Networks, scheduling and assignment - Test 1

10 questions | 58 marks | 65 minutes

A balanced first paper covering project scans, critical paths, assignment reductions and sensible recommendations.

Equivalent correct methods earn the corresponding marks.

1. Use the display-project precedence table. [6 marks]

A school display project. Times are in days.

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

(a) Name the activities that can begin immediately. [2 marks]

Both have no predecessors.

Answer: A and B.

(b) State the immediate predecessors of F, then give one indirect predecessor. [2 marks]

F waits for C and E.

Earlier tasks reach F through those tasks.

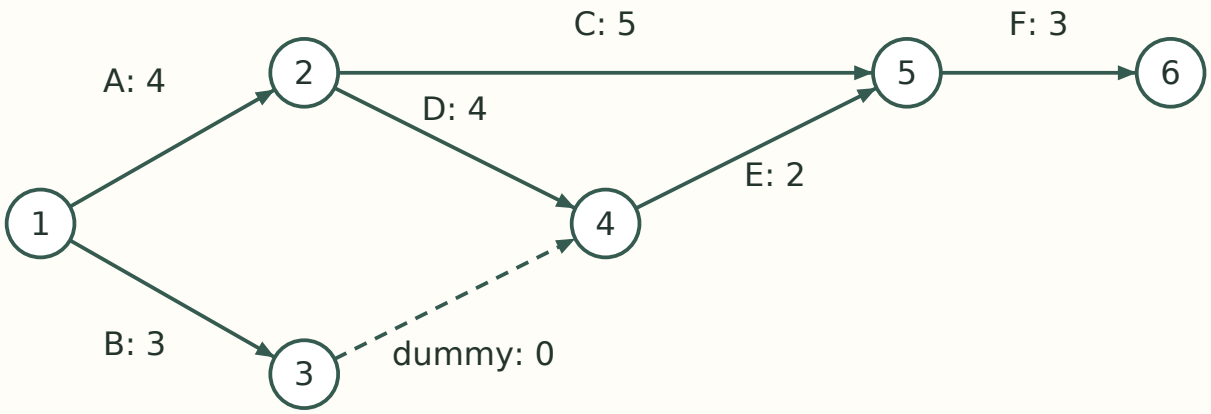
Answer: C and E are immediate; A, B or D is indirect.

(c) Explain why a single chain A-B-C-D-E-F would not represent this project. [2 marks]

A and B may start together; C and D are separate branches after A.

Answer: It adds unstated dependencies and prevents permitted parallel work.

2. Use this activity-on-arrow network. Durations are in days. [6 marks]



Activity-on-arrow network; durations are in days.

(a) Complete the forward scan for events 1-6. [4 marks]

E1=0; E2=4; E3=3.

E4=max(8,3)=8; E5=max(9,10)=10; E6=13.

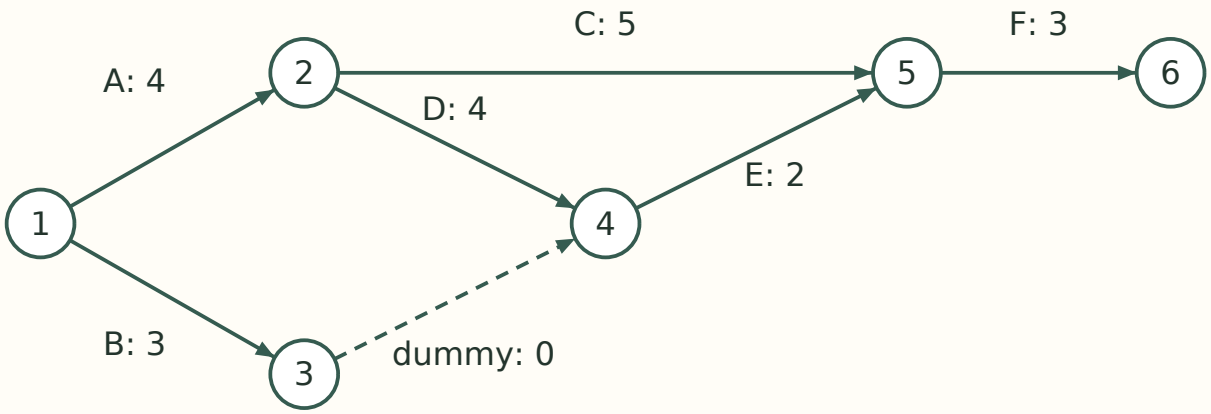
Answer: 0,4,3,8,10,13.

(b) State the earliest completion and explain the max calculation at event 5. [2 marks]

Choosing 9 would allow F to start before E finishes.

Answer: 13 days; event 5 must wait for both C and E, so max(9,10)=10.

3. Use the same displayed network, reproduced here. [6 marks]



Activity-on-arrow network; durations are in days.

(a) Carry out a backward scan for a day-13 finish. [4 marks]

Work backwards:13,10,8,8.

L2=min(10−5,8−4)=4; L1=min(4−4,8−3)=0.

Answer: L1=0, L2=4, L3=8, L4=8, L5=10, L6=13.

(b) Find the latest start and total float of B. [2 marks]

B has duration 3 and latest finish 8.

LS=8−3=5; ES=0.

Answer: LS=5, float=5 days.

4. Consider changes to the display project; each change is made separately. [5 marks]

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

(a) Find its critical path before any change. [2 marks]

4+4+2+3=13; A-C-F=12.

Answer: A-D-E-F, 13 days.

(b) Reduce D from 4 to 1 day. Find the new completion and explain why the saving is not 3 days. [3 marks]

D route becomes 10, but C route remains 12.

Overall saving is only 13−12=1.

Answer: 12 days; the A-C-F route controls.

5. Two independent tasks P and Q take 5 and 8 hours. R takes 2 hours and follows both. [5 marks]

(a) Find total task-hours and the minimum elapsed duration with separate workers. [3 marks]

Sum work=5+8+2=15.

Parallel branch time=max(5,8)=8; add R: 2.

Answer: 15 task-hours;10 elapsed hours.

(b) Find the duration if the same sole worker must do P and Q before R. [2 marks]

P and Q cannot overlap, so 5+8+2=15.

Answer: 15 hours.

6. Use the technician cost table. [6 marks]

Cost ($) of assigning one technician to each job.

Technician	Job 1	Job 2	Job 3
Ali	9	2	7
Bea	6	4	3
Chen	5	8	1

(a) Calculate the total for Ali→3, Bea→2, Chen→1. [2 marks]

7+4+5=16.

Answer: $16.

(b) Find a minimum complete assignment and justify its minimum by comparing all six totals. [4 marks]

The six totals are 14,20,9,10,21,16.

The smallest is 9.

Answer: Ali→2, Bea→1, Chen→3;$9.

7. The time table below is to be minimised. [7 marks]

Times in hours for one person to perform one task.

Person	X	Y	Z
Amy	4	1	3
Ben	2	0	5
Cal	3	2	2

(a) Show row reduction followed by column reduction. [3 marks]

Row minima 1,0,2; column minima 1,0,0 after row reduction.

Answer: After rows:[3,0,2],[2,0,5],[1,0,0]; after columns:[2,0,2],[1,0,5],[0,0,0].

(b) Cover column Y and row Cal, adjust by the smallest uncovered value, then state the optimum. [4 marks]

Smallest uncovered is 1.

Original total 1+2+2=5.

Answer: Adjusted:[1,0,1],[0,0,4],[0,1,0]. Amy→Y, Ben→X, Cal→Z;5 hours.

8. Use the team profit table; table units are $100. [6 marks]

Profit ($100 units) from assigning each team to one distinct contract.

Team	Contract 1	Contract 2	Contract 3
P	18	14	13
Q	15	17	12
R	16	11	19

(a) Form the opportunity-loss matrix with K=19. [3 marks]

Subtract every profit from 19.

Answer: [1,5,6],[4,2,7],[3,8,0].

(b) State a maximum-profit assignment and the profit in dollars. [3 marks]

The feasible row maxima sum 18+17+19=54.

54×100=5,400.

Answer: P→1, Q→2, R→3;$5,400.

9. Four workers cover three jobs; idling is free. [6 marks]

Costs ($) for four workers and three required jobs. A worker may remain idle at no cost.

Worker	Job 1	Job 2	Job 3
A	4	8	7
B	6	3	8
C	5	7	2
D	9	4	6

(a) Describe the dummy entries needed. [2 marks]

One of the four workers must be idle.

Answer: Add one all-zero dummy-job column.

(b) Find the cheapest assignment, identify the idle worker and give a lower-bound justification. [4 marks]

Real-job column minima are 4,3,2 and are feasible together.

Their sum 9 is attained, so it is optimal.

Answer: A→1, B→2, C→3, D idle;$9.

10. The display-project model predicts 13 days. A manager wants a promise of completion in 13 days. [5 marks]

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(a) State two assumptions needed before making that promise. [2 marks]

The network alone does not reserve staff or allow for uncertain supplies.

Answer: For example reliable durations and enough resources for the parallel tasks.

(b) B is revised from 3 to 9 days. Find the new project finish and controlling sequence. [3 marks]

E now starts at max(9,8)=9, ends 11; F ends 14.

Answer: 14 days; B-E-F.