

Write your name here

Surname

Other names

Pearson Edexcel
Level 3 GCE

Centre Number

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Candidate Number

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Further Mathematics

Advanced Subsidiary

Further Mathematics options

Paper 2F: Further Statistics 1 and Decision Mathematics 1

Sample Assessment Material for first teaching September 2017

Time: 1 hour 40 minutes

Paper Reference

8FM0/2F

You must have:

Decision Mathematics 1 question insert for Section B
Mathematical Formulae and Statistical Tables, calculator

Total Marks

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Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- There are **two** sections in this question paper. Answer **all** the questions in Section A and **all** the questions in Section B.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 9 questions in this question paper. The total mark for this paper is 80.
- The questions for Section B (Decision Mathematics) can be found in the question insert.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

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SECTION A

Answer ALL questions. Write your answers in the spaces provided.

1. A university foreign language department carried out a survey of prospective students to find out which of three languages they were most interested in studying.

A random sample of 150 prospective students gave the following results.

		Language		
		French	Spanish	Mandarin
Gender	Male	23	22	20
	Female	38	32	15

A test is carried out at the 1% level of significance to determine whether or not there is an association between gender and choice of language.

- (a) State the null hypothesis for this test. (1)
- (b) Show that the expected frequency for females choosing Spanish is 30.6 (1)
- (c) Calculate the test statistic for this test, stating the expected frequencies you have used. (3)
- (d) State whether or not the null hypothesis is rejected. Justify your answer. (2)
- (e) Explain whether or not the null hypothesis would be rejected if the test was carried out at the 10% level of significance. (1)

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Question 1 continued

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2. The discrete random variable X has probability distribution given by

x	-1	0	1	2	3
$P(X = x)$	c	a	a	b	c

The random variable $Y = 2 - 5X$

Given that $E(Y) = -4$ and $P(Y \geq -3) = 0.45$

(a) find the probability distribution of X .

(7)

Given also that $E(Y^2) = 75$

(b) find the exact value of $\text{Var}(X)$

(2)

(c) Find $P(Y > X)$

(2)

Question 2 continued

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(Total for Question 2 is 11 marks)

3. Two car hire companies hire cars independently of each other.

Car Hire *A* hires cars at a rate of 2.6 cars per hour.

Car Hire *B* hires cars at a rate of 1.2 cars per hour.

(a) In a 1 hour period, find the probability that each company hires exactly 2 cars. (2)

(b) In a 1 hour period, find the probability that the total number of cars hired by the two companies is 3 (2)

(c) In a 2 hour period, find the probability that the total number of cars hired by the two companies is less than 9 (2)

On average, 1 in 250 new cars produced at a factory has a defect.

In a random sample of 600 new cars produced at the factory,

(d) (i) find the mean of the number of cars with a defect,
(ii) find the variance of the number of cars with a defect. (2)

(e) (i) Use a Poisson approximation to find the probability that no more than 4 of the cars in the sample have a defect.
(ii) Give a reason to support the use of a Poisson approximation. (2)

Question 3 continued

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(Total for Question 3 is 10 marks)

4. The discrete random variable X follows a Poisson distribution with mean 1.4

(a) Write down the value of

(i) $P(X = 1)$

(ii) $P(X \leq 4)$

(2)

The manager of a bank recorded the number of mortgages approved each week over a 40 week period.

Number of mortgages approved	0	1	2	3	4	5	6
Frequency	10	16	7	4	2	0	1

(b) Show that the mean number of mortgages approved over the 40 week period is 1.4

(1)

The bank manager believes that the Poisson distribution may be a good model for the number of mortgages approved each week.

She uses a Poisson distribution with a mean of 1.4 to calculate expected frequencies as follows.

Number of mortgages approved	0	1	2	3	4	5 or more
Expected frequency	9.86	r	9.67	4.51	1.58	s

(c) Find the value of r and the value of s giving your answers to 2 decimal places.

(2)

The bank manager will test, at the 5% level of significance, whether or not the data can be modelled by a Poisson distribution.

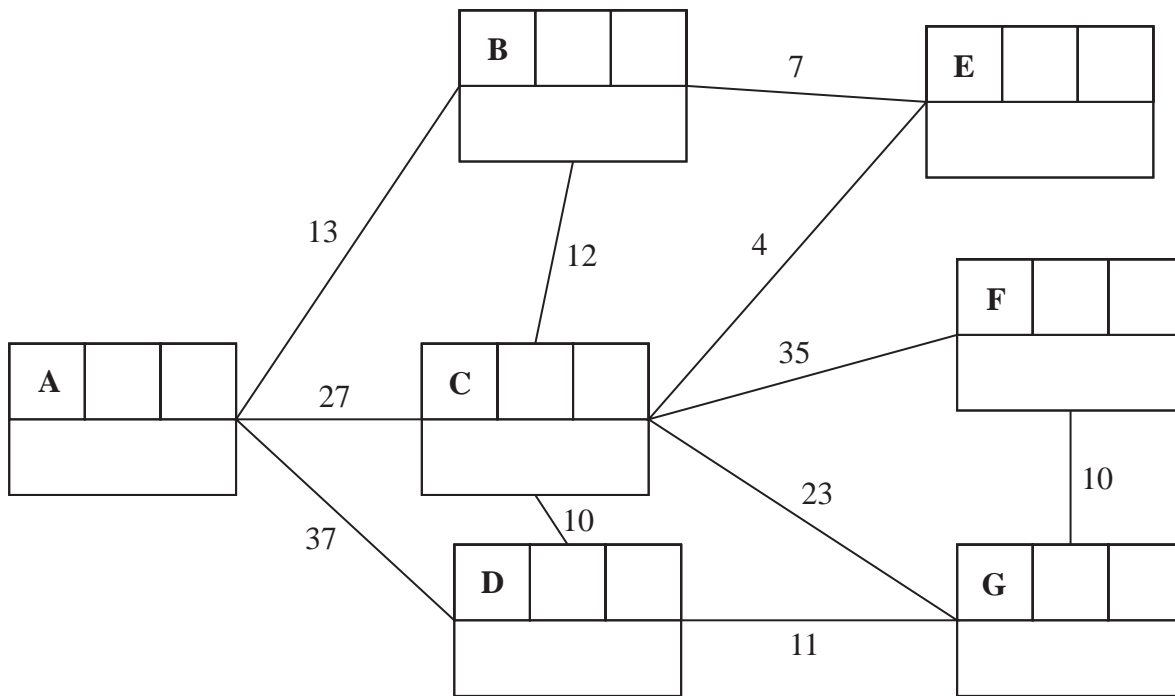
(d) Calculate the test statistic and state the conclusion for this test. State clearly the degrees of freedom and the hypotheses used in the test.

(6)

SECTION B

The questions for this section, Decision Mathematics 1, are provided in the Decision Mathematics 1 question insert.

5.



Key:

Vertex	Order of labelling	Final value
Working values		

Shortest path: _____

Length of shortest path: _____

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Question 5 continued

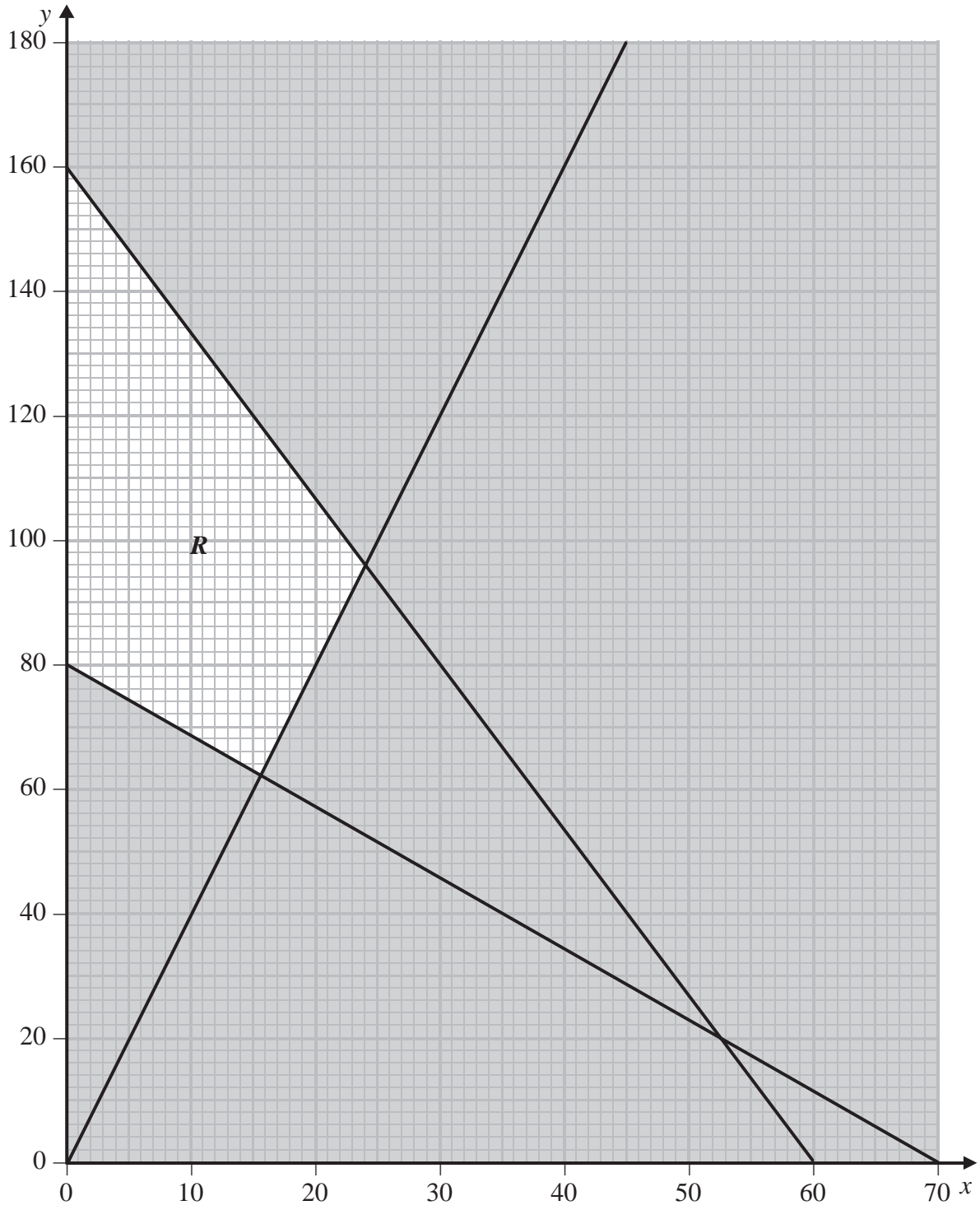
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(Total for Question 5 is 12 marks)

6.



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Question 6 continued

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(Total for Question 6 is 7 marks)

7. (a) and (b)

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(Total for Question 7 is 7 marks)

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8.

(Total for Question 8 is 9 marks)

9.

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(Total for Question 9 is 5 marks)

**TOTAL FOR SECTION B IS 40 MARKS
TOTAL FOR PAPER IS 80 MARKS**

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Paper 2F: Section B Decision Mathematics 1

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Decision Mathematics 1 question insert for Section B

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SECTION B

Answer ALL questions. Write your answers in the answer book provided.

5.

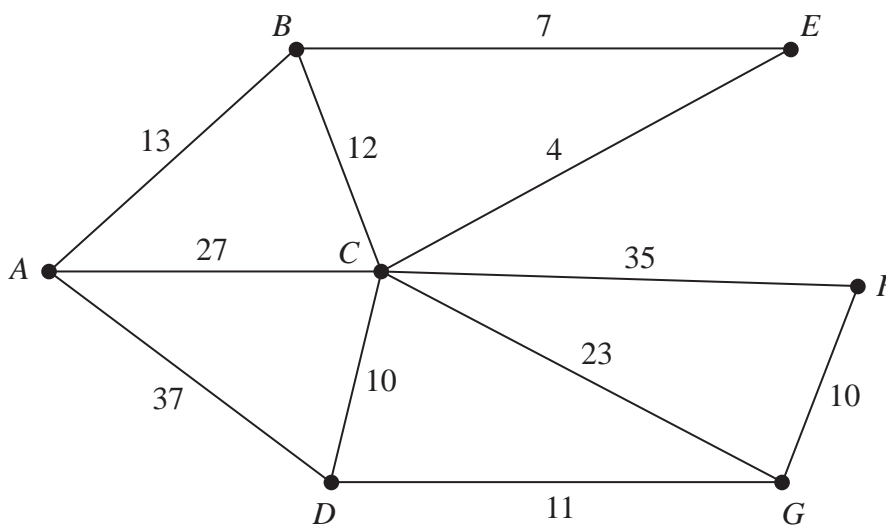


Figure 1

[The total weight of the network is 189]

Figure 1 represents a network of pipes in a building. The number on each arc is the length, in metres, of the corresponding pipe.

- (a) Use Dijkstra's algorithm to find the shortest path from A to F. State the path and its length. (5)

On a particular day, Gabriel needs to check each pipe. A route of minimum length, which traverses each pipe at least once and which starts and finishes at A, needs to be found.

- (b) Use an appropriate algorithm to find the pipes that will need to be traversed twice. You must make your method and working clear. (4)
- (c) State the minimum length of Gabriel's route. (1)

A new pipe, BG, is added to the network. A route of minimum length that traverses each pipe, including BG, needs to be found. The route must start and finish at A.

Gabriel works out that the addition of the new pipe increases the length of the route by twice the length of BG.

- (d) Calculate the length of BG. You must show your working. (2)

(Total for Question 5 is 12 marks)

6.

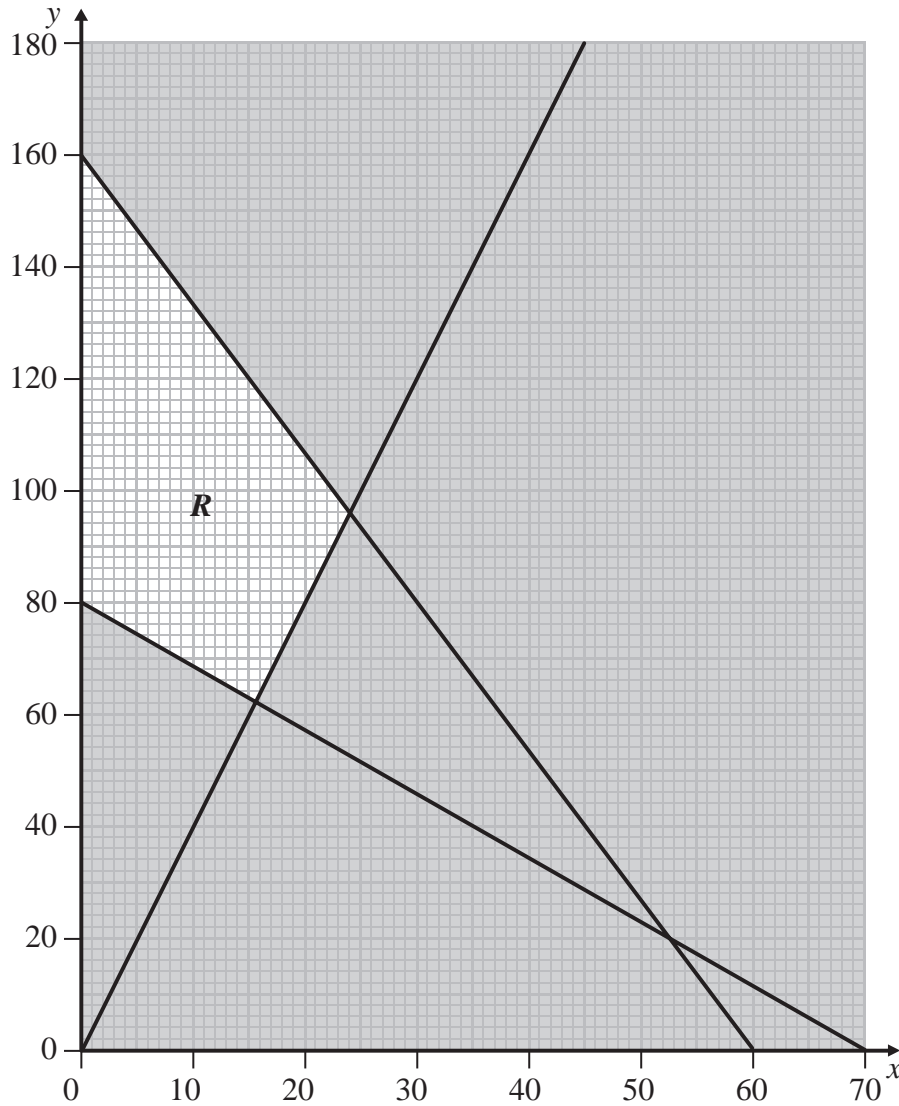


Figure 2

A teacher buys pens and pencils. The number of pens, x , and the number of pencils, y , that he buys can be represented by a linear programming problem as shown in Figure 2, which models the following constraints:

$$8x + 3y \leq 480$$

$$8x + 7y \geq 560$$

$$y \geq 4x$$

$$x, y \geq 0$$

The total cost, in pence, of buying the pens and pencils is given by

$$C = 12x + 15y$$

Determine the number of pens and the number of pencils which should be bought in order to minimise the total cost. You should make your method and working clear.

(Total for Question 6 is 7 marks)

7.

Activity	Time taken (days)	Immediately preceding activities
A	5	-
B	7	-
C	3	-
D	4	A, B
E	4	D
F	2	B
G	4	B
H	5	C, G
I	10	C, G

The table above shows the activities required for the completion of a building project. For each activity, the table shows the time taken in days to complete the activity and the immediately preceding activities. Each activity requires one worker. The project is to be completed in the shortest possible time.

- (a) Draw the activity network described in the table, using activity on arc. Your activity network must contain the minimum number of dummies only. (3)
- (b) (i) Show that the project can be completed in 21 days, showing your working. (4)
- (ii) Identify the critical activities.

(Total for Question 7 is 7 marks)

8. (a) Explain why it is not possible to draw a graph with exactly 5 nodes with orders 1, 3, 4, 4 and 5 (1)

A connected graph has exactly 5 nodes and contains 18 arcs. The orders of the 5 nodes are $2^{2x} - 1$, 2^x , $x + 1$, $2^{x+1} - 3$ and $11 - x$.

- (b) (i) Calculate x .
(ii) State whether the graph is Eulerian, semi-Eulerian or neither. You must justify your answer. (6)

- (c) Draw a graph which satisfies all of the following conditions:
• The graph has exactly 5 nodes.
• The nodes have orders 2, 2, 4, 4 and 4
• The graph is not Eulerian. (2)

(Total for Question 8 is 9 marks)

9. Jonathan makes two types of information pack for an event, *Standard* and *Value*.

Each *Standard* pack contains 25 posters and 500 flyers.

Each *Value* pack contains 15 posters and 800 flyers.

He must use at least 150 000 flyers.

Between 35% and 65% of the packs must be *Standard* packs.

Posters cost 20p each and flyers cost 4p each.

Jonathan wishes to minimise his costs.

Let x and y represent the number of *Standard* packs and *Value* packs produced respectively.

Formulate this as a linear programming problem, stating the objective and listing the constraints as simplified inequalities with integer coefficients.

You should not attempt to solve the problem.

(Total for Question 9 is 5 marks)

TOTAL FOR SECTION B IS 40 MARKS