Paper Reference(s)

6689/01

Edexcel GCE

Decision Mathematics D1

Advanced/Advanced Subsidiary

Friday 15 January 2010 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination
Nil

Items included with question papers
D1 Answer Book

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

Write your answers for this paper in the D1 answer book provided.
In the boxes on the answer book, write your centre number, candidate number, your surname, initials and signature.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.
Complete your answers in blue or black ink or pencil.
Do not return the question paper with the answer book.

Information for Candidates

Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 7 questions in this question paper. The total mark for this paper is 75.
There are 8 pages in this question paper. The answer book has 16 pages. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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Write your answers in the D1 answer book for this paper.

1.

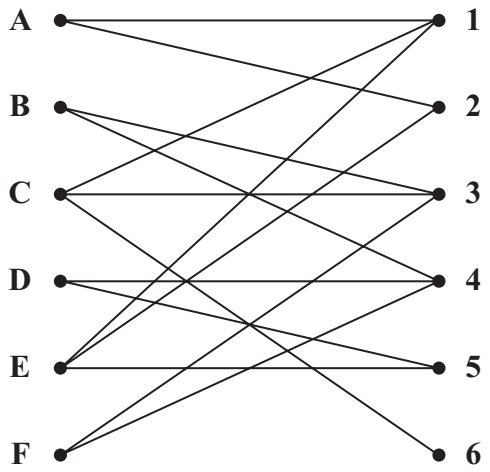

Figure 1

Figure 1 shows the possible allocation of six people, Alice (A), Brian (B), Christine (C), David (D), Elizabeth (E) and Freddy (F), to six tasks, 1, 2, 3, 4, 5 and 6.

An initial matching is Alice to task 1, Christine to task 3, David to task 4 and Elizabeth to task 5.

(a) Show this initial matching on Diagram 1 in the answer book.

(1)

(b) Starting from this initial matching, use the maximum matching algorithm to find a complete matching. List clearly the alternating paths that you use, and give your final matching.

(5)

(Total 6 marks)

2. Prim's algorithm finds a minimum spanning tree for a connected graph.

(a) Explain the terms

(i) connected graph,

(ii) tree,

(iii) spanning tree.

(3)

(b) Name an alternative algorithm for finding a minimum spanning tree.

(1)

	Cambridge	London	Norwich	Oxford	Portsmouth	Salisbury	York
Cambridge (C)	-	60	62	81	132	139	156
London (L)	60	-	116	56	74	88	211
Norwich (N)	62	116	-	144	204	201	181
Oxford (O)	81	56	144	-	84	63	184
Portsmouth (P)	132	74	204	84	-	43	269
Salisbury (S)	139	88	201	63	43	-	248
York (Y)	156	211	181	184	269	248	-

Figure 2

Figure 2 shows the distances by road, in miles, between seven cities.

(c) (i) Use Prim's algorithm, starting at London, to find the minimum spanning tree for these cities. You must clearly state the order in which you selected the **edges** of your tree, and the weight of the final tree.

(ii) Draw your tree using the vertices given in Diagram 2 in the answer book.

(5)

(Total 9 marks)

3.

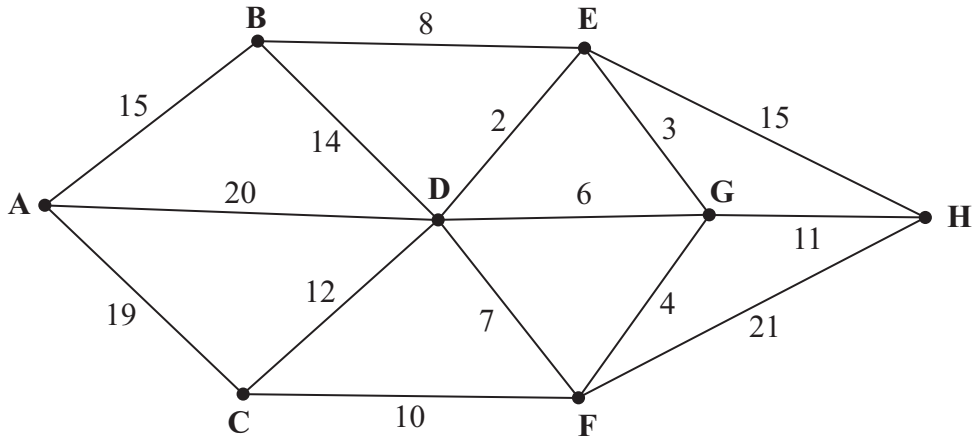

Figure 3

[*The total weight of the network is 167*]

Figure 3 represents a network of paths. The number on each arc gives the time, in minutes, to travel along that path.

(a) Use Dijkstra's algorithm to find the quickest route from A to H. State your quickest route and the time taken.

(5)

Kevin must walk along each path at least once and return to his starting point.

(b) Use an appropriate algorithm to find the time of Kevin's quickest possible route, starting and finishing at A. You should make your method and working clear.

(5)

(Total 10 marks)

4. A builder is asked to replace the guttering on a house. The lengths needed, in metres, are

0.6, 4.0, 2.5, 3.2, 0.5, 2.6, 0.4, 0.3, 4.0 and 1.0

Guttering is sold in 4 m lengths.

(a) Carry out a quick sort to produce a list of the lengths needed in **descending** order. You should show the result of each pass and identify your pivots clearly.

(5)

(b) Apply the first-fit decreasing bin-packing algorithm to your ordered list to determine the total number of 4 m lengths needed.

(4)

(c) Does the answer to part (b) use the minimum number of 4 m lengths? You must justify your answer.

(2)

(Total 11 marks)

5.

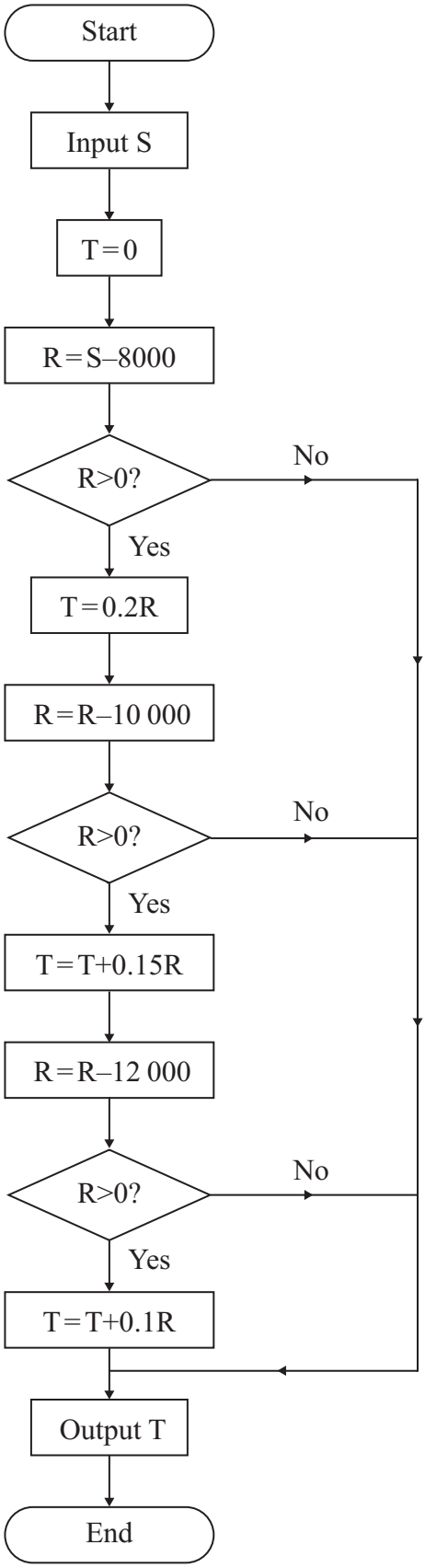
Start
Input S
T = 0
R = S–8000
R>0?
No
Yes
T = 0.2R
R = R–10 000
R>0?
No
Yes
T = T+0.15R
R = R–12 000
R>0?
No
Yes
T = T+0.1R
Output T
End

Figure 4

An algorithm is described by the flowchart shown in Figure 4.

(a) Given that S = 25 000, complete the table in the answer book to show the results obtained at each step when the algorithm is applied.

(5)

This algorithm is designed to model a possible system of income tax, T, on an annual salary, £S.

(b) Write down the amount of income tax paid by a person with an annual salary of £25 000.

(1)

(c) Find the maximum annual salary of a person who pays no tax.

(1)

(Total 7 marks)

6.

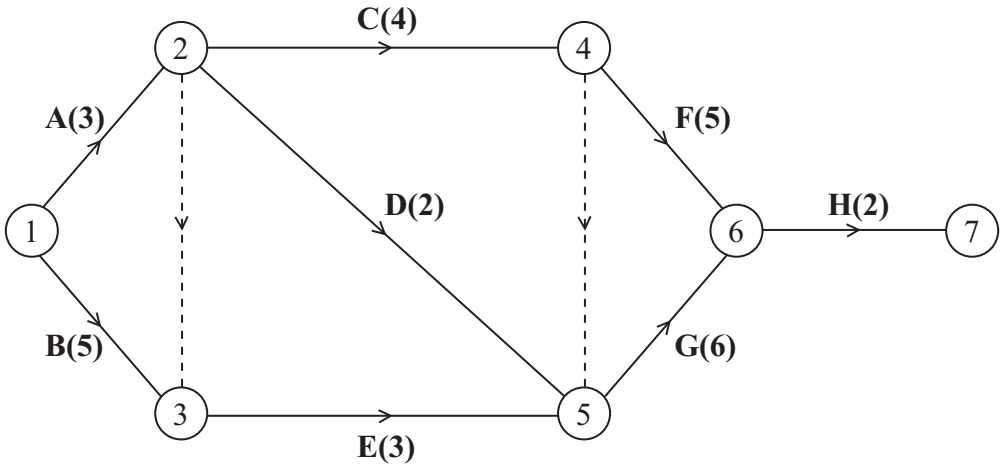

Figure 5

Figure 5 is the activity network relating to a building project. The number in brackets on each arc gives the time taken, in days, to complete the activity.

(a) Explain the significance of the dotted line from event ② to event ③.

(2)

(b) Complete the precedence table in the answer booklet.

(3)

(c) Calculate the early time and the late time for each event, showing them on the diagram in the answer booklet.

(4)

(d) Determine the critical activities and the length of the critical path.

(2)

(e) On the grid in the answer booklet, draw a cascade (Gantt) chart for the project.

(4)

(Total 15 marks)

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7. You are in charge of buying new cupboards for a school laboratory.
The cupboards are available in two different sizes, standard and large.
The maximum budget available is £1800. Standard cupboards cost £150 and large cupboards cost £300.
Let x be the number of standard cupboards and y be the number of large cupboards.

(a) Write down an inequality, in terms of x and y, to model this constraint.

(2)

The cupboards will be fitted along a wall 9 m long. Standard cupboards are 90 cm long and large cupboards are 120 cm long.

(b) Show that this constraint can be modelled by

$$3x + 4y \leqslant 30.$$

You must make your reasoning clear.

(2)

Given also that $y \geqslant 2$,

(c) explain what this constraint means in the context of the question.

(1)

The capacity of a large cupboard is 40% greater than the capacity of a standard cupboard. You wish to maximise the total capacity.

(d) Show that your objective can be expressed as

$$\text{maximise } 5x + 7y$$

(2)

(e) Represent your inequalities graphically, on the axes in your answer booklet, indicating clearly the feasible region, R.

(6)

(f) Find the number of standard cupboards and large cupboards that need to be purchased. Make your method clear.

(4)

(Total 17 marks)

TOTAL FOR PAPER: 75 MARKS

END

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Candidate No.						6	6	8	9	/	0	1	Signature	

Paper Reference(s)

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Answer Book

Do not return the question paper with the answer book

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

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1.

A •	• **1**
B •	• **2**
C •	• **3**
D •	• **4**
E •	• **5**
F •	• **6**

Diagram 1

Leave blank

(Question 1 continued)

A •	• **1**	**A** •	• **1**
B •	• **2**	**B** •	• **2**
C •	• **3**	**C** •	• **3**
D •	• **4**	**D** •	• **4**
E •	• **5**	**E** •	• **5**
F •	• **6**	**F** •	• **6**

Q1

(Total 6 marks)

Leave blank

2. (a) (i) _____

_____

_____

(ii) _____

_____

_____

(iii) _____

_____

_____

(b) _____

	Cambridge	London	Norwich	Oxford	Portsmouth	Salisbury	York
Cambridge (C)	-	60	62	81	132	139	156
London (L)	60	-	116	56	74	88	211
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Salisbury (S)	139	88	201	63	43	-	248
York (Y)	156	211	181	184	269	248	-

Figure 2

Leave blank

(Question 2 continued)

(c) (i)

Weight of tree: _____

(ii)

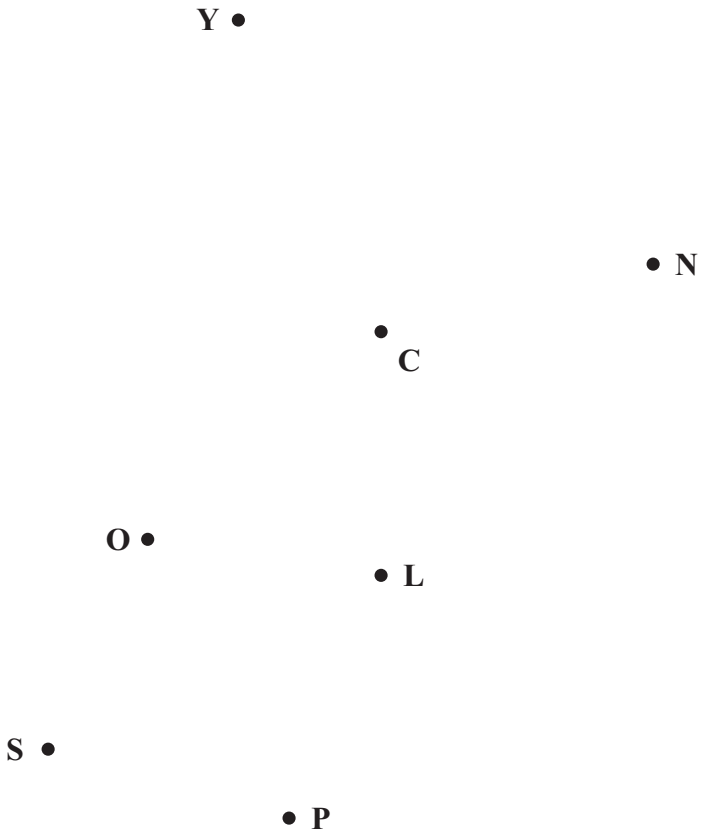
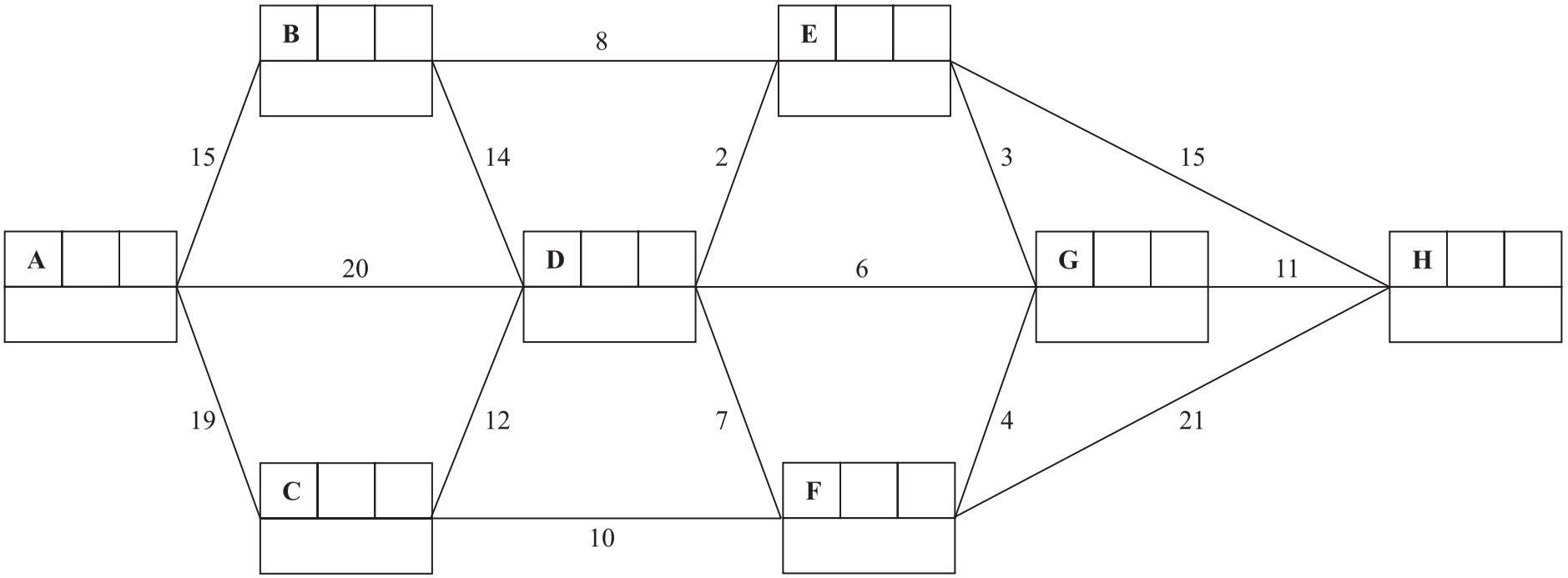


Diagram 2

(Total 9 marks)

Q2

3. (a)



Key:

Vertex	Order of labelling	Final value
Working values		

Quickest route: _____

Time taken: _____

Leave blank

Leave blank

(Question 3 continued)

(b)

Q3

(Total 10 marks)

Leave blank

4. 0.6, 4.0, 2.5, 3.2, 0.5, 2.6, 0.4, 0.3, 4.0, 1.0

Leave blank

(Question 4 continued)

Q4

(Total 11 marks)

Leave blank

5. (a) *You may not need to use all the lines in this table*

S	T	R	R>0?	Output

(b)

(c)

Q5

(Total 7 marks)

Leave blank

6.

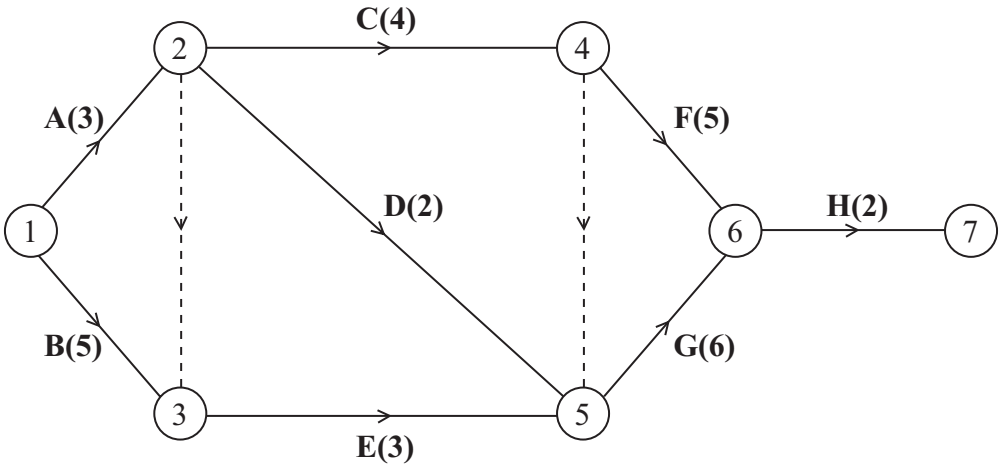


Figure 5

(a)

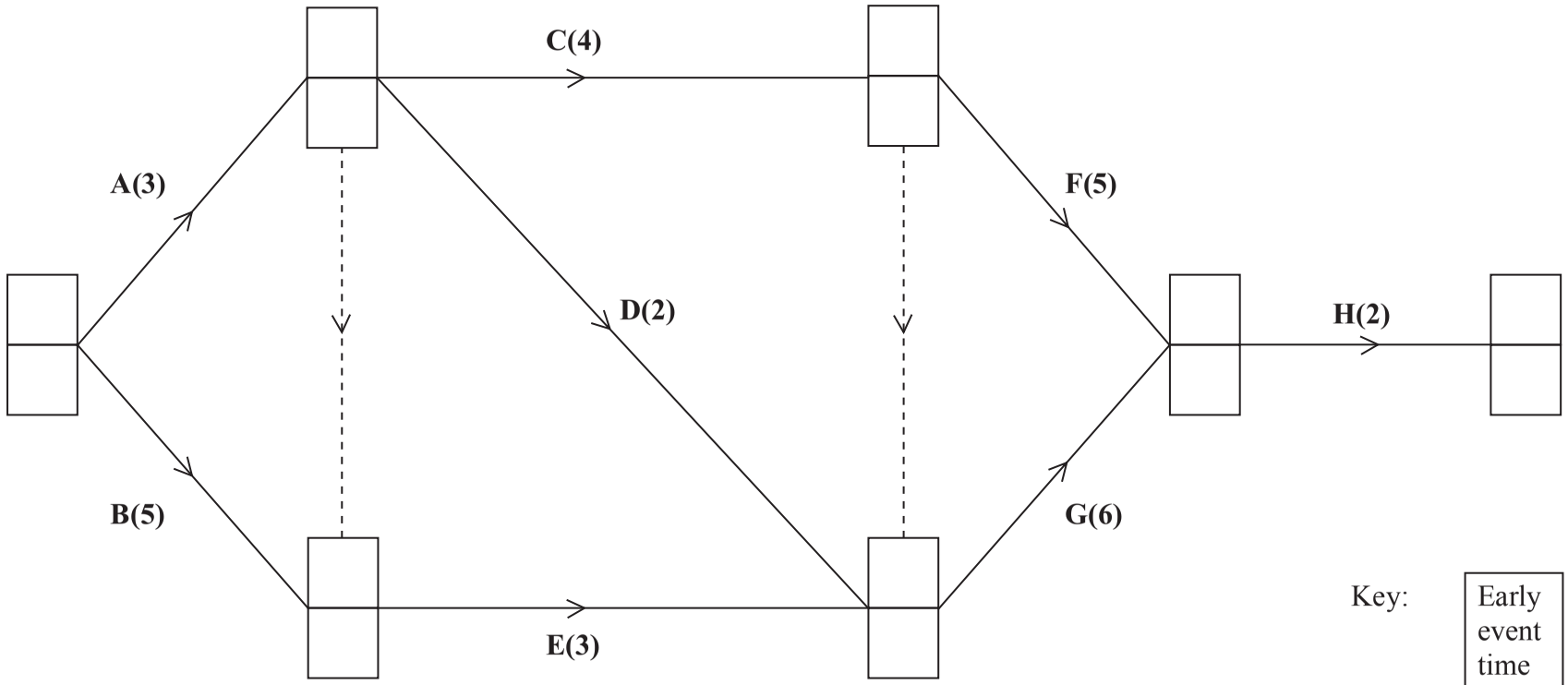
(b)

Event	Immediately preceding activity
A	-
B	-
C	
D	
E	
F	
G	
H	

Question 6 continues on the next page

(Question 6 continued)

(c)



(d) Critical activities: _____

Length of critical path: _____

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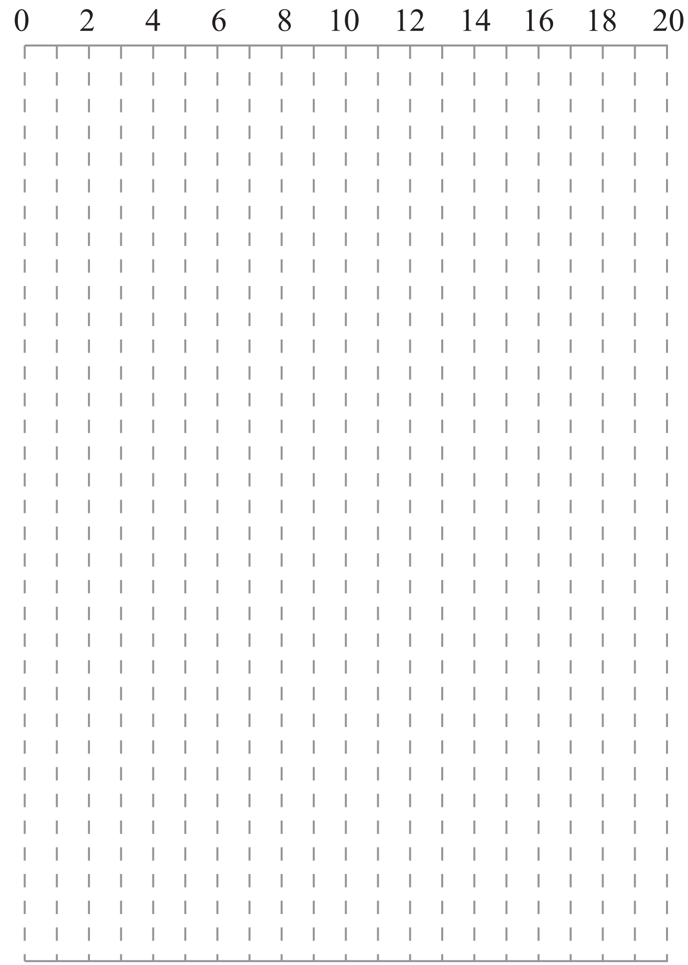
(Question 6 continued)

(e)



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Q6

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7.

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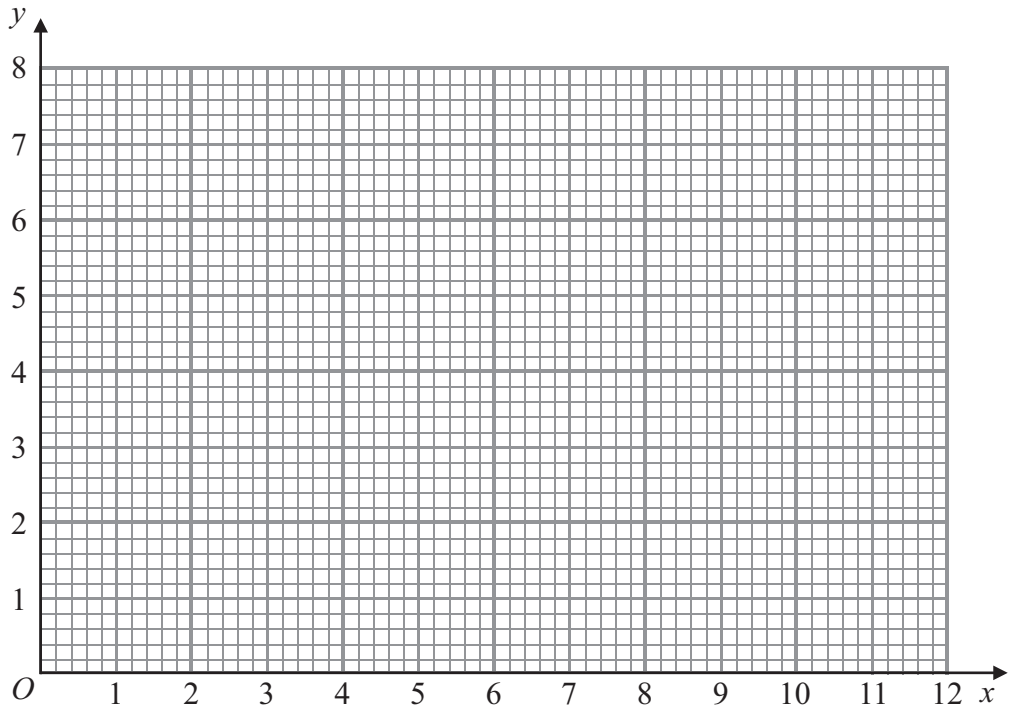
(Question 7 continued)



Q7

(Total 17 marks)

TOTAL FOR PAPER: 75 MARKS

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