Networks, scheduling and assignment - Test 3

Name: _____ Date: _____

10 questions | 58 marks | 75 minutes

Analyse multiple critical paths, constrained resources and assignments with unavailable or unfilled tasks.

A scientific calculator may be used.

1. Use the science-display project. [7 marks]

Preparing a science display; all durations are in days.

Activity	Duration	Immediate predecessors
A	2	None
B	4	None
C	5	A
D	3	B
E	2	C and D

(a) Find the earliest start and finish of every activity. [4 marks]

(b) State all critical paths and the minimum completion. [3 marks]

2. Use the science-display project. [6 marks]

Preparing a science display; all durations are in days.

Activity	Duration	Immediate predecessors
A	2	None
B	4	None
C	5	A
D	3	B
E	2	C and D

(a) Find the latest starts of A, B, C, D, E for a day-9 completion. [4 marks]

(b) Explain why all activities have zero float even though not all lie on one single route. [2 marks]

3. Each change to the science-display project is considered separately. [7 marks]

Preparing a science display; all durations are in days.

Activity	Duration	Immediate predecessors
A	2	None
B	4	None
C	5	A
D	3	B
E	2	C and D

(a) Reduce C by 2 days. Find the finish. [2 marks]

(b) Reduce C by 2 days and D by 1 day. Find the finish. [3 marks]

(c) Instead reduce only E by 1 day. Find the finish. [2 marks]

4. Only A and B in the science-display project share one crew. C, D, E have separate available crews. [6 marks]

Preparing a science display; all durations are in days.

Activity	Duration	Immediate predecessors
A	2	None
B	4	None
C	5	A
D	3	B
E	2	C and D

(a) If A is done before B, find the earliest completion. [3 marks]

(b) If B is done before A, find the earliest completion. Recommend the better order. [3 marks]

5. Ali cannot perform job 2 in the cost table. [5 marks]

Costs ($); an unavailable pairing cannot be used.

Worker	1	2	3
Ali	9	Unavailable	7
Bea	6	4	3
Chen	5	8	1

(a) Find a minimum feasible assignment and total. [3 marks]

(b) A software model replaces the unavailable entry by 1000. Justify this substitution for these nonnegative costs. [2 marks]

6. Minimise the displayed cost table. [5 marks]

Assignment costs ($).

Worker	1	2	3
A	4	4	9
B	4	4	9
C	9	9	1

(a) Give two different optimal assignments and their costs. [3 marks]

(b) Prove that no assignment can cost less. [2 marks]

7. The table gives net profits in \$100 units, including losses. [6 marks]

Net profit (\$100 units); negative entries are losses.

Team	1	2	3
A	5	-2	3
B	4	6	-1
C	-3	2	7

(a) Transform it to a minimisation problem using $K = 7$. [3 marks]

(b) Find the best allocation and total profit. [3 marks]

8. Three workers cover two jobs; free idling is allowed. [6 marks]

Costs ($); an idle worker costs $0.

Worker	1	2
A	6	4
B	5	3
C	2	8

(a) Add the required dummy structure and find the optimum. [3 marks]

(b) The cost of leaving A idle is revised to $4; B and C may still idle for free. Find the new optimum. [3 marks]

9. Using the unfilled-job penalty table, a manager reports a $7 assignment by A→2 and B→3. [5 marks]

Costs ($), including a permitted unfilled-job penalty row.

Resource	1	2	3
A	6	4	8
B	5	7	3
Unfilled	10	2	7

(a) Identify the missing term and correct this allocation's cost. [2 marks]

(b) Find the better allocation and state precisely what remains undone. [3 marks]

10. A council's model predicts a $14 assignment and a 9-day project. It uses last year's costs and assumes activities can overlap freely. [5 marks]

(a) State two checks needed before adopting the recommendation. [2 marks]

(b) Explain how to test sensitivity to a likely delay without claiming the old critical path must remain critical. [3 marks]