Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Paper reference **8FM0/27**

Further Mathematics

Advanced Subsidiary

Further Mathematics options

27: Decision Mathematics 1

(Part of options D, F, H and K)

Answer Book

Do not return the question paper with the answer book.

Total Marks

P66794A

1/1/1/1/1/

P 6 6 7 9 4 A 0 1 1 2

Turn over

Pearson

Write your answers in the answer book provided.

1. 3.5 6.3 2.9 5.4 3.1 2.8 3.7 1.7 4.1 3.3 2.2

The numbers listed above are to be sorted into descending order.

(a) (i) Perform **one** pass of a bubble sort, starting at the left-hand end of the list. You must write down the list that results at the end of this first pass.

(ii) Write down the number of comparisons and the number of swaps performed during this first pass.

(3)

After a second pass using this bubble sort, the updated list is

6.3 5.4 3.5 3.1 3.7 2.9 4.1 3.3 2.8 2.2 1.7

(b) Use a quick sort on this updated list to obtain the fully sorted list. You should show the result of each pass and identify your pivots clearly.

(3)

(c) Apply the first-fit decreasing bin packing algorithm to the fully sorted list to pack the numbers into bins of size 11.5

(3)

(d) Determine whether your answer to part (c) uses the minimum number of bins. You must justify your answer.

(2)

(Total for Question 1 is 11 marks)

1.

(a) 3·5 6·3 2·9 5·4 3·1 2·8 3·7 1·7 4·1 3·3 2·2

6·3 3·5 5·4 3·1 2·9 3·7 2·8 4·1 3·3 2·2 1·7

COMPARISONS: |||||||||| (10)

SWAPS: |||||| (7)

(b)

6·3	5·4	3·5	3·1	3·7	**2·9**	4·1	3·3	2·8	2·2	1·7
6·3	5·4	3·5	**3·1**	3·7	4·1	3·3	2·9	2·8	**2·2**	1·7
6·3	5·4	3·5	**3·7**	4·1	3·3	3·1	2·9	2·8	2·2	1·7
6·3	**5·4**	4·1	3·7	3·5	**3·3**	3·1	2·9	2·8	2·2	1·7
6·3	5·4	4·1	3·7	3·5	3·3	3·1	2·9	2·8	2·2	1·7

∴ SORT COMPLETE

(c) IN DECREASING ORDER:

6·3 5·4 4·1 3·7 3·5 3·3 3·1 2·9 2·8 2·2 1·7

BIN 1	6·3 4·1	11·5 5·2 1·1
BIN 2	5·4 3·7 2·2	11·5 6·1 2·4 0·2
BIN 3	3·5 3·3 3·1	11·5 8·0 4·7 1·6
BIN 4	2·9 2·8 1·7	11·5 8·6 5·8 4·1

∴ 4 BINS REQUIRED

(d) $LB = \frac{3·5 + 6·3 + 2·9 + 5·4 + 3·1 + 2·8 + 3·7 + 1·7 + 4·1 + 3·3 + 2·2}{11·5}$

Question 1 continued

$\therefore$ LB = 3.391... < 4

$\therefore$ ANSWER TO (c) USES MINIMUM NUMBER OF BINS

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2.

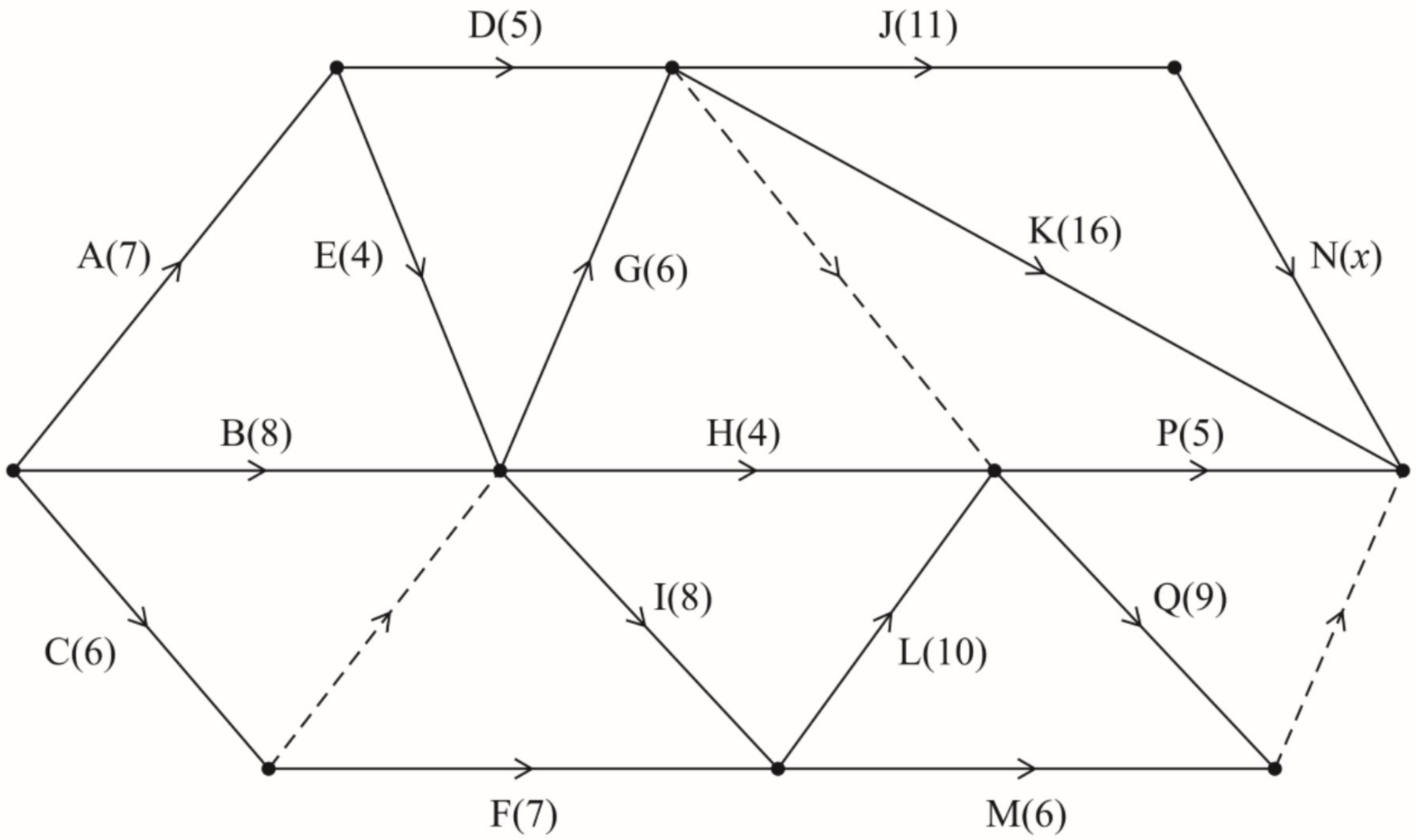


Figure 1

A project is modelled by the activity network shown in Figure 1. The activities are represented by the arcs. The number in brackets on each arc gives the time, in hours, to complete the corresponding activity. The exact duration, x, of activity N is unknown, but it is given that $5 < x < 10$

Each activity requires one worker. The project is to be completed in the shortest possible time.

(a) Complete the precedence table in the answer book.

(2)

(b) Complete Diagram 1 in the answer book to show the early event times and the late event times.

(4)

(c) List the critical activities.

(1)

It is given that activity J can be delayed by up to 4 hours without affecting the shortest possible completion time of the project.

(d) Determine the value of x. You must make the numbers used in your calculation clear.

(1)

(e) Draw a cascade chart for this project on Grid 1 in the answer book.

(4)

(Total for Question 2 is 12 marks)

2. (a)

Activity	Immediately preceding activities
A	–
B	–
C	–
D	A
E	A
F	C

Activity	Immediately preceding activities
G	B, C, E
H	B, C, E
I	B, C, E
J	D, G
K	D, G
L	F, I

Activity	Immediately preceding activities
M	F, I
N	J
P	D, G, H, L
Q	D, G, H, L

(b)

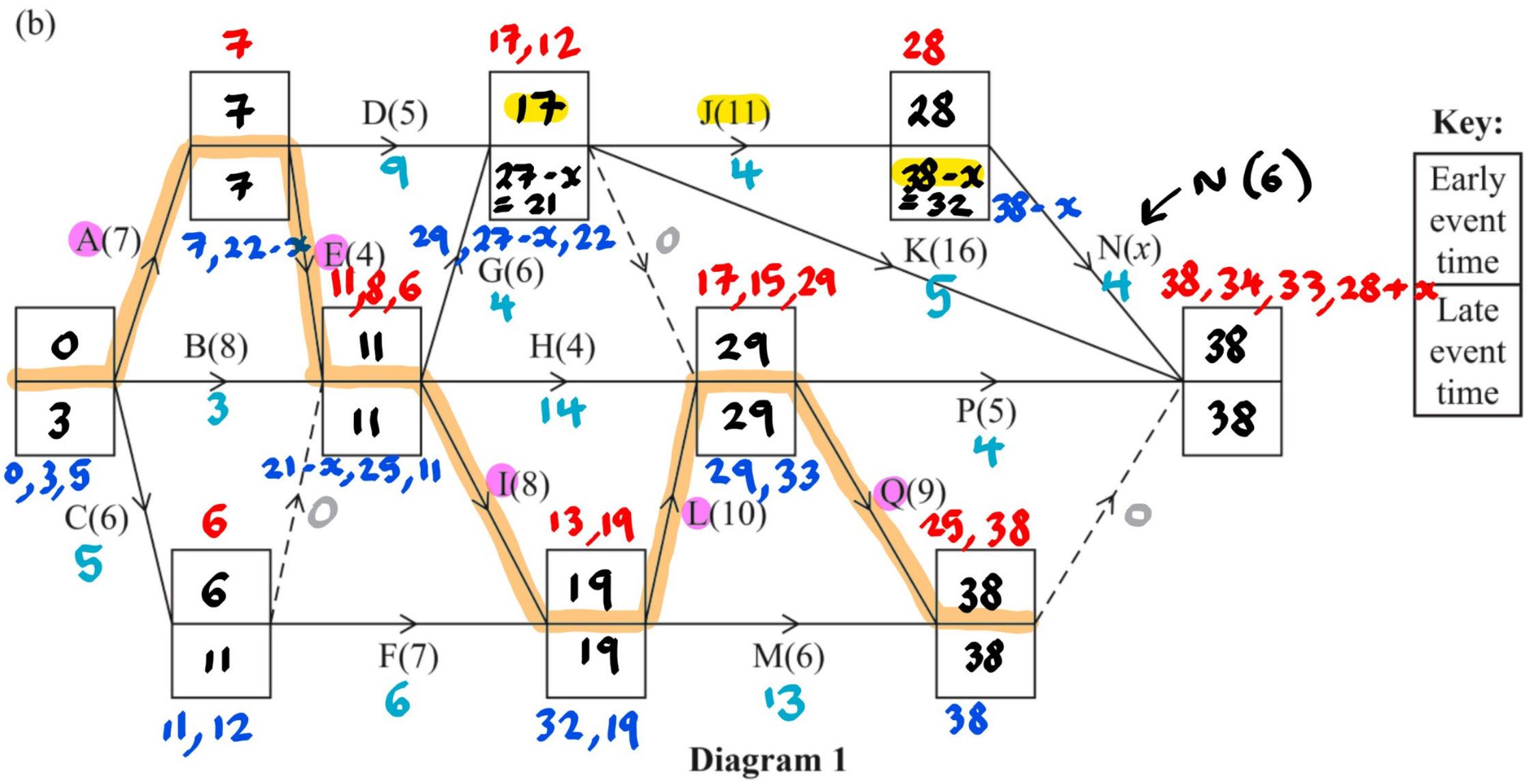


Diagram 1

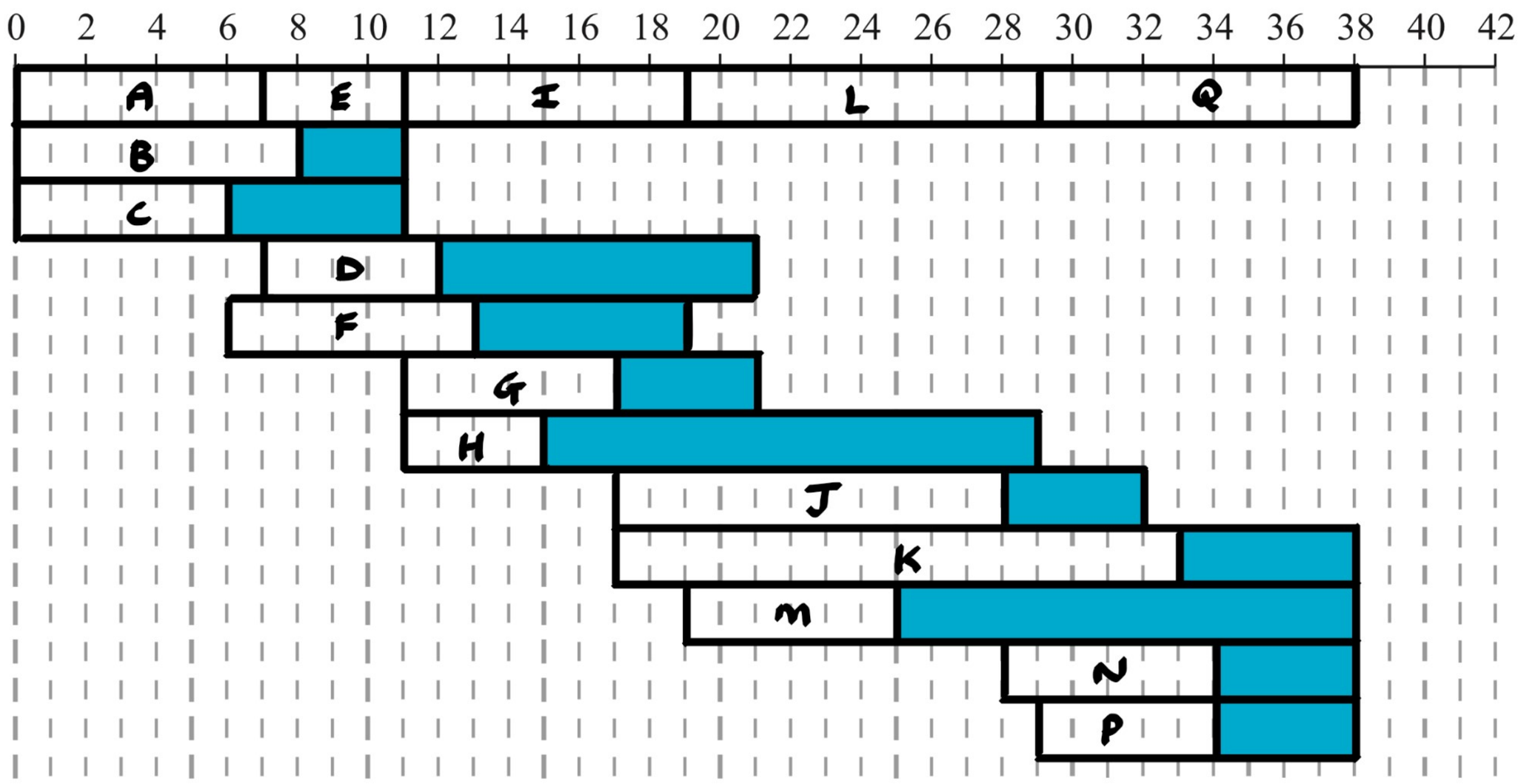
(c) CRITICAL ACTIVITIES: A, E, I, L, Q

(d) FLOAT = (38 - x) - (11) - (17) = 4

∴ x = 6

(e) CRITICAL PATH : A E I L Q

Question 2 continued



Grid 1

(Total for Question 2 is 12 marks)

3. Donald plans to bake and sell cakes. The three types of cake that he can bake are brownies, flapjacks and muffins.

Donald decides to bake 48 brownies and muffins in total.

Donald decides to bake at least 5 brownies for every 3 flapjacks.

At most 40% of the cakes will be muffins.

Donald has enough ingredients to bake 60 brownies or 45 flapjacks or 35 muffins.

Donald plans to sell each brownie for £1.50, each flapjack for £1 and each muffin for £1.25
He wants to maximise the total income from selling the cakes.

Let x represent the number of brownies, let y represent the number of flapjacks and let z represent the number of muffins that Donald will bake.

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

You should **not** attempt to solve the problem.

(Total for Question 3 is 9 marks)

3.

MAXIMISE $P = 1.5x + y + 1.25z$ ①

SUBJECT TO: $x + z = 48$ ②

$3x \geq 5y$ ③

$\frac{2}{5}(x + y + z) \geq z$ ④

$\frac{x}{60} + \frac{y}{45} + \frac{z}{35} \leq 1$ ⑤

FROM ②: $z = 48 - x$ ⑥

FROM ④: $2x + 2y + 2z \geq 5z$

$2x + 2y \geq 3z$ ⑦

FROM ⑤: $1575x + 2100y + 2700z \leq 94500$ $(\div 75)$

$21x + 28y + 36z \leq 1260$ ⑧

⑥ → ①: $P = 1.5x + y + 1.25(48 - x)$

$P = 0.25x + y + 60$ ⑨

⑥ → ⑦: $2x + 2y \geq 3(48 - x)$

$5x + 2y \geq 144$ ⑩

⑥ → ⑧: $21x + 28y + 36(48 - x) \leq 1260$

$-15x + 28y \leq -468$

$15x \geq 28y + 468$ ⑪

Question 3 continued

$\therefore$ MAXIMISE $P = 0.25x + y + 60$

SUBJECT TO : $3x \geq 5y$

$5x + 2y \geq 144$

$15x \geq 28y + 468$

(Total for Question 3 is 9 marks)

4.

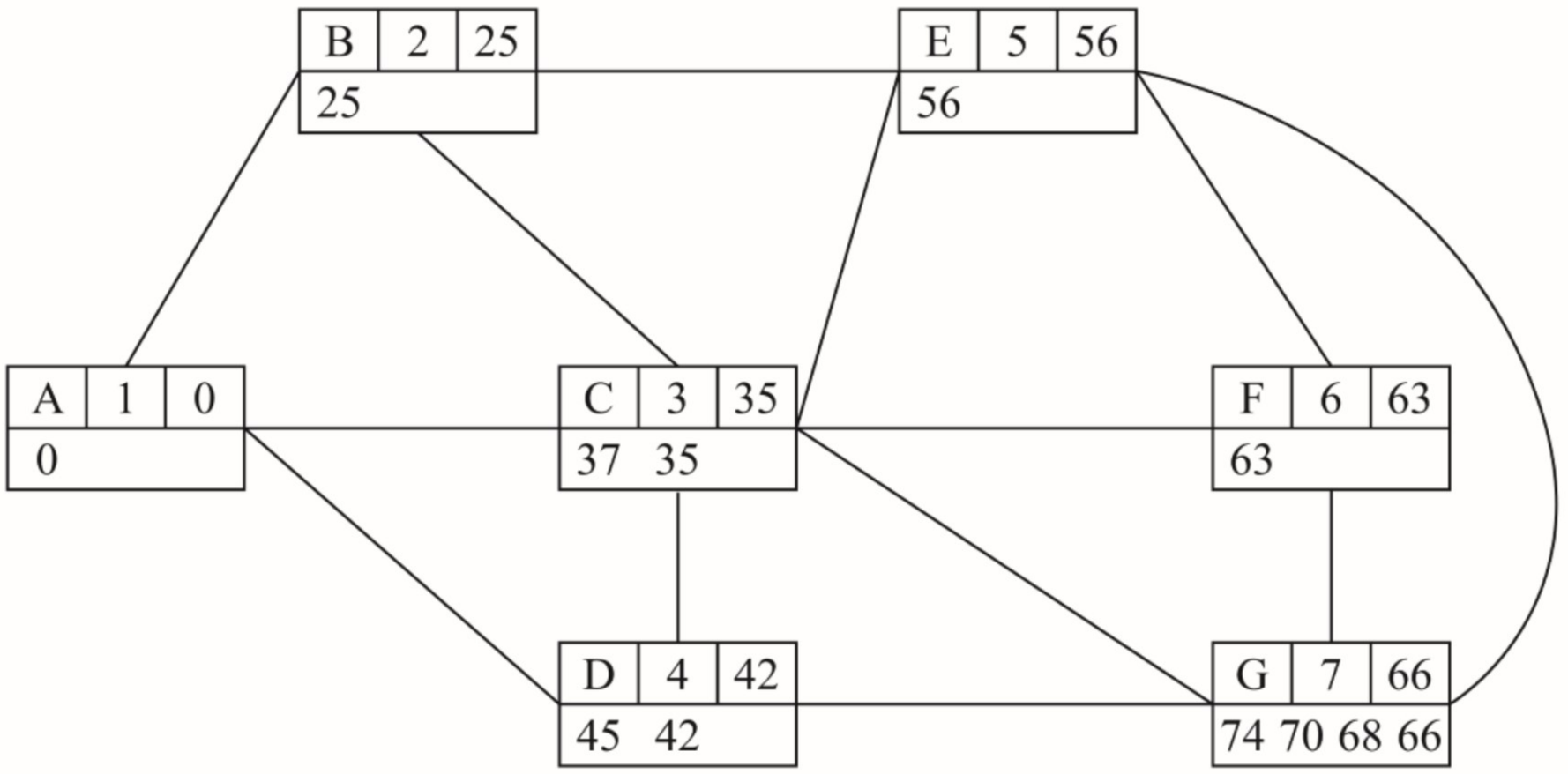


Figure 2

Dijkstra's algorithm has been applied to the network in Figure 2.

A working value has only been replaced at a node if the new working value is smaller.

(a) State the length of the shortest path from A to G.

(1)

(b) Complete the table in the answer book giving the weight of each arc listed.
(Note that arc CE and arc EF are not in the table.)

(3)

(c) State the shortest path from A to G.

(1)

It is now given that

- when Prim's algorithm, starting from A, is applied to the network, the order in which the arcs are added to the tree is AB, BC, CD, CE, EF and FG
- the weight of the corresponding minimum spanning tree is 80
- the shortest path from A to F via E has weight 67

(d) Determine the weight of arc CE and the weight of arc EF, making your reasoning clear.

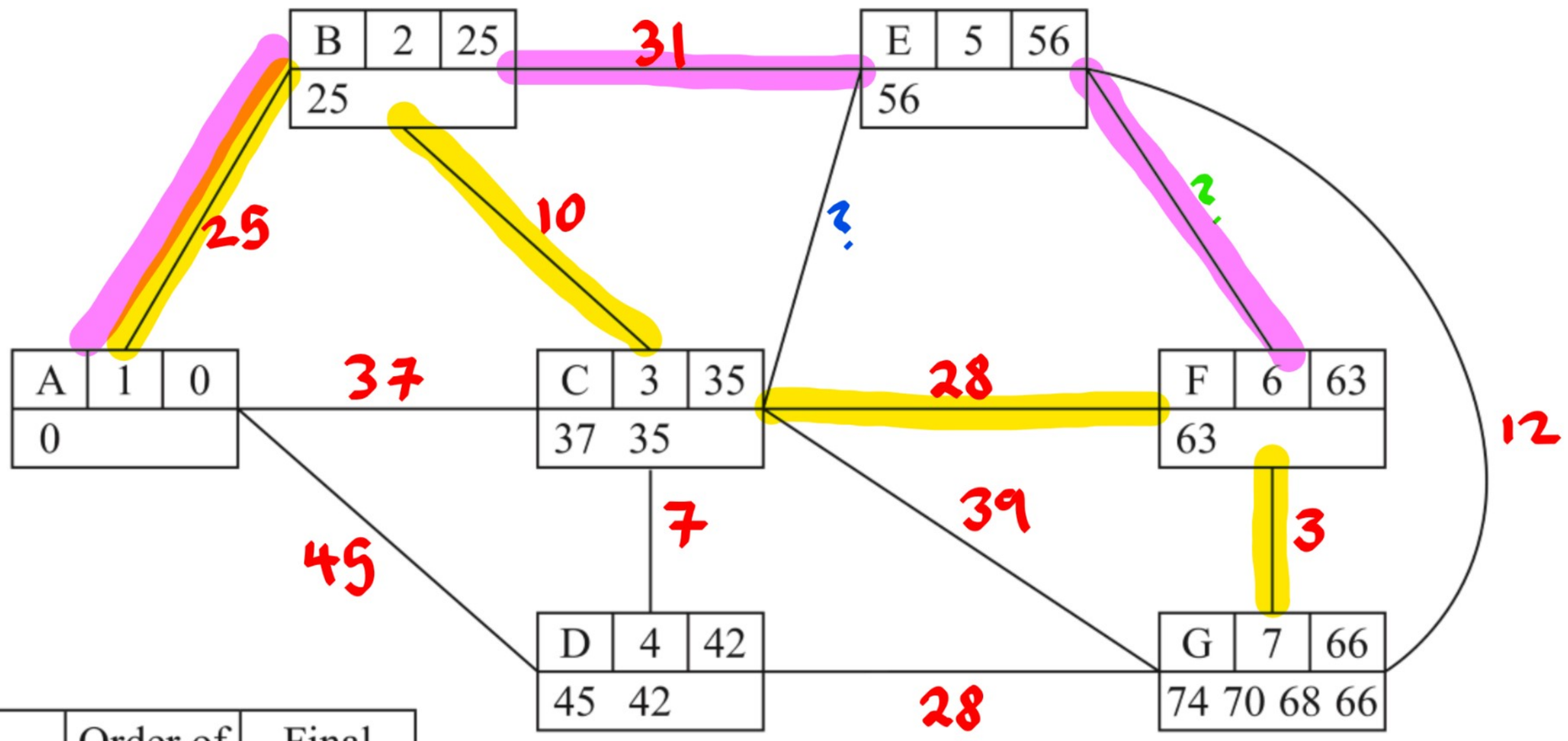
(3)

(Total for Question 4 is 8 marks)

TOTAL FOR DECISION MATHEMATICS 1 IS 40 MARKS

END

4.



Key:

Vertex	Order of labelling	Final value
Working values		

(a) length of the shortest path from A to G: 66

(b)

Arc	Weight
AB	25
AC	37
AD	45
BC	10
BE	31
CD	7
CF	28
CG	39
DG	28
EG	12
FG	3

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Question 4 continued

(c) shortest path from A to G: A B C F G

(d) AB BC CD CE EF FG

$25 + 10 + 7 + CE + EF + 3 = 80$

$\therefore CE + EF = 35$ ①

SHORTEST PATH FROM A TO F VIA E : A B E F

$\therefore 56 + EF = 67$ ②

$\therefore EF = 11$, $CE = 24$

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