

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 2H: Further Mechanics 1 and
Decision Mathematics 1**

Sample Assessment Material for first teaching September 2017

Time: 1 hour 40 minutes

Paper Reference

8FM0/2H

You must have:

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

Total Marks

**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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(1)

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2. A small stone of mass 0.5 kg is thrown vertically upwards from a point A with an initial speed of 25 m s^{-1} . The stone first comes to instantaneous rest at the point B which is 20 m vertically above the point A . As the stone moves it is subject to air resistance. The stone is modelled as a particle.

(a) Find the energy lost due to air resistance by the stone, as it moves from A to B . (3)

The air resistance is modelled as a constant force of magnitude R newtons.

(b) Find the value of R . (2)

(c) State how the model for air resistance could be refined to make it more realistic. (1)

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[illegible]

3. [In this question use $g = 10\text{ m s}^{-2}$]

A jogger of mass 60 kg runs along a straight horizontal road at a constant speed of 4 m s^{-1} . The total resistance to the motion of the jogger is modelled as a constant force of magnitude 30 N.

(a) Find the rate at which the jogger is working.

(3)

The jogger now comes to a hill which is inclined to the horizontal at an angle α , where

$\sin \alpha = \frac{1}{15}$. Because of the hill, the jogger reduces her speed to 3 m s^{-1} and maintains this

constant speed as she runs up the hill. The total resistance to the motion of the jogger from non-gravitational forces continues to be modelled as a constant force of magnitude 30 N.

(b) Find the rate at which she has to work in order to run up the hill at 3 m s^{-1} .

(5)

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[illegible]

4. A particle P of mass $3m$ is moving in a straight line on a smooth horizontal table. A particle Q of mass m is moving in the opposite direction to P along the same straight line. The particles collide directly. Immediately before the collision the speed of P is u and the speed of Q is $2u$. The velocities of P and Q immediately after the collision, measured in the direction of motion of P before the collision, are v and w respectively. The coefficient of restitution between P and Q is e .

(a) Find an expression for v in terms of u and e .

(6)

Given that the direction of motion of P is changed by the collision,

(b) find the range of possible values of e .

(2)

(c) Show that $w = \frac{u}{4}(1 + 9e)$.

(2)

Following the collision with P , the particle Q then collides with and rebounds from a fixed vertical wall which is perpendicular to the direction of motion of Q . The coefficient of restitution between Q and the wall is f .

Given that $e = \frac{5}{9}$, and that P and Q collide again in the subsequent motion,

(d) find the range of possible values of f .

(6)

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Question 4 continued

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Question 4 continued

(Total for Question 4 is 16 marks)

TOTAL FOR SECTION A IS 40 MARKS

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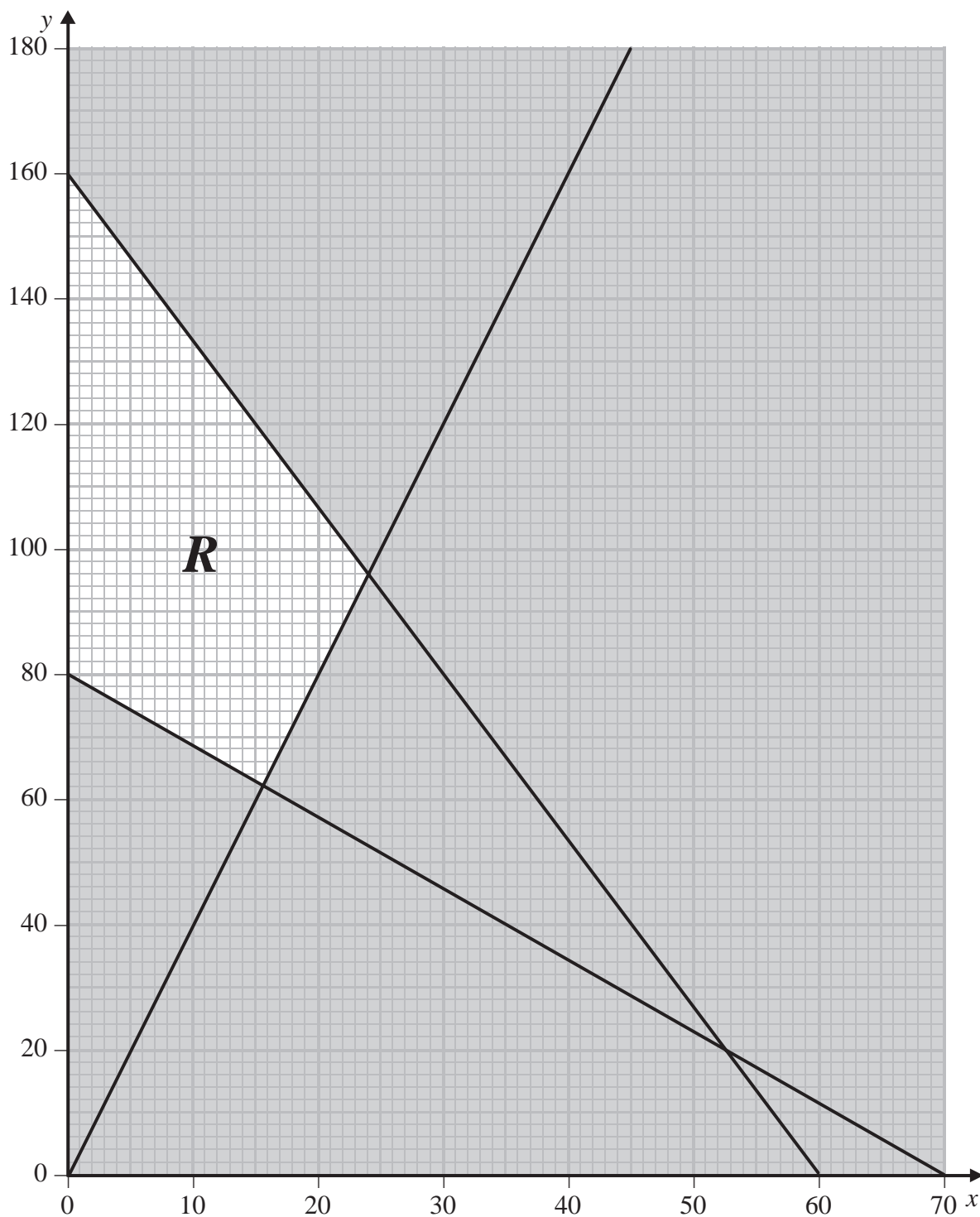
Length of shortest path: _____

[illegible]

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[illegible]

6.



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[illegible]

7. (a) and (b)

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(Total for Question 7 is 7 marks)

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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 2H: Section B Decision Mathematics 1

Sample Assessment Material for first teaching September 2017

Paper Reference

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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.

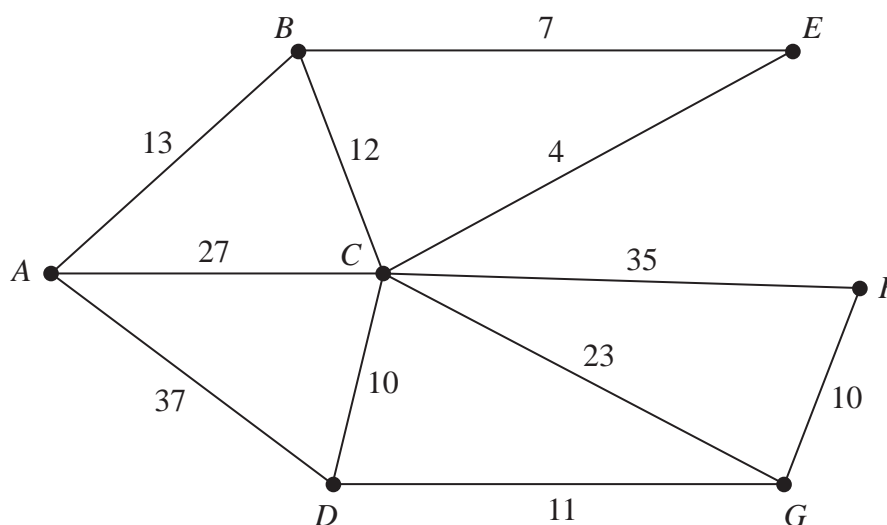


Figure 1

[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.

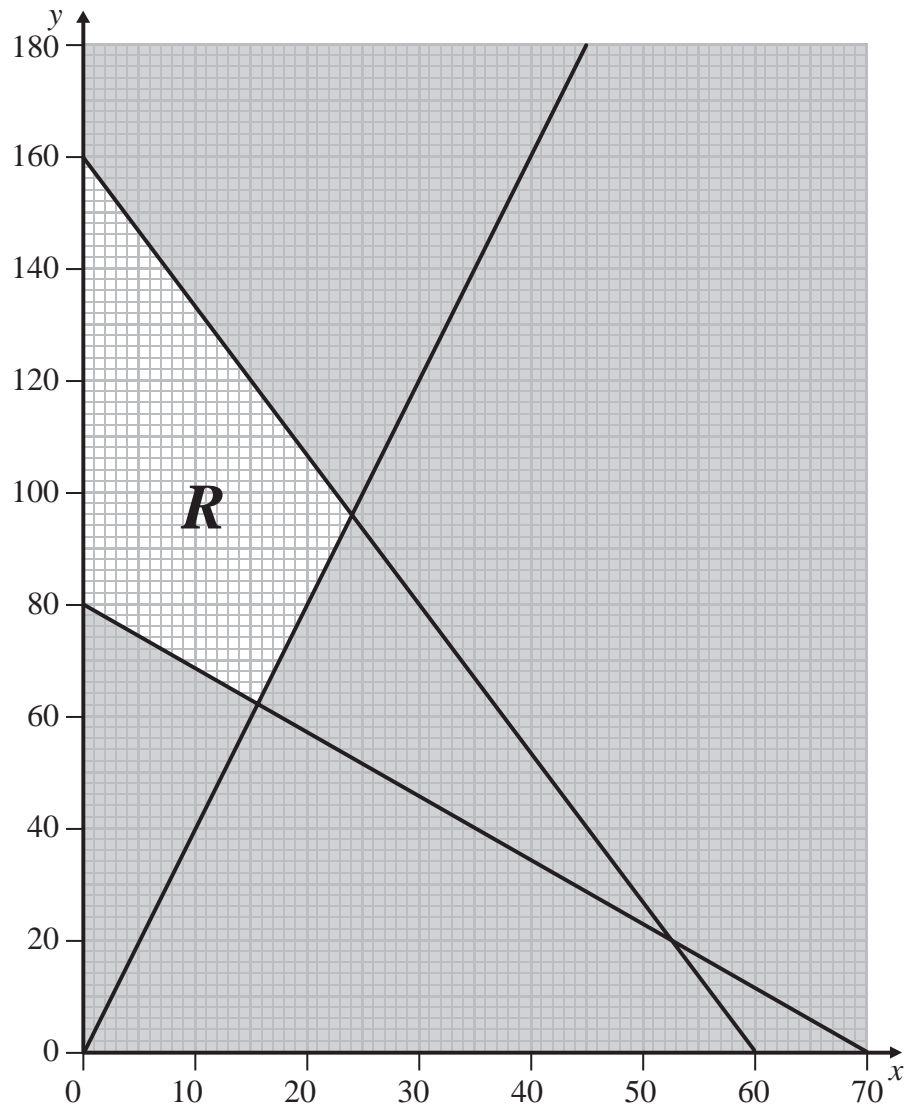


Figure 2

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