Dynamic Programming

Question Paper

Course	Edexcel Further Maths
Section	Further Statistics
Topic	Dynamic Programming
Difficulty	Medium

To be used by all students studying Edexcel Further Mathematics (9FM0)

Students of other boards may also find this useful

Q1.

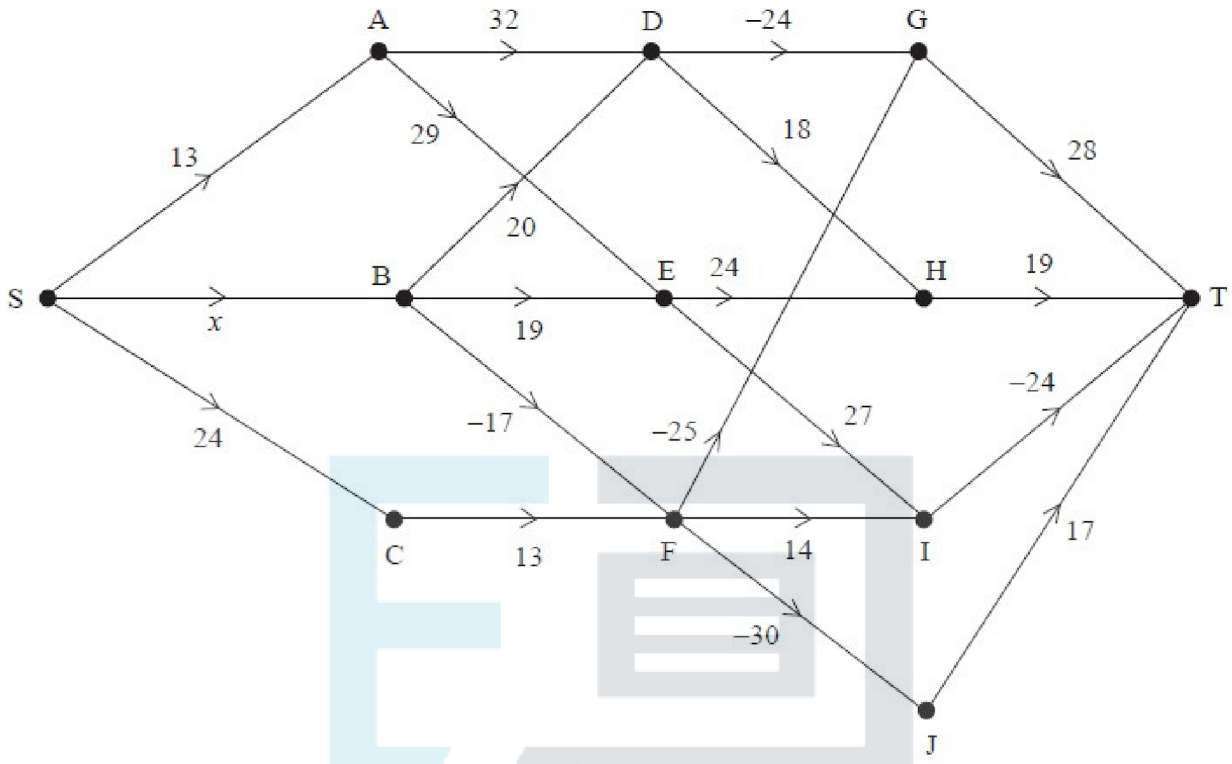

Figure 1

In Figure 1 the weight of arc SB is denoted by ***x*** where ***x*** ≥ 0

(a) Explain why Dijkstra's algorithm cannot be used on the directed network in Figure 1.

(1)

It is given that the minimum weight route from S to T passes through B.

(b) Use dynamic programming to find

(i) the range of possible values of ***x***

(ii) the minimum weight route from S to T.

(12)

(Total for question = 13 marks)

Q2.

A manufacturer can export five batches of footwear each year. Each exported batch contains just one type of footwear. The types of footwear are trainers, sandals or high heels.

The table below shows the profit, in £1000s, for the number of batches of each type of footwear.

Number of batches	0	1	2	3	4	5
Trainers	0	50	90	170	225	295
Sandals	0	70	110	165	245	300
High heels	0	75	115	x	235	305

The total annual profit is to be maximised.

(a) Use dynamic programming to determine the two possible values of the maximum total annual profit, giving one of these values in terms of x.

(10)

Given that the maximum total annual profit is £320 000

(b) advise the manufacturer on the possible ways in which the five batches should be allocated.

(2)

(Total for question = 12 marks)

Q3.

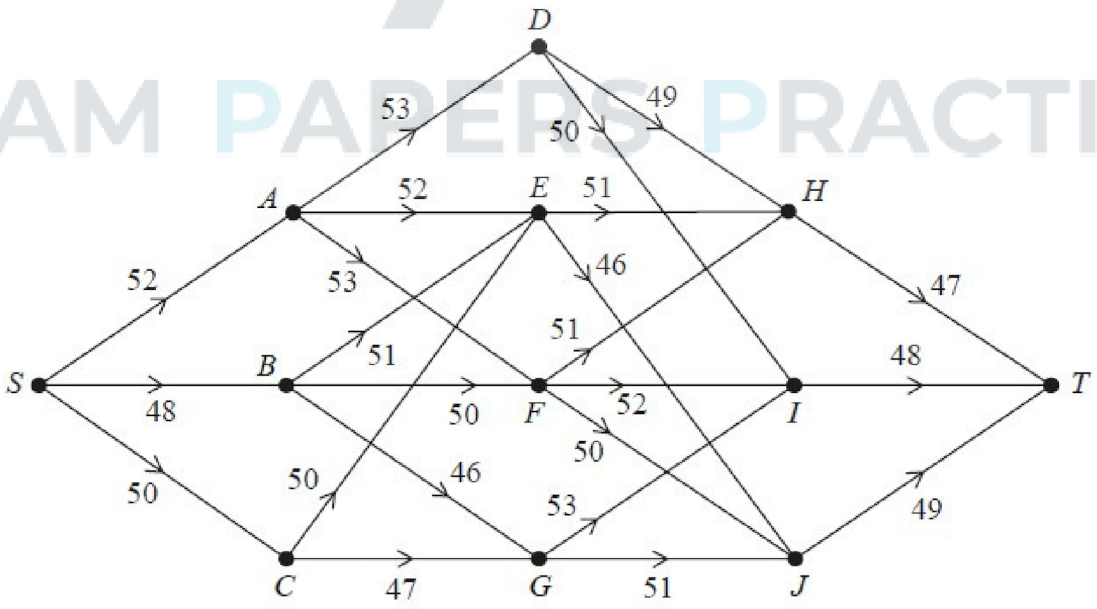

Figure 3

The staged, directed network in Figure 3 represents a series of roads connecting 12 towns, S, A, B, C, D, E, F, G, H, I, J and T. The number on each arc shows the distance between these towns, in miles.

Bradley is planning a four-day cycle ride from S to T.

He plans to leave his home at *S*. On the first night he will stay at *A*, *B* or *C*, on the second night he will stay at *D*, E, *F* or *G*, on the third night he will stay at *H*, I or *J*, and he will arrive at his friend's house at *T* on the fourth day.

Bradley decides that the maximum distance he will cycle on any one day should be as small as possible.

(a) Write down the type of dynamic programming problem that Bradley needs to solve.

(1)

(b) Use dynamic programming to complete the table in the answer book.

(9)

(c) Hence write down the possible routes that Bradley could take.

(2)

(Total for question = 12 marks)

Q4.

Bernie makes garden sheds. He can build up to four sheds each month.

If he builds more than two sheds in any one month, he must hire an additional worker at a cost of £250 for that month.

In any month in which sheds are made, the overhead costs are £35 for each shed made that month.

A maximum of three sheds can be held in storage at the end of any one month, at a cost of £80 per shed per month.

Sheds must be delivered at the end of the month.

The order schedule for sheds is

Month	January	February	March	April	May
Number ordered	1	3	3	5	2

There are no sheds in storage at the beginning of January and Bernie plans to have no sheds left in storage after the May delivery.

Use dynamic programming to determine the production schedule that minimises the costs given above. Complete the working in the table provided in the answer book and state the minimum

cost.

(14)

(Total for question = 14 marks)

Q5.

A company assembles boats.

They can assemble up to five boats in any one month, but if they assemble more than three they will have to hire additional space at a cost of £800 per month.

The company can store up to two boats at a cost of £350 each per month.

The overhead costs are £1500 in any month in which work is done.

Boats are delivered at the end of each month. There are no boats in stock at the beginning of January and there must be none in stock at the end of May.

The order book for boats is

Month	January	February	March	April	May
Number ordered	3	2	6	3	4

Use dynamic programming to determine the production schedule which minimises the costs to the company. Show your working in the table provided in the answer book and state the minimum production cost.

(12)

(Total for question = 12 marks)