



## Section A (36 marks)

- 1 Solve the equation  $\frac{5x}{2x+1} - \frac{3}{x+1} = 1$ . [5]
- 2 Express  $6 \cos 2\theta + \sin \theta$  in terms of  $\sin \theta$ .  
Hence solve the equation  $6 \cos 2\theta + \sin \theta = 0$ , for  $0^\circ \leq \theta \leq 360^\circ$ . [7]
- 3 (i) Find the first three terms of the binomial expansion of  $\frac{1}{\sqrt[3]{1-2x}}$ . State the set of values of  $x$  for which the expansion is valid. [5]  
(ii) Hence find  $a$  and  $b$  such that  $\frac{1-3x}{\sqrt[3]{1-2x}} = 1 + ax + bx^2 + \dots$ . [3]
- 4 You are given that  $f(x) = \cos x + \lambda \sin x$  where  $\lambda$  is a positive constant.  
(i) Express  $f(x)$  in the form  $R \cos(x - \alpha)$ , where  $R > 0$  and  $0 < \alpha < \frac{1}{2}\pi$ , giving  $R$  and  $\alpha$  in terms of  $\lambda$ . [4]  
(ii) Given that the maximum value (as  $x$  varies) of  $f(x)$  is 2, find  $R$ ,  $\lambda$  and  $\alpha$ , giving your answers in exact form. [4]
- 5 A curve has parametric equations  $x = \sec \theta$ ,  $y = 2 \tan \theta$ .  
(i) Given that the derivative of  $\sec \theta$  is  $\sec \theta \tan \theta$ , show that  $\frac{dy}{dx} = 2 \operatorname{cosec} \theta$ . [3]  
(ii) Verify that the cartesian equation of the curve is  $y^2 = 4x^2 - 4$ . [2]

Fig. 5 shows the region enclosed by the curve and the line  $x = 2$ . This region is rotated through  $180^\circ$  about the  $x$ -axis.

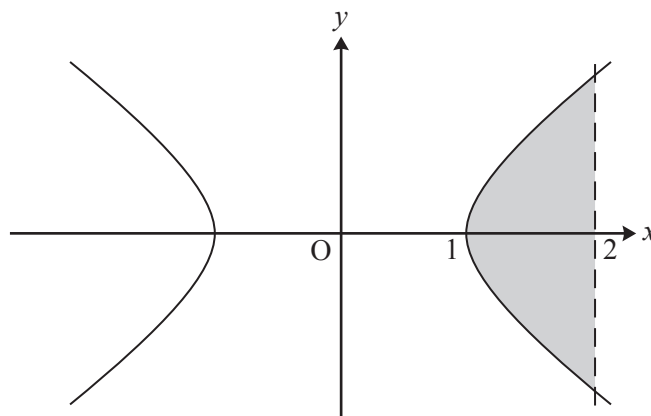


Fig. 5

- (iii) Find the volume of revolution produced, giving your answer in exact form. [3]

## Section B (36 marks)

- 6 Fig. 6 shows a lean-to greenhouse ABCDHEFG. With respect to coordinate axes  $Oxyz$ , the coordinates of the vertices are as shown. All distances are in metres. Ground level is the plane  $z = 0$ .

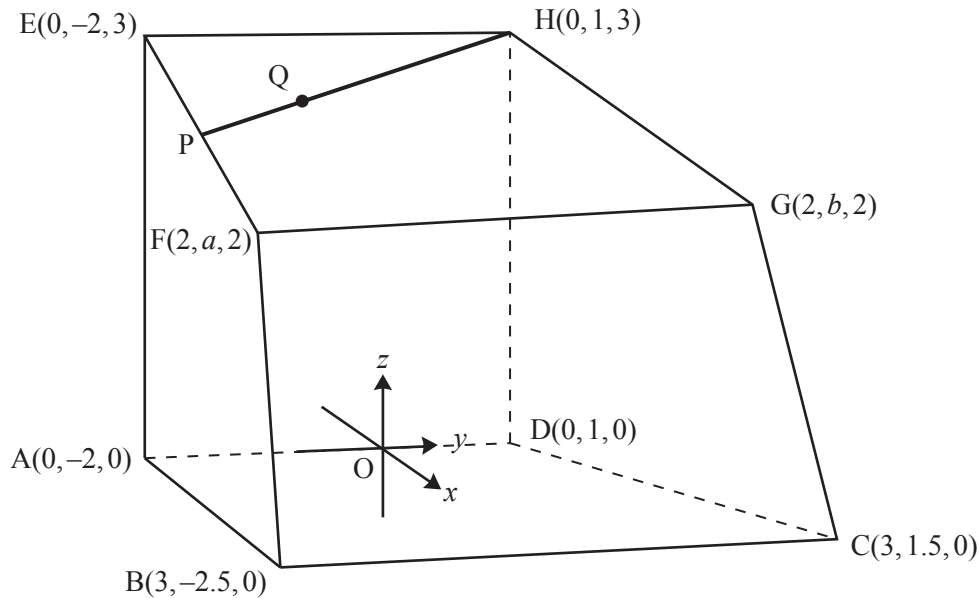


Fig. 6

- (i) Verify that the equation of the plane through A, B and E is  $x + 6y + 12 = 0$ .

Hence, given that F lies in this plane, show that  $a = -2\frac{1}{3}$ . [4]

- (ii) (A) Show that the vector  $\begin{pmatrix} 1 \\ -6 \\ 0 \end{pmatrix}$  is normal to the plane DHC. [2]

(B) Hence find the cartesian equation of this plane. [2]

(C) Given that G lies in the plane DHC, find  $b$  and the length FG. [2]

- (iii) Find the angle EFB. [5]

A straight wire joins point H to a point P which is half way between E and F. Q is a point two-thirds of the way along this wire, so that  $HQ = 2QP$ .

- (iv) Find the height of Q above the ground. [3]

Question 7 begins on page 4.

- 7 A drug is administered by an intravenous drip. The concentration,  $x$ , of the drug in the blood is measured as a fraction of its maximum level. The drug concentration after  $t$  hours is modelled by the differential equation

$$\frac{dx}{dt} = k(1 + x - 2x^2),$$

where  $0 \leq x < 1$ , and  $k$  is a positive constant. Initially,  $x = 0$ .

- (i) Express  $\frac{1}{(1+2x)(1-x)}$  in partial fractions. [3]

- (ii) Hence solve the differential equation to show that  $\frac{1+2x}{1-x} = e^{3kt}$ . [7]

- (iii) After 1 hour the drug concentration reaches 75% of its maximum value and so  $x = 0.75$ .

Find the value of  $k$ , and the time taken for the drug concentration to reach 90% of its maximum value. [3]

- (iv) Rearrange the equation in part (ii) to show that  $x = \frac{1 - e^{-3kt}}{1 + 2e^{-3kt}}$ .

Verify that in the long term the drug concentration approaches its maximum value. [5]

### END OF QUESTION PAPER

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Tuesday 16 June 2015 – Afternoon

**A2 GCE MATHEMATICS (MEI)**

**4754/01B** Applications of Advanced Mathematics (C4) Paper B: Comprehension

**QUESTION PAPER**

Candidates answer on the Question Paper.

**OCR supplied materials:**

- Insert (inserted)
- MEI Examination Formulae and Tables (MF2)

**Other materials required:**

- Scientific or graphical calculator
- Rough paper

**Duration:** Up to 1 hour



Candidate  
forename

Candidate  
surname

Centre number

Candidate number

**INSTRUCTIONS TO CANDIDATES**

- The Insert will be found inside this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.
- The Insert contains the text for use with the questions.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You may find it helpful to make notes and do some calculations as you read the passage.
- You are **not** required to hand in these notes with your question paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **18**.
- This document consists of **8** pages. Any blank pages are indicated.

- 1** In a building with a single lift, the car is located on the ground floor. The following calls arrive in quick succession, all before the car has started on its upward journey.

- Passenger P on floor 9 calls for a down-car (intending to go to floor 1);
- Passenger Q on floor 5 calls for an up-car (intending to go to floor 10);
- Passenger R on floor 4 calls for a down-car (intending to go to floor 1).

The following events need to take place, but not necessarily in the order given.

- E1. Pick up P
- E2. Pick up Q
- E3. Pick up R
- E4. Drop off P and R
- E5. Drop off Q

Assuming the car serves requests as described in lines 16 to 20,

- (i) which event occurs first? [1]
- (ii) which event occurs second? [1]
- (iii) which event occurs last? [1]

<b>1 (i)</b>	
<b>1 (ii)</b>	
<b>1 (iii)</b>	

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- 2 In line 79 it says “For most journeys, more than half the journey time is composed of load time and transfer time”. For what percentage of the journey time for the round trip made by car A in Table 4 is the car stationary? [2]

2	

- 3 Using the expression on line 51, work out the answer to the question on lines 39 and 40 for the case where there are 10 upper floors and 7 people. Give your answer to 2 decimal places. [2]

3	

- 4 In lines 89 and 90 it says “... on average there will be approximately 8 stops per trip. A round trip with 8 stops would take between 188 and 200 seconds”. Explain how the figure of 188 seconds has been derived. [2]

4	

**5** (i) Referring to Strategy 3 and lines 99 to 101, complete the table below for car C. **[3]**

(ii) Calculate the time car C will take to transport all the people who work on floors 7 and 8, and return to the ground floor. **[1]**

<b>5(i)</b>			
		Car C	
		Arrival time (seconds)	Departure time (seconds)
	Ground floor	0	20
	Floor 1		
	Floor 2		
	Floor 3		
	Floor 4		
	Floor 5		
	Floor 6		
	Floor 7		
	Floor 8		
	Floor 9		
	Floor 10		
	Return to ground floor		
<b>5(ii)</b>			



- 6** 8 people make independent visits to any one of the upper floors of a building with 10 upper floors. What is the probability that at least one of the visitors goes to the top floor? **[2]**

<b>6</b>	

- 7** On lines 94 and 95 it says “Table 4 gives the timings for round trips in which the cars are required to stop at every floor they serve; Table 2 suggests this is a common occurrence in this case”. Explain how Table 2 is used to make this claim. **[3]**

<b>7</b>	

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