**Western Australian Certificate of Education
Examination, 2010**

Question/Answer Booklet

MATHEMATICS: SPECIALIST 3C/3D

**Section One:
Calculator-free**

Please place your student identification label in this box

Student Number: In figures

In words _____

_____

Time allowed for this section
Reading time before commencing work: five minutes
Working time for this section: fifty minutes

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, pencils, pencil sharpener, eraser, correction fluid/tape, ruler, highlighters

Special items: nil

Important note to candidates
No other items may be used in this section of the examination. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Ref: 10-139

2010/30391

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	40	
Section Two: Calculator-assumed	11	11	100	80	
			Total	120	100

Instructions to candidates

1.　The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2010.* Sitting this examination implies that you agree to abide by these rules.

2.　Answer the questions in the spaces provided.

　　Section One:　Write answers in this Question/Answer Booklet. Answer **all** questions.

　　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 an answer to 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.

3.　You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.

4.　Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
   - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
   - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

See next page

DO NOT WRITE IN THIS AREA

Section One: Calculator-free   **(40 Marks)**

This section has **seven (7)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Working time: 50 minutes.

Question 1   **(4 marks)**

(a)   On the axes below, draw the graphs of $r = 4$ and $r = \dfrac{3\theta}{\pi} + 2$, for $0 \le \theta \le 2\pi$.   (3 marks)
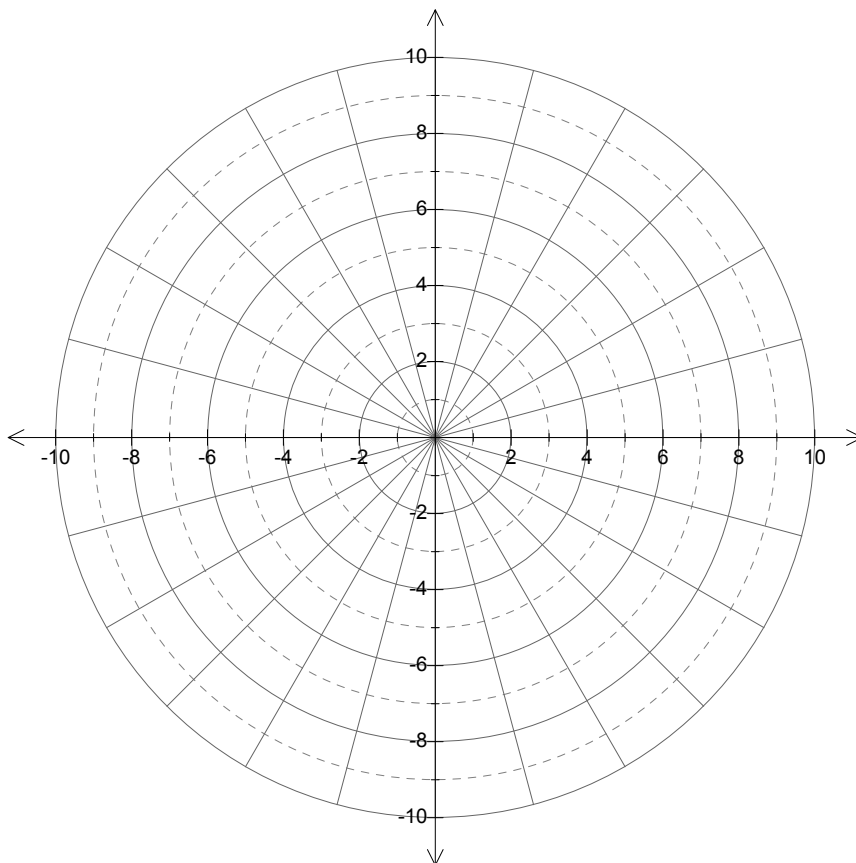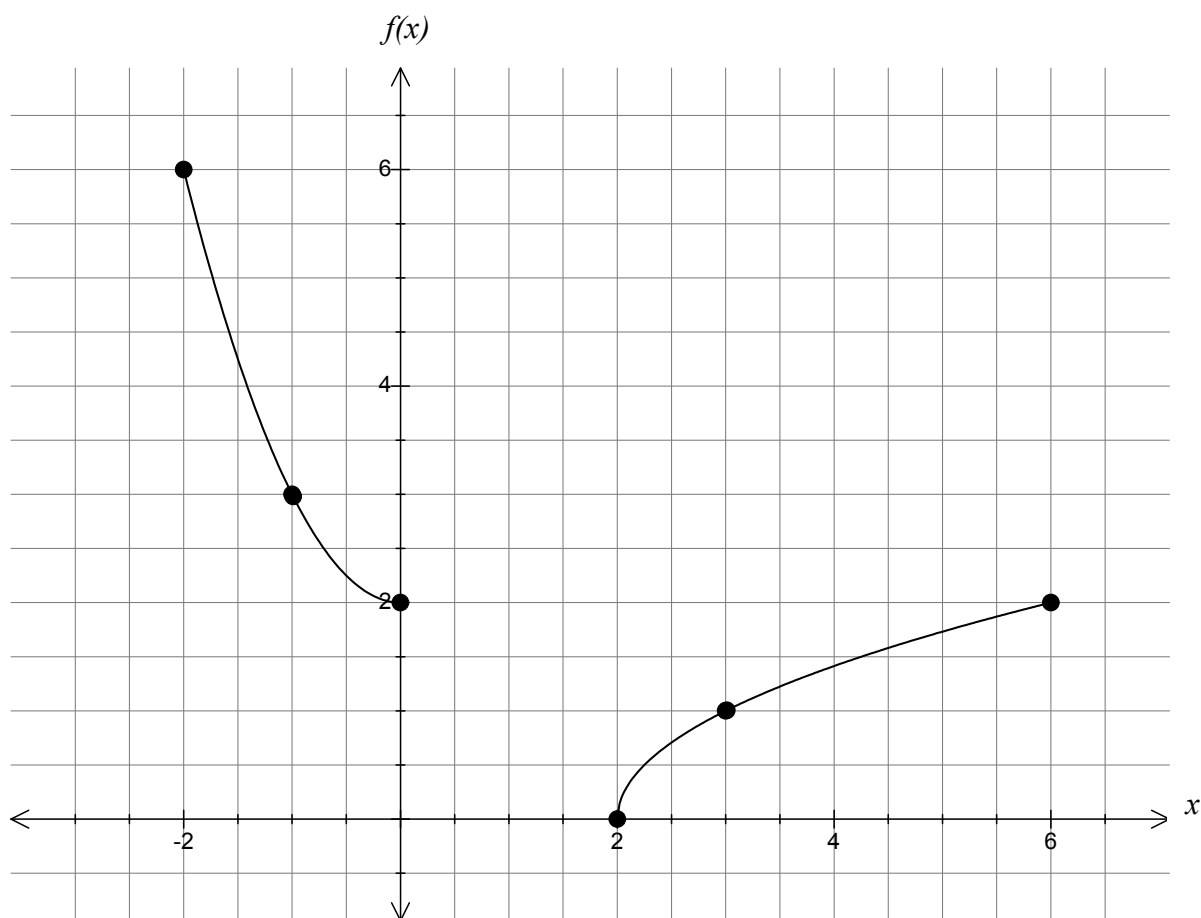

(b)   Write down the polar coordinates of the point where these graphs intersect.   (1 mark)

Question 2   **(7 marks)**

The points $(-2,\ 6)$, $(-1,\ 3)$ and $(0,\ 2)$ on the graph of the function $f(x) = x^2 + 2$ are moved by a linear transformation as shown in the diagram below.

(a)   State the appropriate transformation matrix.   (1 mark)

See next page

(b) Under a second transformation, $(2, 0)$ and $(3, 1)$ become $(2, 0)$ and $(5, 1)$ respectively.

 (i) Determine the matrix that will achieve this. (2 marks)

 (ii) State the new coordinates of $(6, 2)$. (1 mark)

(c) Find the transformation matrix which will transform the points from their final positions in part (b) back to their original positions. (3 marks)

See next page

Question 3　　　　　　　　　　　　　　　　　　　　　**(7 marks)**

Find the following indefinite integrals:

(a)　　$\int \dfrac{e^{2x}}{3+e^{2x}}\,dx$　　　　　　　　　　　　　　　　　(2 marks)

(b)　　$\int \left(x^e - \dfrac{1}{\cos^2 3x} \right) dx$　　　　　　　　　　　　(2 marks)

(c)　　$\int \cos x \left(1 - \cos x\right) dx$　　　　　　　　　　　　(3 marks)

Question 4 **(4 marks)**

The graph of $y = e^{(x-1)}$ is shown below.
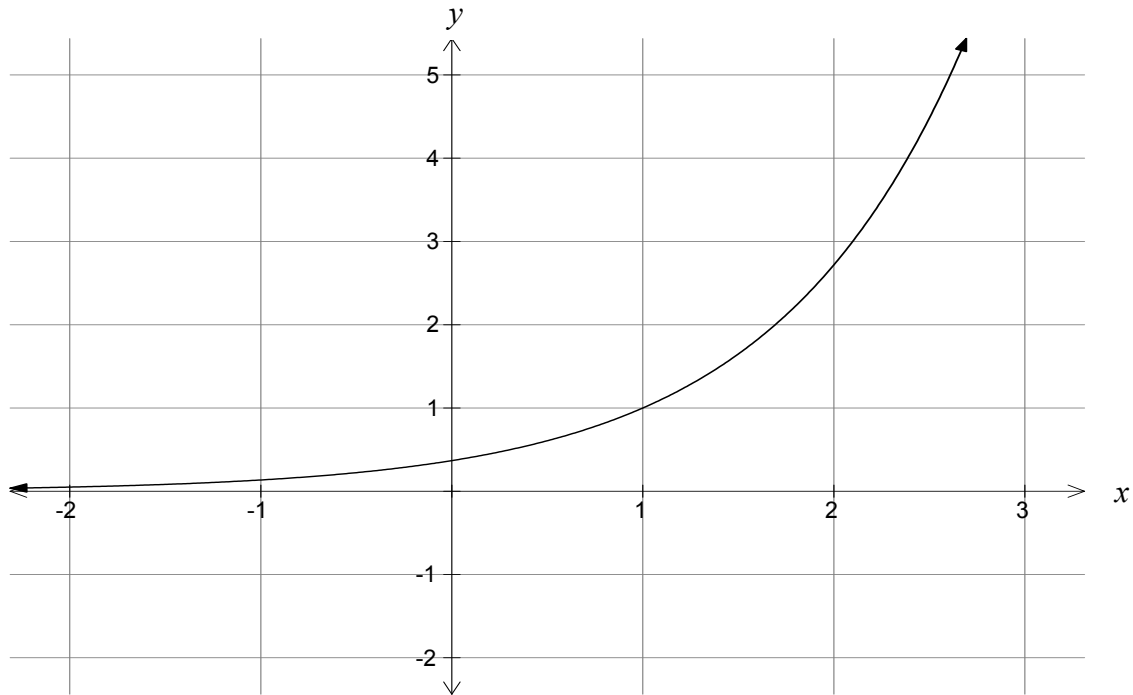
Calculate the exact area between the graphs of $y = e^{(x-1)}$, $y = 2 - x$ and the two axes.

Question 5   **(9 marks)**

A farmer has a water trough of length 8 metres with a semi-circular cross-section of diameter 1 m, as shown below.
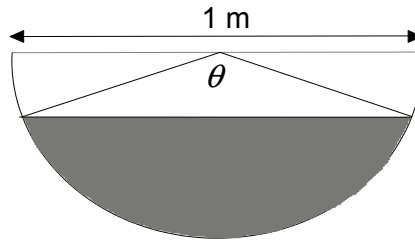
(a)   Show that the volume (V m^3) of water in the trough is given by

$V = \theta - \sin\theta$, where θ is measured in radians.   (1 mark)

Water is pumped into the trough at a constant rate of 0.1 m^3 per minute.

(b)   Use the above to determine an expression for $\dfrac{d\theta}{dt}$.   (2 marks)

See next page

Let x m be the depth of the water in the trough.

(c) Use the triangle pictured here to express x in terms of θ. (2 marks)

$\dfrac{\theta}{2}$

$(0.5-x)$ m   0.5 m
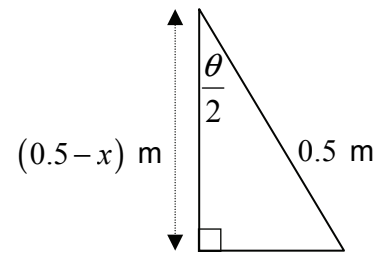
(d) Show that $\dfrac{dx}{dt} = \dfrac{1}{4}\sin\left(\dfrac{\theta}{2}\right)\dfrac{d\theta}{dt}$. (1 mark)

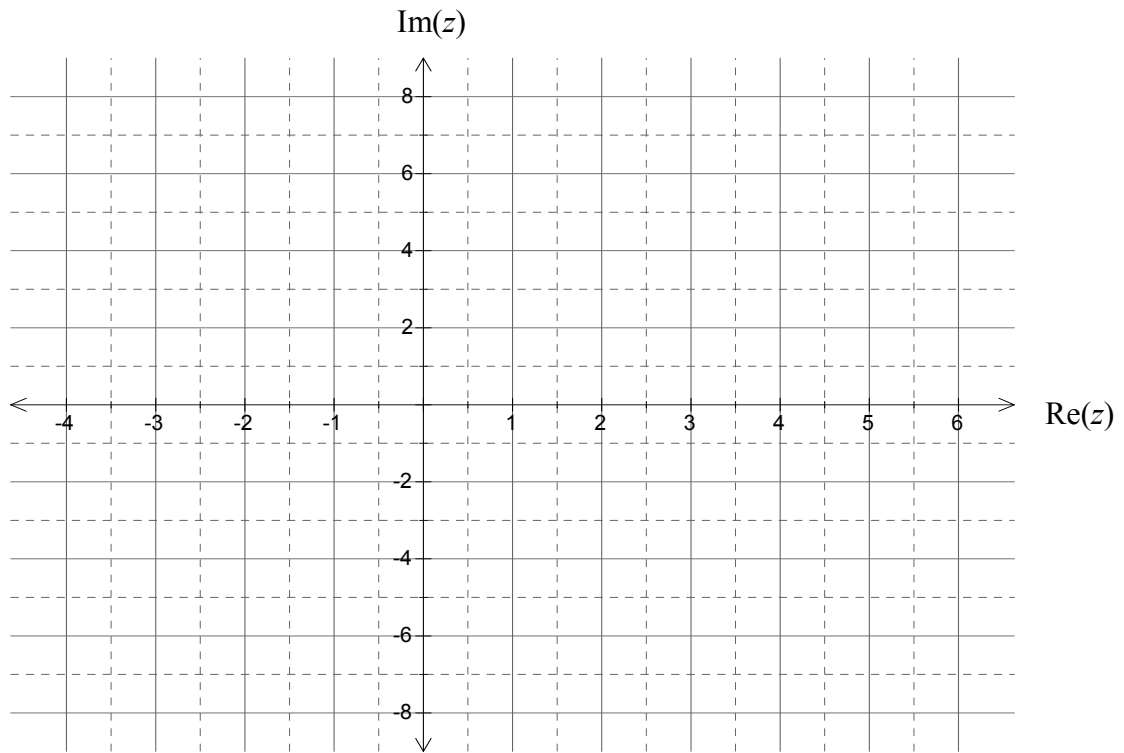(e) Determine, exactly, the rate at which the water level is rising at the instant when the water is 25 cm deep. (3 marks)
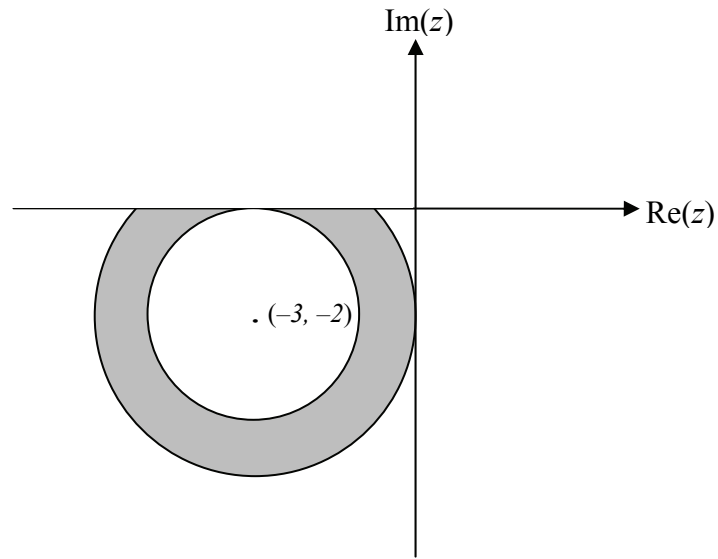
Question 6   **(5 marks)**

(a)   Sketch, on the complex plane below, the region defined by $0 \le 2\operatorname{Re}(z) + \operatorname{Im}(z) \le 3$.

(2 marks)

See next page

(b) State the inequalities that together describe the set of points illustrated by the shading below.   (3 marks)

Question 7   **(4 marks)**

In the diagram below, D, E and F are midpoints of the sides of the triangle ABC. Prove that
$\overrightarrow{AD} + \overrightarrow{BE} + \overrightarrow{CF} = \underset{\sim}{0}$.
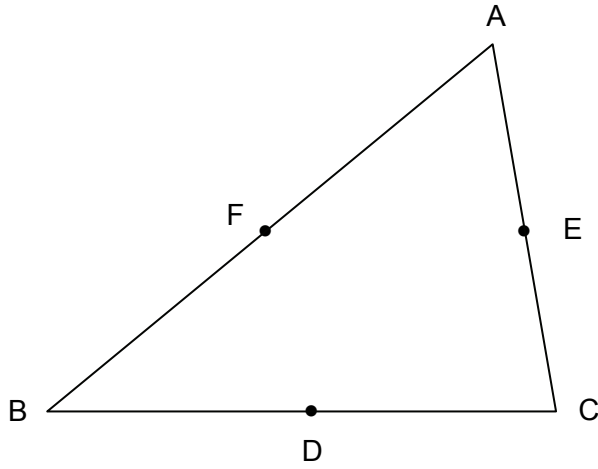
End of questions

Additional working space

Question number: _____

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Question number: _____

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Question number: _____