marks)
- (b) In the population as a whole, it was thought that 3% had surnames beginning with A, 4% had first names beginning with A and 0.15% had both names beginning with A. Estimate how many people in a group of 2000 will have neither name beginning with A. (3 marks)

Question 14

(7 marks)

A function and a relation have been graphed on the axes below.



- (a) Draw the line $x = -2$ on the graph and explain how it can be used to identify the relation. (2 marks)
- (b) State the domain and range of the function. (2 marks)
- (c) The relation can be expressed in the form $y^2 = ax + by - 2$. Determine the values of the constants a and b . (3 marks)

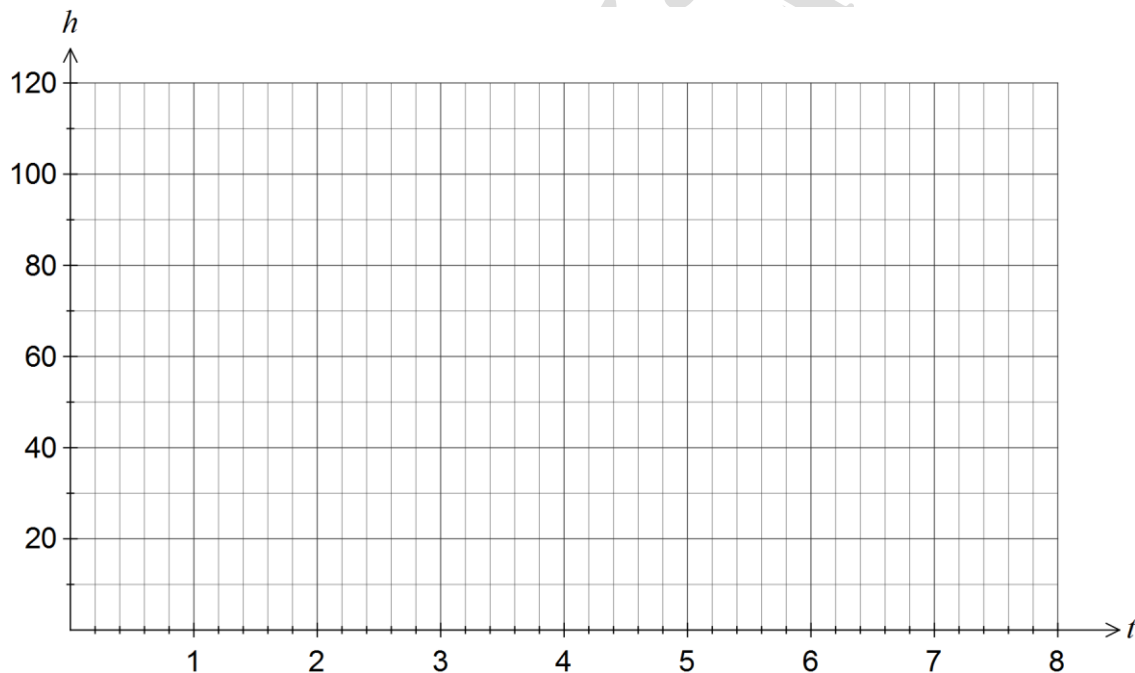
Question 15**(9 marks)**

A sensor was fitted to the tip of a blade on a wind turbine to measure the height, h metres, of the blade above the ground. The height was observed to vary according to the function

$$h(t) = 72 - 38 \sin\left(\frac{\pi t}{2}\right), \text{ where } t \text{ is the time in seconds since measurements began.}$$

- (a) Determine the height of the blade tip above the ground when $t = 3$. (1 mark)

- (b) Sketch the graph of $h(t)$ on the axes below for $0 \leq t \leq 8$. (4 marks)



- (c) How long does the blade take to rotate once? (1 mark)

- (d) Assuming the blade continues to rotate in this manner, determine the percentage of time during which the blade tip is at least 90 m above the ground. (3 marks)

Question 16**(8 marks)**

A selection of four representatives is to be made from eleven students, comprising six girls and five boys. Determine

(a) the number of ways in which this can be done. (2 marks)

(b) the number of selections that contain the same number of girls and boys. (2 marks)

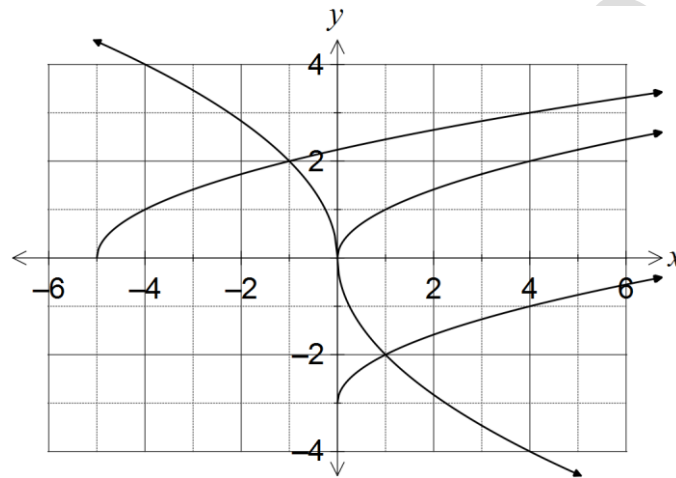
(c) the probability that three of the representatives chosen are girls. (2 marks)

(d) the probability that more boys than girls are chosen. (2 marks)

Question 17

(9 marks)

- (a) The diagram below shows the five graphs $y = f(x)$, $y = f(x) + a$, $y = f(x + b)$, $y = cf(x)$ and $y = f(dx)$, where a , b , c and d are constants.



- (i) Determine $f(4)$. (1 mark)
- (ii) Determine the values of the constants a , b , c and d . (4 marks)
- (b) Describe two transformations that will transform the graph of $y = g(x)$ to:
- (i) $y = g(x - 1) - 2$. (2 marks)
- (ii) $y = -5g(x)$. (2 marks)

Question 18**(8 marks)**

The events A and B are such that $P(A) = 0.3$ and $P(B) = 0.6$.

(a) Determine $P(A \cup B)$ in each of the following cases.

(i) A and B are mutually exclusive.

(1 mark)

(ii) $P(A \cap B) = 0.18$.

(2 marks)

(iii) $P(A|B) = 0.2$.

(2 marks)

(b) Are A and B independent in any of the above three cases? Justify each decision.

(3 marks)

Question 19

(8 marks)

(a) Given that $\tan \theta = -\frac{1}{3}$, where $\frac{\pi}{2} < \theta < \pi$, show how to determine the exact value of

(i) $\sin \theta$.

(2 marks)

(ii) $\cos \theta$.

(2 marks)

(iii) $\sin 2\theta$.

(2 marks)

(b) Determine the two smallest solutions to the equation $6\sin\left(\frac{x}{5} - 50^\circ\right) = 3$ for $x \geq 0^\circ$.

(2 marks)

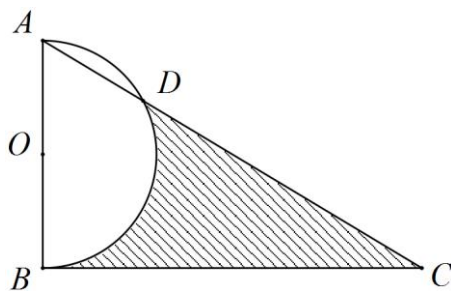
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Question 20

(7 marks)

- (a) Determine the exact area of a sector enclosed by an arc of length 42 cm in a circle of radius 12 cm. (2 marks)

- (b) In the diagram below, BC is a tangent to the circle with diameter AB and centre O . Given that $AB = 20$ cm and $BC = 30$ cm, determine the shaded area. (5 marks)



Additional working space

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