**D1 JUNE 08 (ADAPTED)**

**1.** 29 52 73 87 74 47 38 61 41

The numbers in the list represent the lengths in minutes of nine radio programmes. They are to be recorded onto tapes which each store up to 100 minutes of programmes.

(*a*) Obtain a lower bound for the number of tapes needed to store the nine programmes.

**(2)**

(*b*) Use the first-fit bin packing algorithm to fit the programmes onto the tapes.

**(3)**

(*c*) Use the first-fit decreasing bin packing algorithm to fit the programmes onto the tapes.

**(3)**

**2.**

 ****

Five tour guides, Alice, Emily, George, Rose and Weidi, need to be assigned to five coach trips, 1, 2, 3, 4 and 5. A bipartite graph showing their preferences is given in Figure 1 and an initial matching is given in Figure 2.

(*a*) Use the maximum matching algorithm, starting with vertex G, to increase the number of matchings. State the alternating path you used.

**(2)**

(*b*) List the improved matching you found in (*a*).

**(1)**

(*c*) Explain why a complete matching is not possible.

**(2)**

Weidi agrees to be assigned to coach trip 3, 4 or 5.

 (*d*) **Starting with your current maximal matching**, use the maximum matching algorithm to obtain a complete matching.

**(3)**

**3.**

 ****

**Figure 3**

Figure 3 shows a network of roads. The number on each arc represents the length, in km, of that road.

(*a*) Use Dijkstra’s algorithm to find the shortest route from A to I. State your shortest route and its length.

**(5)**

Sam has been asked to inspect the network and assess the condition of the roads. He must travel along each road at least once, starting and finishing at A.

(*b*) Use an appropriate algorithm to determine the length of the shortest route Sam can travel. State a shortest route.

**(4)**

**(The total weight of the network is 197 km.)**

**4.** (*a*) State two differences between Kruskal’s algorithm and Prim’s algorithm for finding a minimum spanning tree.

**(2)**

(*b*) Listing the arcs in the order that you consider them, find a minimum spanning tree for the network in Figure 4, using

 (i) Prim’s algorithm,

 (ii) Kruskal’s algorithm.

**(6)**

**7.**

****

**Figure 6**

The network in Figure 6 shows the activities that need to be undertaken to complete a building project. Each activity is represented by an arc. The number in brackets is the duration of the activity in days. The early and late event times are shown at each vertex.

(*a*) Find the values of *v*, *w*, *x*, *y* and *z*.

**(3)**

(*b*) List the critical activities.

**(1)**

(*c*) Calculate the total float on each of activities H and J.

**(2)**

(*d*) Draw a cascade (Gantt) chart for the project.

**(4)**

The engineer in charge of the project visits the site at midday on day 8 and sees that activity E has not yet been started.

(*e*) Determine if the project can still be completed on time. You must explain your answer.

**(2)**

Given that each activity requires one worker and that the project must be completed in 35 days,

(*f*) use your cascade chart to determine a lower bound for the number of workers needed. You must justify your answer.

**(2)**

**8.** Class 8B has decided to sell apples and bananas at morning break this week to raise money for charity. The profit on each apple is 20p, the profit on each banana is 15p. They have done some market research and formed the following constraints.

**•** They will sell at most 800 items of fruit during the week.

**•** They will sell at least twice as many apples as bananas.

**•** They will sell between 50 and 100 bananas.

Assuming they will sell all their fruit, formulate the above information as a linear programming problem, letting *a* represent the number of apples they sell and *b* represent the number of bananas they sell.

Write your constraints as inequalities.

**(7)**

**TOTAL FOR PAPER: 75 MARKS**

**END**