Paper Reference(s)

6689/01

Edexcel GCE

Decision Mathematics D1

Advanced/Advanced Subsidiary

Wednesday 24 May 2006 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination	Items included with question papers
Nil	D1 Answer book

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

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.

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 question paper is 75.

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.

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

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1. 52 48 50 45 64 47 53

The list of numbers above is to be sorted into **descending** order. Perform a bubble sort to obtain the sorted list, giving the state of the list after each completed pass.

(4)

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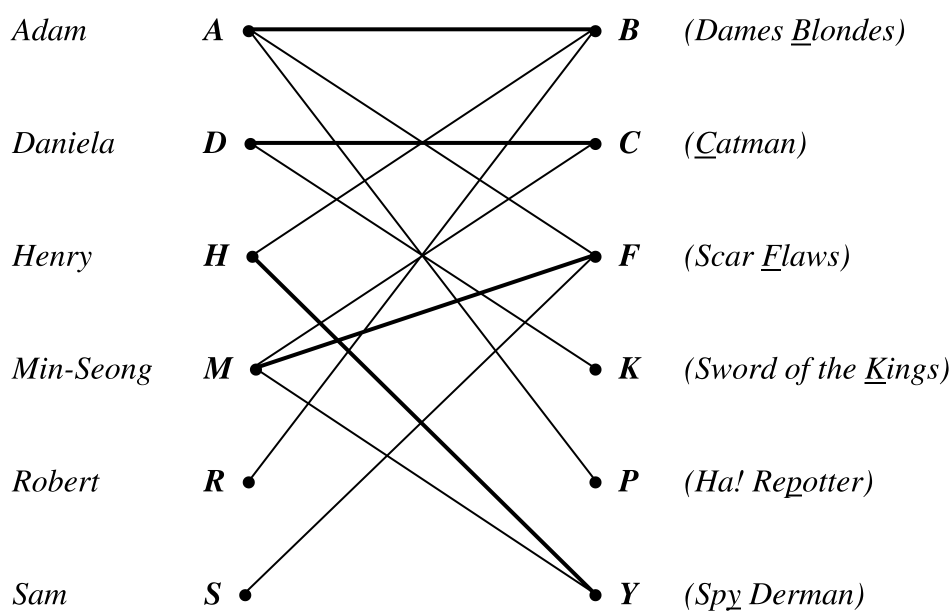
2. (*a*) Define the term 'alternating path'.

(2)

Figure 1



The bipartite graph in Figure 1 shows the films that six customers wish to hire this Saturday evening. The shop has only one copy of each film. The bold lines indicate an initial matching.

(*b*) Starting from this initial matching use the maximum matching algorithm twice to obtain a complete matching. You should clearly state the alternating paths you use.

(5)

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3. **Figure 2**

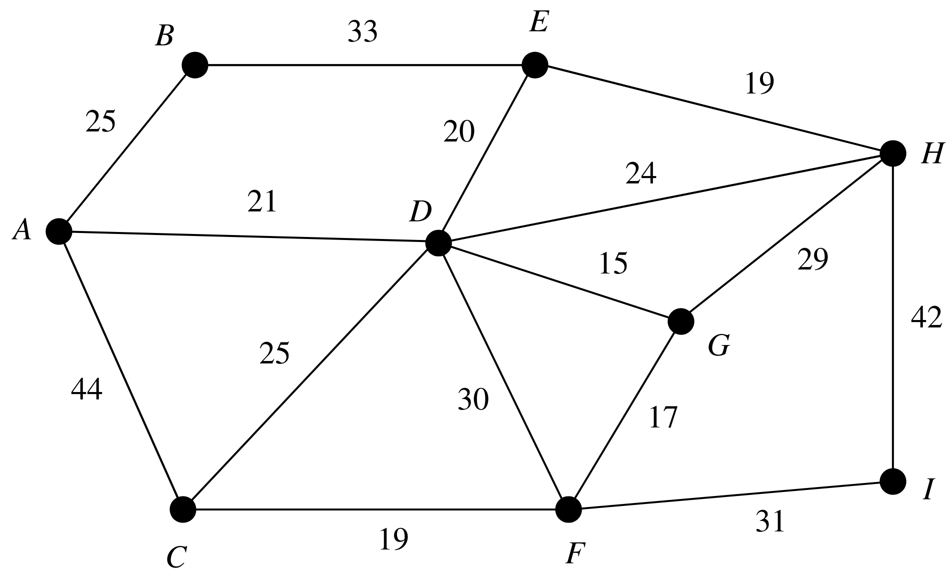


Figure 2 shows the network of pipes represented by arcs. The length of each pipe, in kilometres, is shown by the number on each arc. The network is to be inspected for leakages, using the shortest route and starting and finishing at A.

(a) Use the route inspection algorithm to fins which arcs, if any, need to be traversed twice.

(4)

(b) State the length of the minimum route. [The total **weight** of the network is 394 km.]

(1)

It is now permitted to start and finish the inspection at two distinct vertices.

(c) State, with a reason, which two vertices should be chosen to minimise the length of the **new** route.

(2)

4. (*a*) Explain what is meant by the term ‘path’.

Figure 3

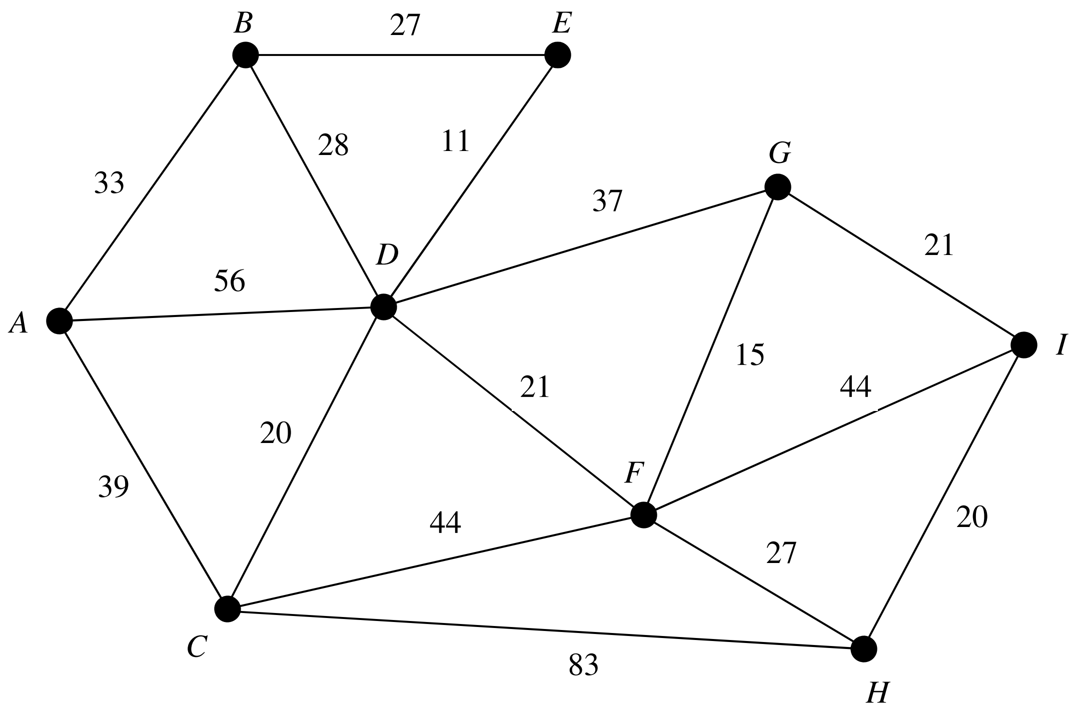


Figure 3 shows a network of cycle tracks. The number on each edge represents the length, in miles, of that track. Mary wishes to cycle from A to I as part of a cycling holiday. She wishes to minimise the distance she travels.

(*b*) Use Dijkstra’s algorithm to find the shortest path from A to I. Show all necessary working in the boxes in Diagram 1 in the answer book. State your shortest path and its length.

(6)

(*c*) Explain how you determined the shortest path from your labelling.

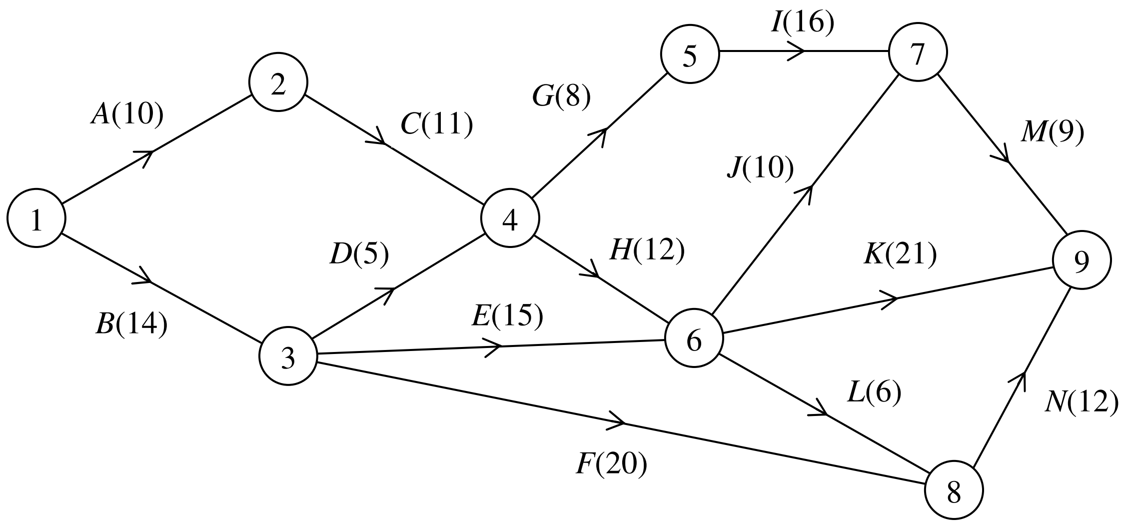
(2)

Mary wants to visit a theme park at E.

(*d*) Find a path of minimal length that goes from A to I via E and state its length.

(2)

5. **Figure 4**



An engineering project is modelled by the activity network shown in Figure 4. The activities are represented by the arcs. The number in brackets on each arc gives the time, in days, to complete the activity. Each activity requires one worker. The project is to be completed in the shortest time.

(*a*) Calculate the early time and late time for each event. Write these in boxes in Diagram 1 in the answer book.

(4)

(*b*) State the critical activities.

(1)

(*c*) Find the total float on activities *D* and *F*. You must show your working.

(3)

(*d*) On the grid in the answer book, draw a cascade (Gantt) chart for this project.

(4)

The chief engineer visits the project on day 15 and day 25 to check the progress of the work. Given that the project is on schedule,

(*e*) which activities **must** be happening on each of these two days?

(3)

6. The tableau below is the initial tableau for a maximising linear programming problem.

Basic variable	x	y	z	r	s	t	Value
r	7	10	10	1	0	0	3600
s	6	9	12	0	1	0	3000
t	2	3	4	0	0	1	2400
P	–35	–55	–60	0	0	0	0

(*a*) Write down the four equations represented in the initial tableau above.

(4)

(*b*) Taking the most negative number in the profit row to indicate the pivot column at each stage, solve this linear programming problem. State the row operations that you use.

(9)

(*c*) State the values of the objective function and each variable.

(3)

7. **Figure 5**

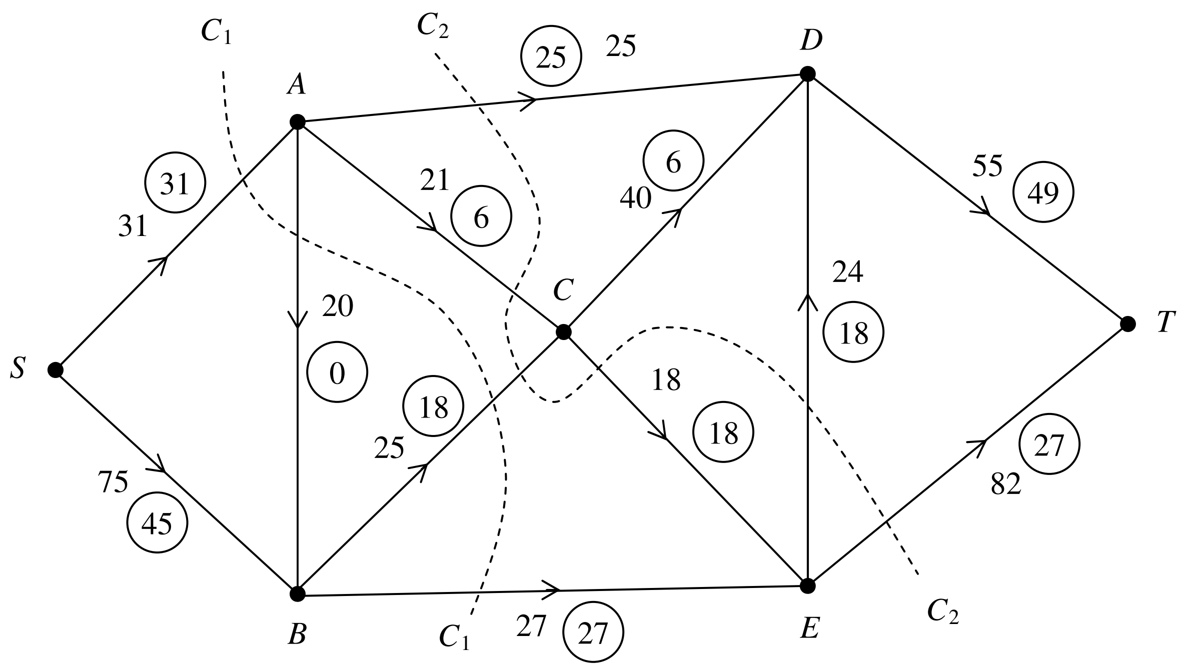


Figure 5 shows a capacitated, directed network. The capacity of each arc is shown on each arc. The numbers in circles represent an initial flow from S to T.

Two cuts C_1 and C_2 are shown on Figure 5.

(*a*) Write down the capacity of each of the two cuts and the value of the initial flow.

(3)

(*b*) Complete the initialisation of the labelling procedure on Diagram 1 by entering values along arcs AC, CD, DE and DT.

(2)

(*c*) Hence use the labelling procedure to find a maximal flow through the network. You must list each flow-augmenting path you use, together with its flow.

(5)

(*d*) Show your maximal flow pattern on Diagram 2.

(2)

(*e*) Prove that your flow is maximal.

(2)

TOTAL FOR PAPER: 75 MARKS

END