Paper Reference(s)

6689

Edexcel GCE

Decision Mathematics D1

Advanced Subsidiary

Specimen Paper

Time: 1 hour 30 minutes

Materials required for examination
Nil

Items included with question papers
D1 Answer booklet

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration. Thus candidates must NOT use calculators such as the Texas Instruments TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.

Instructions to Candidates

In the boxes on the answer book, write your centre number, candidate number, your surname, initials and signature.

Information for Candidates

Full marks may be obtained for answers to ALL questions.
This paper has seven questions.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

1. *This question should be answered on the sheet provided.*

Five packs of sandwiches have been prepared for lunch, one each of egg, cheese, ham, tuna and salmon. Five people have been invited for lunch and the sandwiches which they like are given in the table.

Mr Large	Egg, Cheese
Mrs Moore	Egg, Tuna, Salmon
Ms Nice	Cheese, Ham
Mr Oliver	Cheese, Tuna, Salmon
Miss Patel	Ham, Tuna, Salmon

(*a*) Draw a bipartite graph to model this situation using the nodes printed in the diagram on the answer sheet.

(1)

The host allocates the egg sandwich to Mr Large, the cheese to Ms Nice, the tuna to Mr Oliver and the salmon to Miss Patel.

(*b*) Indicate this initial matching in a distinctive way on the bipartite graph drawn in the diagram on the answer sheet.

(1)

(*c*) Starting from this matching use the maximum matching algorithm to find a complete matching. Indicate clearly how the algorithm has been applied.

(4)

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2. **Figure 1**

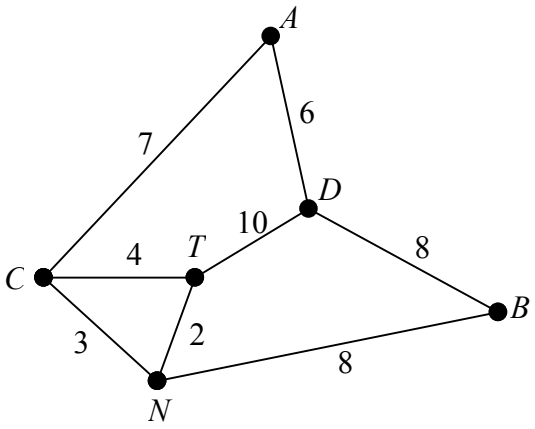

Fig. 1 shows the roads linking villages in an area covered by a district council. The numbers on the edges give the distances, in km, between the villages. After a storm a highways inspector wishes to travel along each road at least once.

(*a*) Use an appropriate algorithm to find the minimum distance she must travel, starting and finishing at *A*.

(5)

(*b*) Write down a possible route which is of minimum length.

(2)

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3. Use the binary search algorithm to locate the name GREGORY in the following list.

1. ARCHER
2. BOWEN
3. COUTTS
4. DENYER
5. EATWELL
6. FULLER
7. GRANT
8. GREGORY
9. LEECH
10. PENNY
11. THOMPSON

(7)

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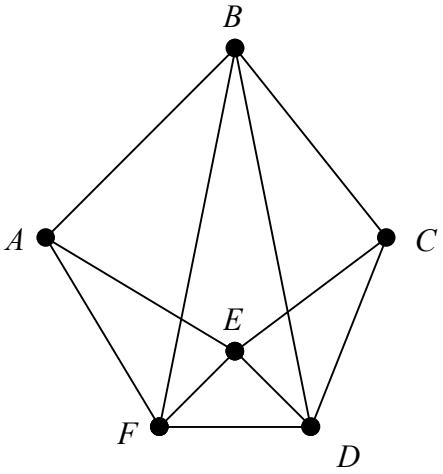
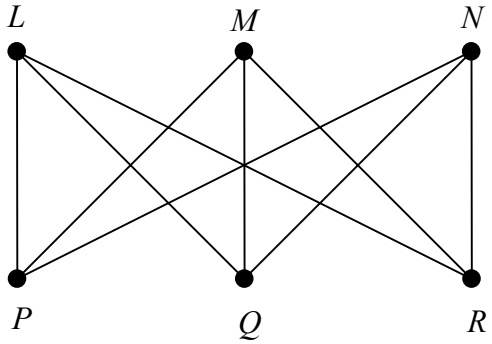
4. **Figure 2** **Figure 3**





Use the planarity algorithm for graphs to determine which, if either, of the graphs shown in Fig. 2 and Fig. 3 is planar. Make your use of the algorithm clear.

(9)

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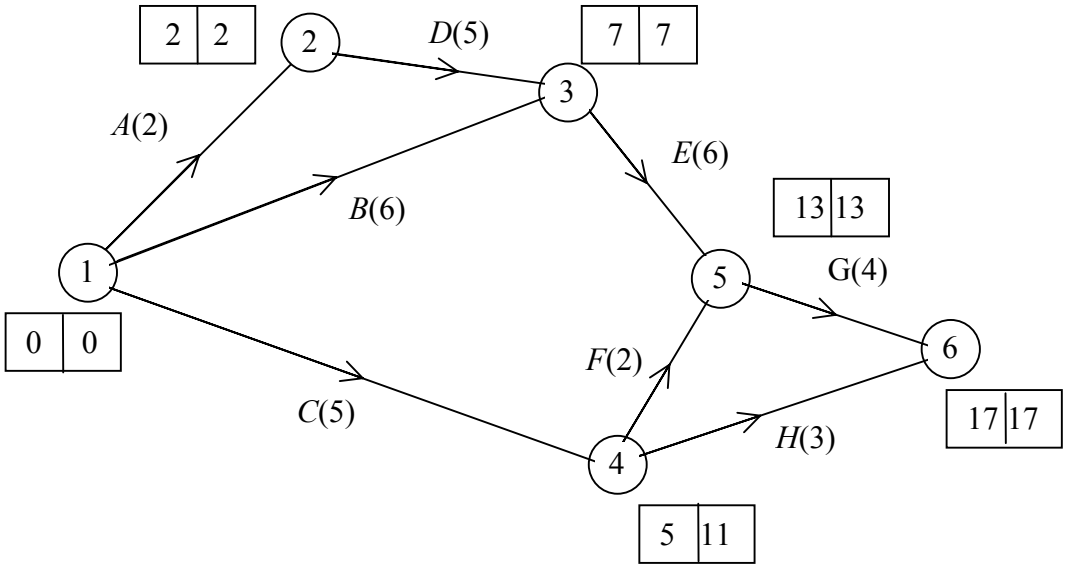
5. *This question should be answered on the sheet provided.*

Figure 4



A project is modelled by the activity network in Fig. 4. The activities are represented by the arcs. The number in brackets on each arc gives the time, in hours, taken to complete the activity. The left box entry at each vertex is the earliest event time and the right box entry is the latest event time.

(*a*) Determine the critical activities and the length of the critical path.

(2)

(*b*) Obtain the total floats for the non-critical activities.

(3)

(*c*) On the grid on the answer sheet, draw a cascade (Gantt) chart showing the information found in parts (*a*) and (*b*).

(4)

Given that each activity requires one worker,

(*d*) draw up a schedule to determine the minimum number of workers required to complete the project in the critical time. State the minimum number of workers.

(3)

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6. *This question should be answered on the sheet provided.*

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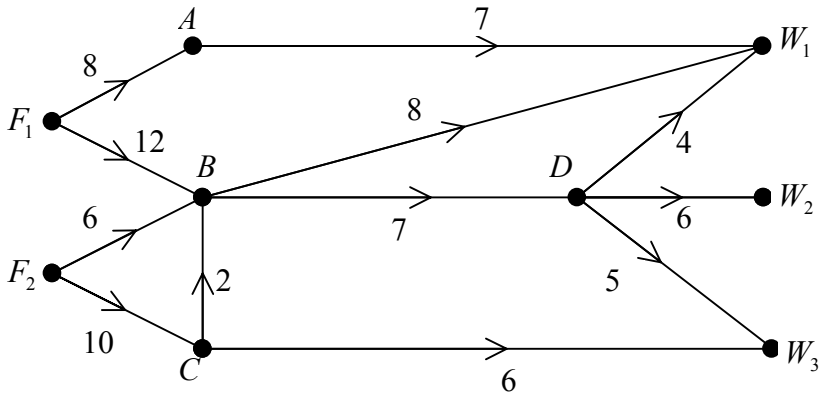
A manufacturing company has two factories F_1 and F_2 and wishes to transport its products to three warehouses W_1, W_2 and W_3. The capacities of the possible routes, in lorry loads per day, are shown in Fig. 5.

Figure 5



(*a*) On the diagram on the answer sheet add a supersource F and a supersink W to obtain a single-source, single-sink capacitated network. State the capacities of the arcs you have added.

(3)

(*b*) Use the labelling procedure to obtain a maximal flow through the network.

(8)

(*c*) Interpret your final flow pattern giving

(i) the number of lorry loads leaving F_1 and F_2,

(ii) the number of lorry loads reaching W_1, W_2 and W_3,

(iii) the number of lorry loads passing through B each day.

(5)

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7. The Bonzo Manufacturing Company makes model cars and lorries. Each car sells at a profit of £2.50 and each lorry sells at a profit of £3.00. Three departments: Manufacturing (Dept *A*); Assembly (Dept *B*); Finishing (Dept *C*) are involved in the production of the models. The times, in hours, that the cars and lorries are in each department are shown in the table.

	Car	Lorry
Dept *A*	1.50	3.00
Dept *B*	2.00	1.00
Dept *C*	0.25	0.25

In a given week, 45 hours are available in Department *A*, 35 hours in Department *B* and 5 hours in Department *C*. The manufacturer wishes to maximise his profit £*P* in this week.

Let x be the number of cars made, and y be the number of lorries made.

You may assume that all models made can be sold.

(*a*) Model this situation as a linear programming problem, giving each inequality in its simplest form with integer coefficients.

(5)

(*b*) Display the inequalities on a graph and identify the feasible region.

(4)

(*c*) By testing each vertex in the feasible region, obtain the maximum profit and the corresponding values of x and y.

(7)

(*d*) State which department has unused time and calculate this time.

(2)

END

Sheet for use in answering question 1

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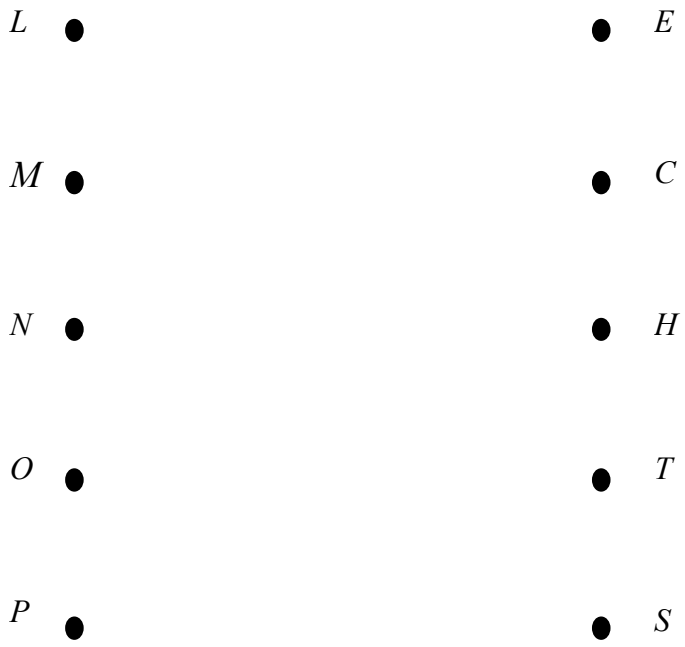
Please hand this sheet in for marking		

(*a*) & (*b*)



(*c*) ……

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Sheet for use in answering question 5

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Centre No.	Candidate No.	Surname & Initials (Block Letters)
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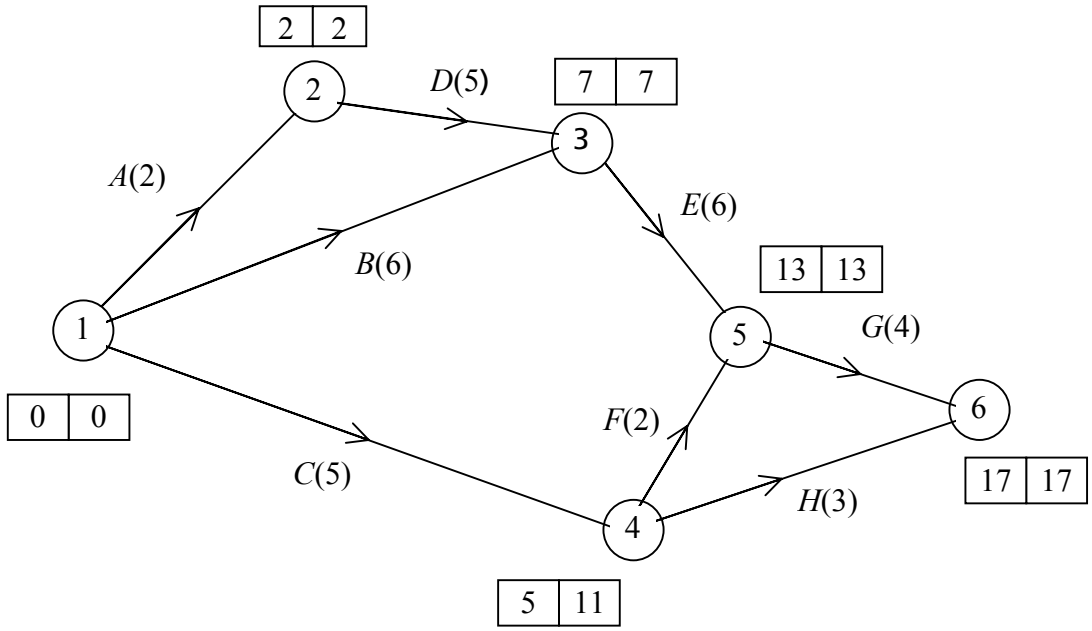


(*a*) Critical activities ……..

Length of critical path ……..

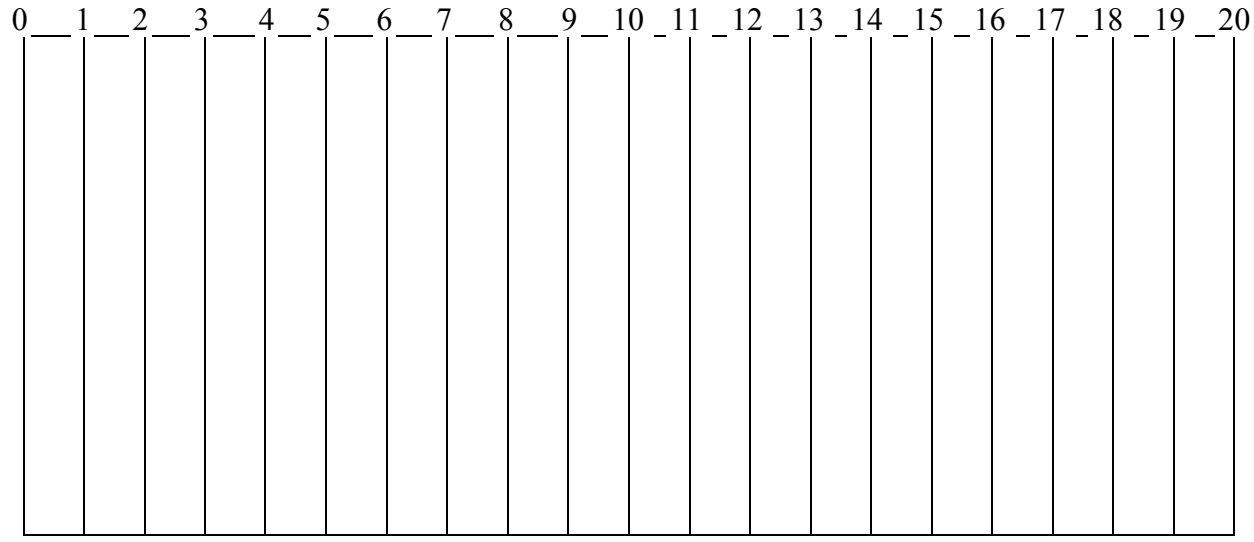
(*b*) Floats ……

…….

…….

…….

(*c*)



Sheet for use in answering question 5

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Centre No.	Candidate No.	Surname & Initials (Block Letters)
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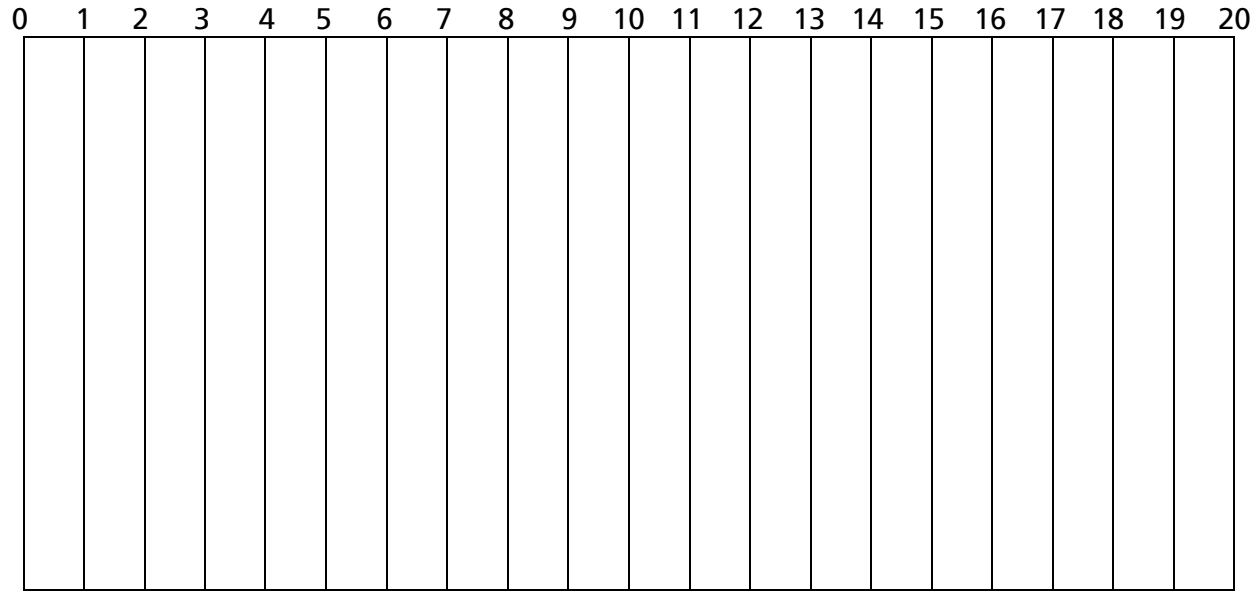
(*d*)



Minimum number of workers …….

Sheet for use in answering question 6

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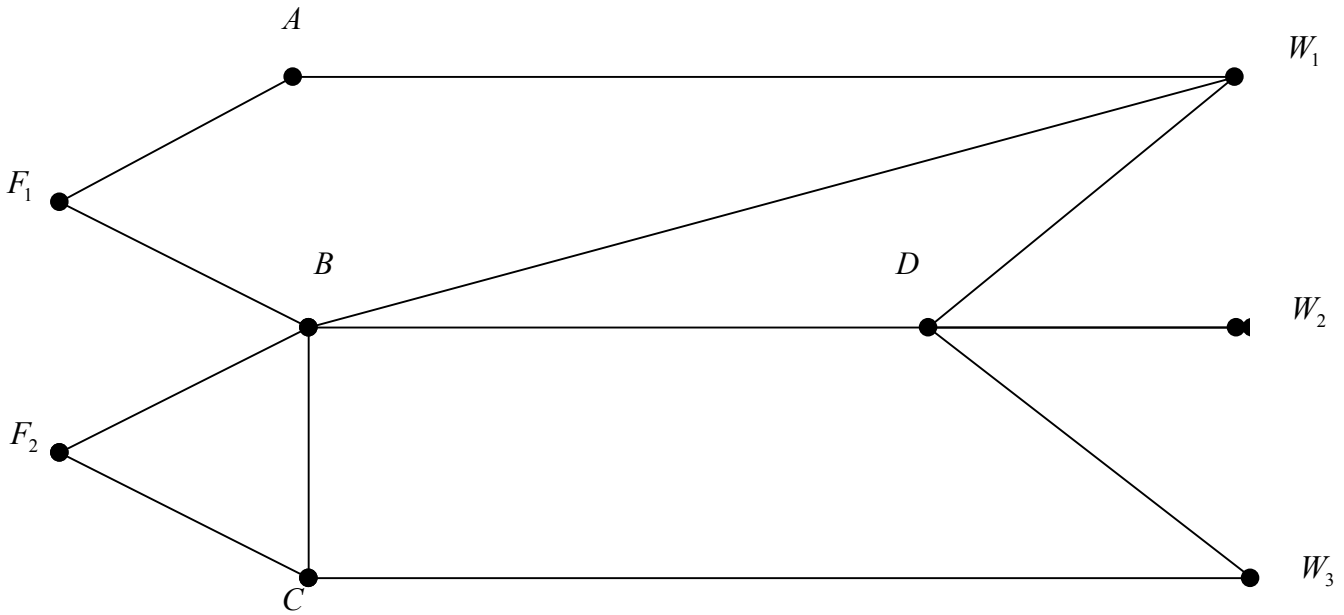
Please hand this sheet in for marking		

(*a*), (*b*)



Capacity of arcs added

(*c*)(i)……..

(ii) ……

(iii) ……