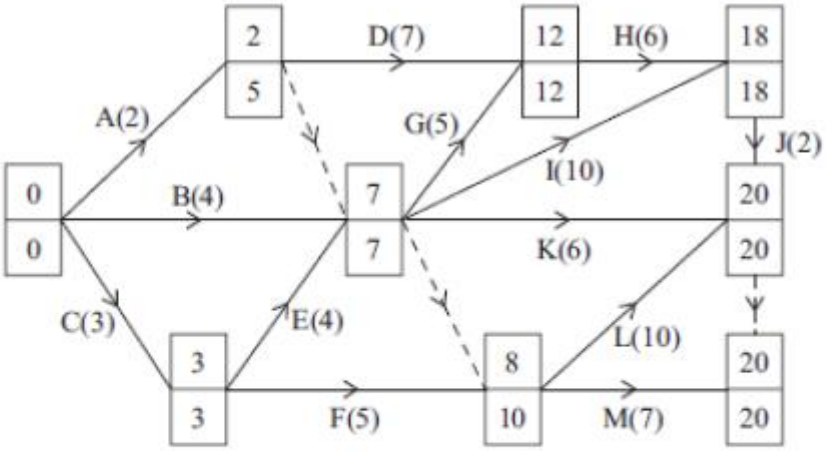
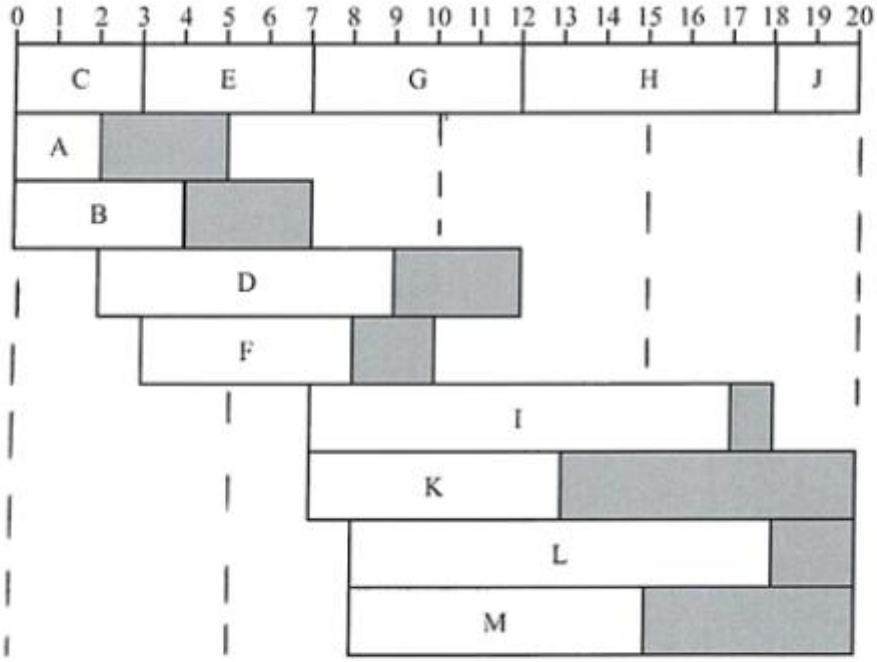
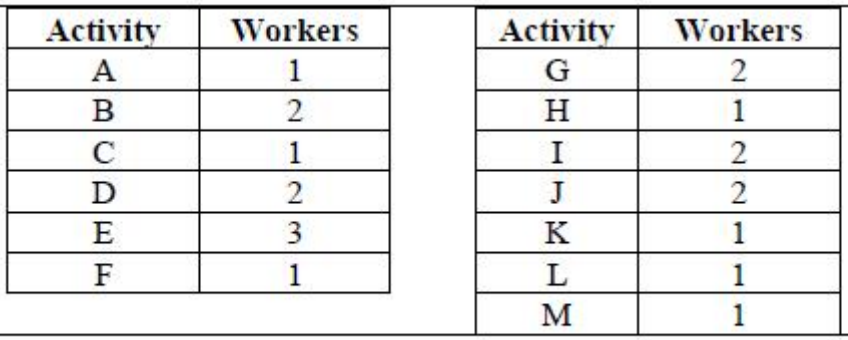
Mark Scheme

Q1.

Qu	Scheme	Marks	AOs
(a)	<table><tr><th>Activity</th><th>IPA</th></tr><tr><td>A</td><td>-</td></tr><tr><td>B</td><td>-</td></tr><tr><td>C</td><td>-</td></tr><tr><td>D</td><td>A</td></tr><tr><td>E</td><td>C</td></tr><tr><td>F</td><td>C</td></tr></table> <table><tr><th>Activity</th><th>IPA</th></tr><tr><td>G</td><td>A, B, E</td></tr><tr><td>H</td><td>D, G</td></tr><tr><td>I</td><td>A, B, E</td></tr><tr><td>J</td><td>H, I</td></tr><tr><td>K</td><td>A, B, E</td></tr><tr><td>L</td><td>A, B, E, F</td></tr><tr><td>M</td><td>A, B, E, F</td></tr></table>	B1 B1	1.1b 1.1b
		(2)	
(b)		M1 A1 M1 A1	1.1b 1.1b 1.1b 1.1b
		(4)	

(c)		**M1** **A1** **A1** **A1**	2.1 1.1b 1.1b 1.1b
		(4)	
(d)		**B3, 2, 1**	3.4 1.1b 1.1b
			(13 marks)

Notes:

a1B1: Five correct rows (not including A, B and C)

a2B1: All rows correct (accept blanks for A, B and C)

b1M1: **All** top boxes complete, values generally increasing in the direction of the arrows ('left to right'), condone one rogue value which is a number in a top box greater than the subsequent value

b1A1: CAO – top boxes

b2M1: **All** bottom boxes complete, values generally decreasing in the opposite direction of the arrows ('right to left'), condone one rogue value which is a number in a bottom box greater than the previous value. Condone missing 0 and/or their 20 (at the end event) for the M mark only

b2A1: CAO – bottom boxes

c1M1: Gantt (cascade) chart with at least 9 activities labelled and at least four activities having non-zero float. A scheduling diagram scores M0

c1A1: Critical activities (C, E, G, H and J) correct (note this may be seen as separate activities listed alphabetically instead of at the top of the chart)

c2A1: At least 4 non-critical activities correct

c3A1: CAO All 13 activities present (just once). No errors.

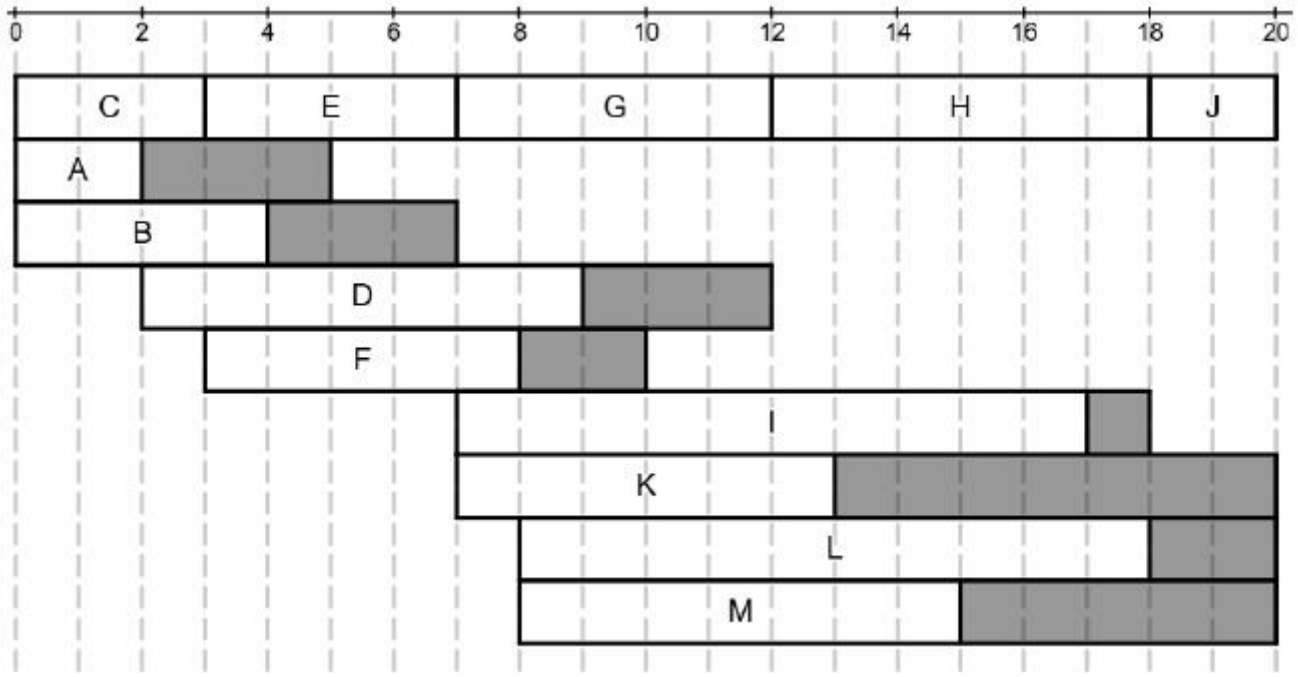
d1B1: At least four correct

d2B1: At least eight correct

d3B1: CAO

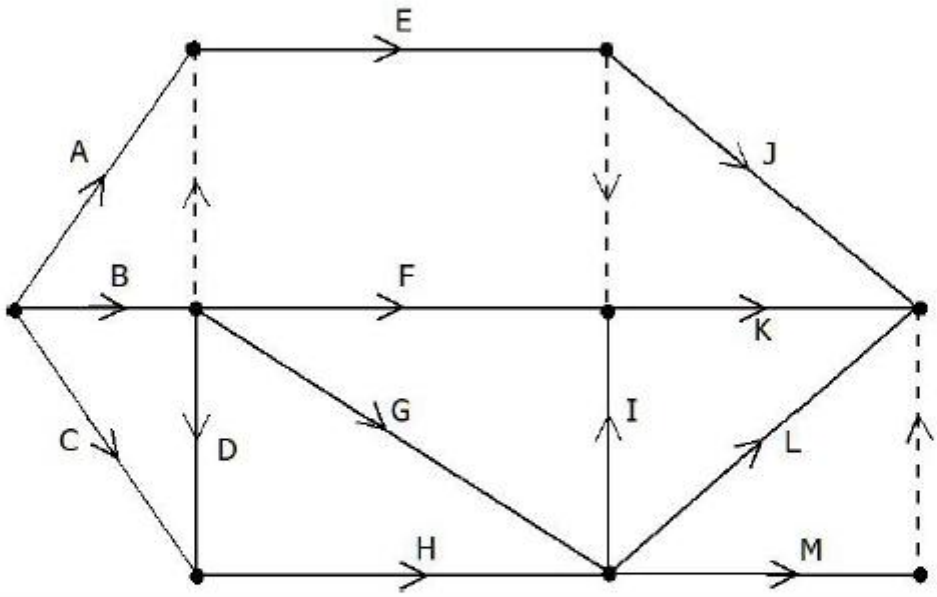
For reference these are the early start, late end and length of float for the non-critical activities

Activity	Start	Late End	Float	Critical	Start	End
A	0	5	3	C	0	3
B	0	7	3	E	3	7
D	2	12	3	G	7	12
F	3	10	2	H	12	18
I	7	18	1	J	18	20
K	7	20	7			
L	8	20	2			
M	8	20	5			



(**Q06 9FM0/03D, June 2025**)

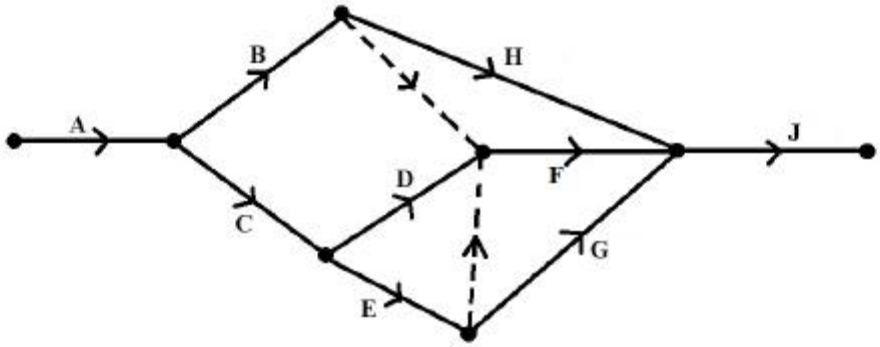
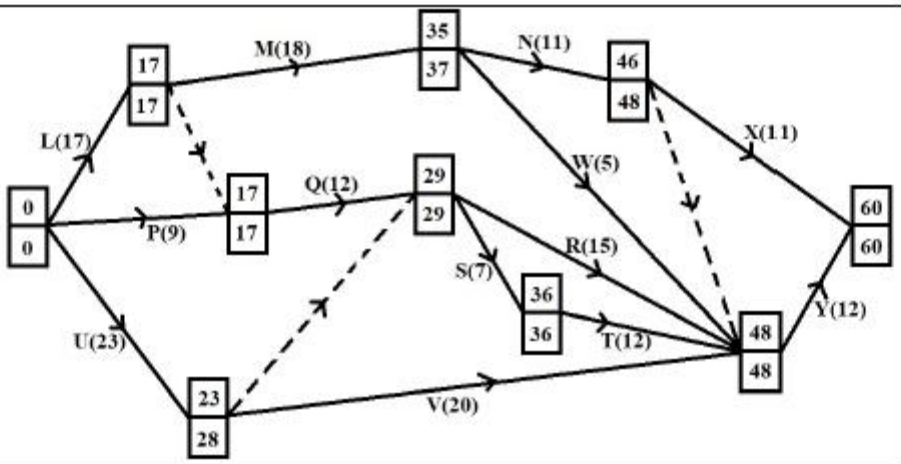
Q2.

Question	Scheme	Marks	AOs
(a)	e.g. Activity D (or F or G) is preceded by activity B only, but activity E is preceded by both activity A and activity B.	B1	2.4
		(1)	
(b)		M1 A1 (ABCDE) A1 (FGHJ) A1 (IKLM) A1	1.1b 1.1b 1.1b 1.1b 1.1b
		(5)	
(c)	15 (hours)	B1	3.1b
		(1)	
(d)	A C E F G J L M	B1	2.2a
		(1)	
			(8 marks)

	Notes
a1B1	e.g. Reference to D (or F or G) is preceded by B only, E depends on both A and B (oe). Reference to J is preceded by E only, K depends on E **and** F and/or I L and M have the same **start** node **and finish** node
(b)	Condone lack of, or incorrect, numbered events throughout. 'Dealt with correctly' means that the activity starts from the correct event but need not necessarily finish at the correct event e.g. 'K dealt with correctly' requires the correct precedences for this activity, i.e. E, F and I labelled correctly and leading into the same node and K starting from that node but do not consider the end event for K. **Activity on node is M0** If an arc is not labelled, for example, if the arc for activity E is not labelled (but the arc is present) then this will lose the first A mark and the final (CSO) A mark – they can still earn the second A mark on the bod. If two or more arcs are not labelled then mark according to the scheme. Assume that a solid line is an activity which has not been labelled rather than a dummy (even if in the correct place for where a dummy should be). **Ignore incorrect or lack of arrows on the activities for the first four marks only**
b1M1	At least eight activities labelled on arc, one start and at least two dummies placed.
b1A1	Activities A, B, C, D and E dealt with correctly and first dummy (from end B to end A) and arrow dealt with correctly.
b2A1	Activities F, G, H and J dealt with correctly and "second" dummy (from end E to end F) and arrow dealt with correctly.
b3A1	Activities I, K, L and M and "final" dummy and arrow dealt with correctly.
b4A1	CSO All arrows present and correctly placed with one finish, no additional dummies and no additional activities. **Please check all arcs carefully for arrows – if there are no arrows on any dummies then M1 only.** **Note that additional (but unnecessary) 'correct' dummies that still maintain precedence for the network should only be penalised with the final A mark if earned. Note that this answer is not unique (e.g. L and M are interchangeable or this dummy could be at the start of M)**
c1B1	CAO
d1B1	CAO

(**Q02 8FM0/27, June 2025**)

Q3.

Question	Scheme	Marks	AOs
(a)		M1 A1 (E,F,H) A1 (3)	1.1b 1.1b 1.1b
(b)		M1 A1 A1 (3)	2.1 1.1b 1.1b
(c)	The critical activities are L, Q, S, T and Y	B1	1.1b
		(1)	
(d)	7:33pm	B1	3.2a
		(1)	
			(8 marks)

Notes:

(a)
'Dealt with correctly' means that the activity starts from the correct event but need not necessarily finishes at the correct event, e.g. 'F dealt with correctly' requires the correct precedences for this activity, i.e. B, D and E labelled correctly and leading into the same node and F starting from that node but do not consider the end event for F.
M1: Any four activities of E, F, G, H, J added (labelled) (condone missing arrows).
A1: Activities E, F and H (labelled) and one dummy (including correct arrow) dealt with correctly (Ignore lack of or incorrect arrows on E/F/H for this mark only)
A1: CAO Completely correct diagram with all labels and arrows placed correctly on activities and dummies, one finish and exactly two dummies (no additional nodes or activities)

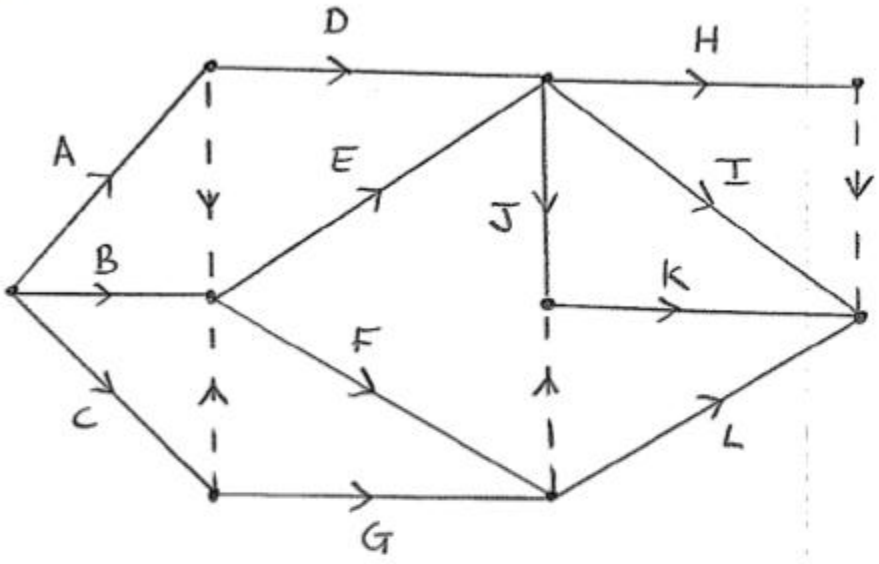
(b)
M1: All boxes completed, number generally increasing L to R (condone one "rogue") and decreasing R to L (condone one "rogue" or missing 0 in first box).
A1: CAO (all top boxes correct)
A1: CAO (all bottom boxes correct)

(c)
B1: CAO (L, Q, S, T and Y)

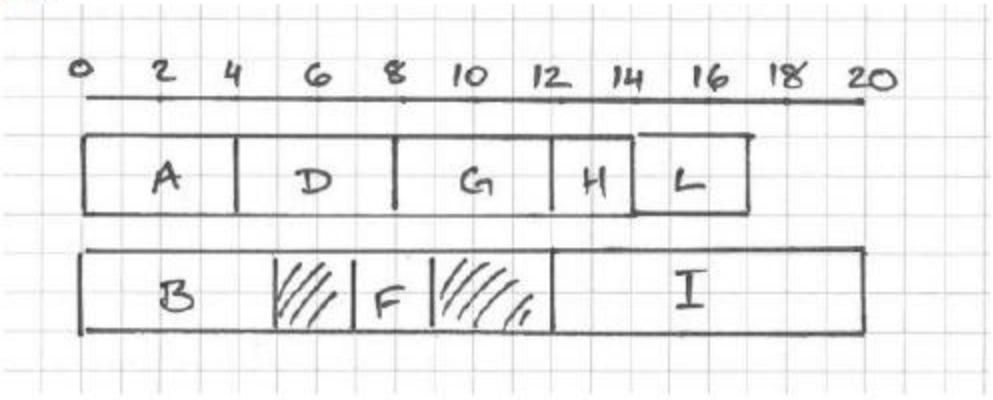
(d)
B1: CAO, can also say 19:33. Do NOT accept 7:33 (without the pm)

(**Q02 8FM0/27, June 2024**)

Q4.

Question	Scheme	Marks	AOs
(a)	e.g.  	M1 A1 A1 A1 A1	2.1 1.1b 1.1b 1.1b 1.1b
		(5)	
(b)(i)	Critical path: C – E – J – K	B1	1.1b
(ii)	Minimum completion time: 20	B1	1.1b
(iii)	Total float on activity B is 2	B1	1.1b
(iv)	Total float on activity G is 4	B1	3.1b
		(4)	
(c)	e.g. (One worker continues to do the critical activities (in time 20)) Second worker completes A, D, G and H as originally planned but now completes activity L in the interval 14 to 20 (but must have started L by time 17 at the latest due to its duration of 3) Third worker completes B and F as planned but now completes activity I exactly in the time interval 12 to 20 so yes, the project can be completed by 3 workers	B2, 1, 0	2.4 2.4

e.g.



Yes – can be completed by 3 workers

(2)

(11 marks)

For reference

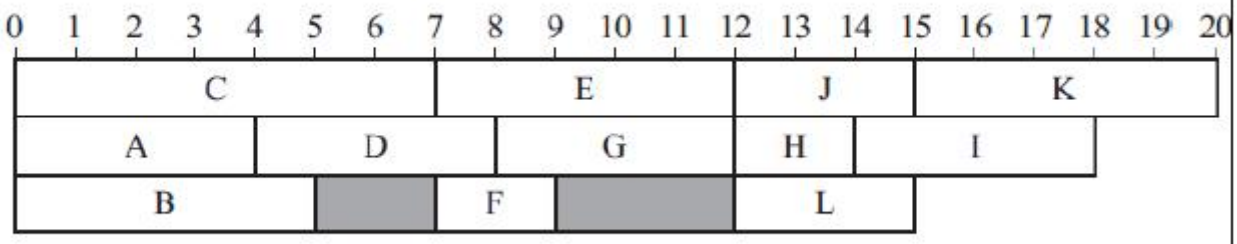


Figure 3

Condone lack of, or incorrect, numbered events throughout. 'Dealt with correctly' means that the activity starts from the correct event but need not necessarily finishes at the correct event, e.g. 'H dealt with correctly' requires the correct precedences for this activity, i.e. D and E labelled correctly and leading into the same node and H starting from that node but do not consider the end event for H. **Activity on node is M0**

If an arc is not labelled, for example, if the arc for activity C is not labelled (but the arc is present) then this will lose the first A mark and the final (CSO) A mark – they can still earn the second A mark on the bod. If two or more arcs are not labelled then mark according to the scheme. Assume that a solid line is an activity which has not been labelled rather than a dummy (even if in the correct place for where a dummy should be)

Note: if they make multiple attempts which are not clearly replaced mark the one which is best for the candidate

Ignore incorrect or lack of arrows on the activities for the first four marks only

(a) M1: At least nine activities (labelled on arc), one start, at least two dummies placed

A1: Activities A, B, C, D and G dealt with correctly

A1: Activities E, F, H, I and J and the first two dummies (+ arrows) at the ends of A and C dealt with correctly (note H and I are interchangeable)

A1: Activities K, L and dummy at the end of F/G (+ arrow) dealt with correctly

A1: CSO – Final dummy (+ arrow) for uniqueness of H/I, all arrows present for every activity with one finish and no additional dummies. (Note direction of arrow on dummy between H and I is interchangeable) (Note the dummy could also be drawn at the start of H and I)

Please check all arcs carefully for arrows – if there are no arrows on dummies then M1A1max

Note that additional (but unnecessary) 'correct' dummies that still maintain precedence for the network should only be penalised with the final A mark if earned

(b)(i)

B1: CAO (critical path CEJK – in this order)

(ii)

B1: CAO (20)

(iii)

B1: CAO (2 – total float on B)

(iv)

B1: CAO (4 – total float on G)

(c)

B1: **Award this mark with an indication that either**

- activities I and L have swapped workers
- activity H has swapped worker and I now starts at 12

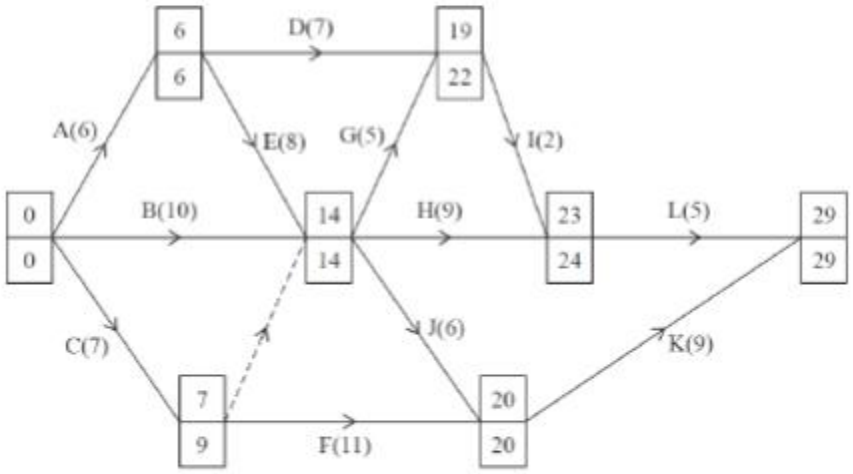
B1: dependent on first B mark – **must have a time reference for both I and either L or H for this mark (L or H may be a range)** completely correct reasoning including mention of workers, times and activities (for example, clear indication that (H and) L (in either order) must take place in the interval 12 to 20 **and** that I must now be done in the interval 12 to 20 or states starts at 12 but not just ends at 20) and either concludes yes **or clearly implies that it can be completed on time**

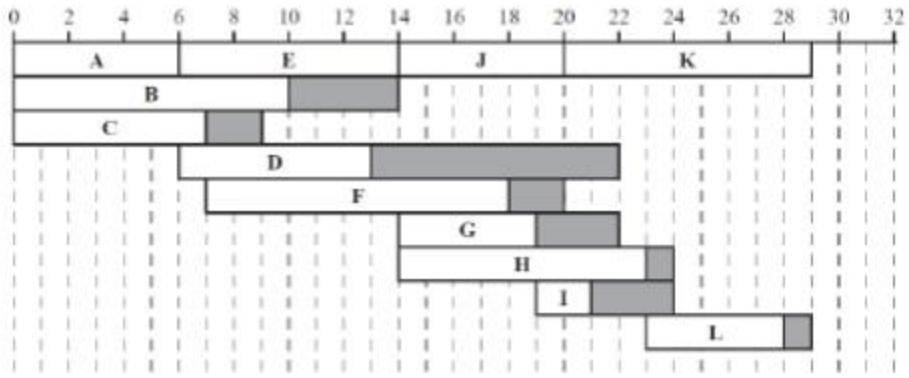
Note their explanation must not include an incorrect statement

Alternatively redraws the schedule for worker 2 and 3 with one completing H and L (in either order) in the time interval 12 – 20 and the other completing I **and** concludes that the project can be completed by 3 workers

(**Q06 9FM0/03D, June 2024**)

Q5.

Question	Scheme	Marks	AOs
(a)	The dummy from event 3 to event 4 is required as activity F depends only on activity C, but activities G, H and J depend on activities C, B and E	B1	2.4
		(1)	
(b)		M1 A1 A1	1.1b 1.1b 1.1b
		(3)	

(c)	Critical activities are A, E, J and K	B1	1.1b
		(1)	
(d)	$\frac{6+10+7+7+8+11+5+9+2+6+9+5}{29}=\frac{85}{29}=2.931\ldots$ so a lower bound of 3 workers	B1ft	2.2a
		(1)	
(e)		M1 A1 A1 A1	2.1 1.1b 1.1b 1.1b
		(4)	
			(10 marks)

Notes

(a)

B1: Correct reasoning for the dummy activity – must mention activities F and C (twice or clearly implied twice), at least one of B/E, and at least one of G/H/J (for example, 'F relies on C, but G relies on C and E')

(b)

M1: All top boxes and all bottom boxes completed. Values generally increasing left to right (for top boxes) and values generally decreasing from right to left (for bottom boxes). Condone missing 0s at the source node or the 29 in the bottom box at the sink node for the M mark only. Condone one rogue value in top boxes and one rogue value in bottom boxes. For a rogue in the top boxes if values do not increase in the direction of the arrows, then if one value is ignored and then the values do increase in the direction of the arrows then this is considered to be only one rogue value (with a similar definition for bottom boxes but in reverse)

A1: cao - Top boxes (including zero at the source node)

A1: cao - Bottom boxes (including zero at the source node and 29 at the sink node)

(c)

B1: cao (the correct four critical activities A, E, J and K and no others)

(d)

B1ft: Correct deduction of lower bound from a correct calculation for **their** minimum project completion time from **(b)** (so if correct in **(b)**, must be 85/29). The follow through is on their 29 only (so no follow through for incorrectly adding up the duration of all the activities). An answer of 3 with no working scores no marks. All working seen must be correct. As a minimum must either see

$\frac{6+10+7+7+8+11+5+9+2+6+9+5}{29}$ **or** $\frac{85}{29}$ **or** an awrt 2.9 (not from incorrect working) followed by 3

(e)

M1: At least nine different activities labelled including at least five floats. A scheduling diagram (so a diagram in which no floats are evident) scores M0

A1: The critical activities dealt with correctly and appearing just once (A, E, J and K) and three non-critical activities dealt with correctly (both duration and total float correct)

A1: Any six non-critical activities correct (this mark is not dependent on the previous A mark)

A1: cso – completely correct Gantt chart (all twelve activities appearing exactly once)

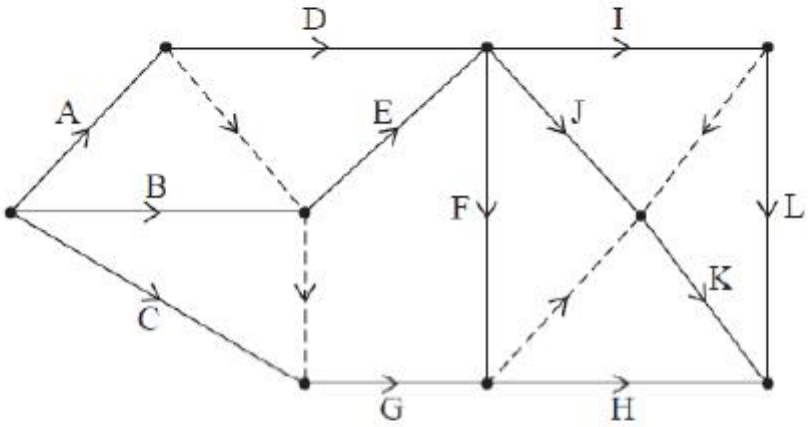
For **(e)** the following may be useful in checking their cascade chart provided the float is shown after the corresponding activity:

Activity	Duration + Float
A	0 to 6 Critical
B	0 to 10 F: 10 to 14
C	0 to 7 F; 7 to 9
D	6 to 13 F: 13 to 22
E	6 to 14 Critical

Activity	Duration + Float
F	7 to 18 F: 18 to 20
G	14 to 19 F: 19 to 22
H	14 to 23 F: 23 to 24
I	19 to 21 F: 21 to 24
J	14 to 20 Critical

Activity	Duration + Float
K	20 to 29 Critical
L	23 to 28 F: 28 to 29

Q6.

Question	Scheme	Marks	AOs
(a)		M1 A1 A1 A1 A1	2.1 1.1b 1.1b 1.1b 1.1b
		(5)	
(b)	Critical activities: B, E, I and L	B1	2.2a
		(1)	
(c)	(Earliest start for F is 12 and latest finish is 18 therefore if the total float is 2) the duration of F is 4 (hours)	B1	2.2a
		(1)	
(d)	(i) Maximum possible total float for activity K is $5-y$	B1	3.1b
	(ii) Total float for activity J is $12-x-y$	B1	2.2a
		(2)	
			(9 marks)

Notes for Question
Condone lack of, or incorrect, numbered events throughout. 'Dealt with correctly' means that the activity starts from the correct event but need not necessarily finishes at the correct event, e.g. 'F dealt with correctly' requires the correct precedences for this activity, i.e. D and E labelled correctly and leading into the same node and F starting from that node but do not consider the end event for F **so use the table below for checking as there a number of acceptable answers. Activity on node is M0**

If an arc is not labelled, for example, if the arc for activity C is not labelled (but the arc is present) then this will lose the first A mark and the final (CSO) A mark – they can still earn the second A mark on the bod. If two or more arcs are not labelled then mark according to the scheme. Assume that a solid line is an activity which has not been labelled rather than a dummy (even if in the correct place for where a dummy should be)

Ignore lack of arrows on the activities for the first four marks only (but assume that they are in the 'correct' direction for checking purposes)

(a)

M1: At least nine activities (labelled on arc), one start, at least two dummies placed

A1: Activities A, B, C, D, E and the dummy (+ arrow) at the end of A dealt with correctly

A1: Activities G, F, I and J and the dummy (+ arrow) at the beginning of G dealt with correctly

A1: Activities H and L dealt with correctly

A1: CSO – Final two dummies + arrows and activity K dealt with correctly, all arrows present for every activity with one finish and no additional dummies

Please check all arcs carefully for arrows – if there are no arrows on dummies then M1max

Note that additional (but unnecessary) 'correct' dummies that still maintain precedence for the network should only be penalised with the final A mark if earned

Activity	A	B	C	D	E	F	G	H	I	J	K	L
IPA	-	-	-	A	A, B	D, E	A, B, C	F, G	D, E	D, E	F, G, I, J	I

(b)
B1: CAO (B, E, I and L only)

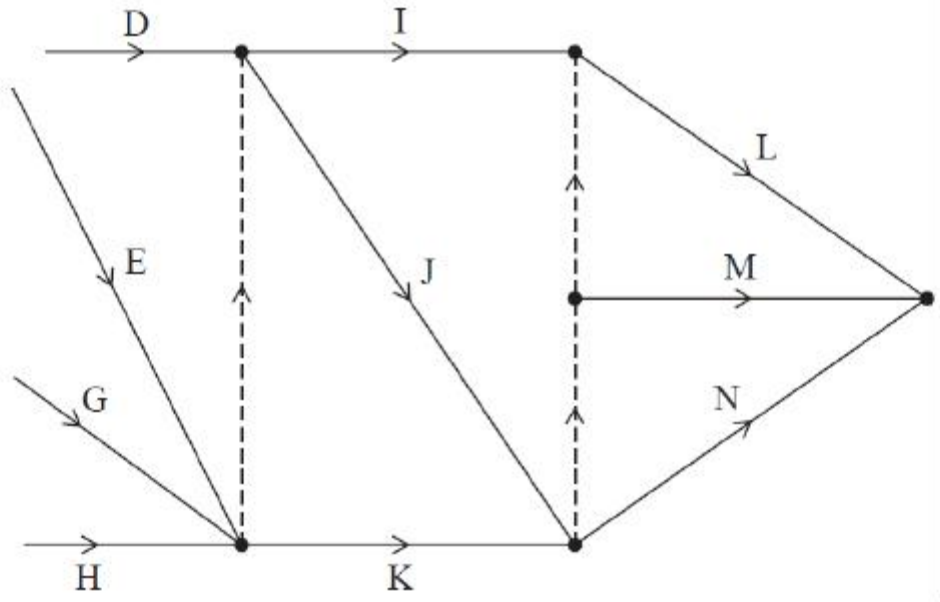
(c)
B1: CAO (4)

(d)(i)
B1: CAO $(5 - y)$

(d)(ii)
B1: CAO $(12 - x - y)$

(**Q06 9FM0/03D, June 2023**)

Q7.

Question	Scheme	Marks	AOs
(a)	<table><tr><th>Activity</th><th>Immediately preceding activities</th></tr><tr><td>A</td><td>-</td></tr><tr><td>B</td><td>-</td></tr><tr><td>C</td><td>-</td></tr><tr><td>D</td><td>A</td></tr><tr><td>E</td><td>A</td></tr><tr><td>F</td><td>A</td></tr><tr><td>G</td><td>B, F</td></tr><tr><td>H</td><td>B, C, F</td></tr></table>	B1 B1	1.1b 1.1b
		(2)	
(b)	e.g.  	M1 A1 A1 A1	2.1 1.1b 1.1b 1.1b
		(4)	
(c)	If all activities have the same duration then any critical path must contain 5 activities. All paths that pass-through D have only 4 activities and so therefore D cannot be critical.	B1 B1	2.4 2.4
		(2)	
			(8 marks)

Notes:

(a)

B1: Either row G or H correct

B1: All rows correct (condone blanks in A, B and C rows)

(b)

Condone lack of, or incorrect, numbered events throughout. 'Dealt with correctly' means that the activity starts from the correct event but need not necessarily finishes at the correct event, e.g. 'K dealt with correctly' requires the correct precedences for this activity, i.e. E, G and H labelled correctly and leading into the same node and K starting from that node but do not consider the end event for K. **Activity on node is M0**

Assume that a solid line is an activity which has not been labelled rather than a dummy (even if in the correct place for where a dummy should be)

Ignore incorrect or lack of arrows on the activities for the first three marks only

(b) M1: At least five activities (labelled on arc), at least two dummies placed

A1: Activities I, J, K and first dummy + arrow dealt with correctly

A1: Activities L, M, N and a second dummy + arrows dealt with correctly

A1: cso – all arrows present for every activity with one finish and exactly three dummies. Note that this is not a unique solution e.g. M and N could be interchanged so please check these carefully.

Please check all arcs carefully for arrows – if there are no arrows on any dummies then M1 only

Note that additional (but unnecessary) 'correct' dummies that still maintain precedence for the network should only be penalised with the final A mark if earned

For reference:

Activity	I	J	K	L	M	N
IPA	D, E, G, H	D, E, G, H	E, G, H	I, J, K	J, K	J, K

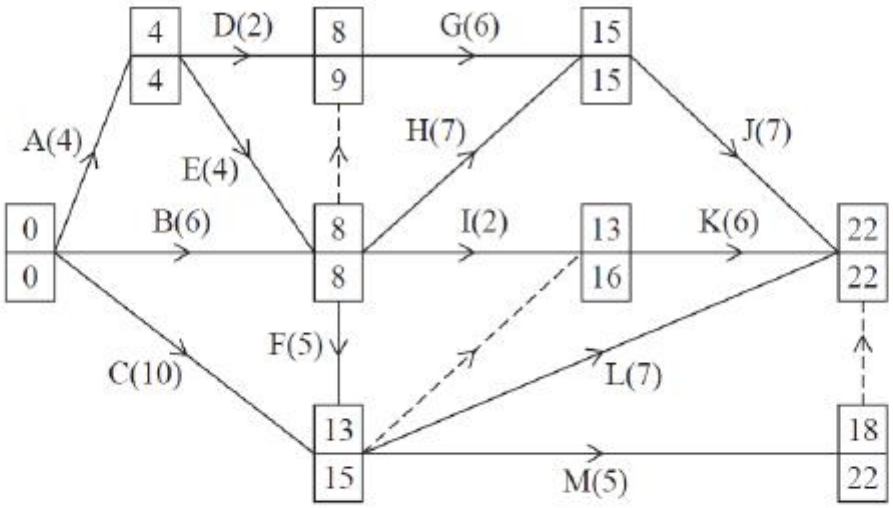
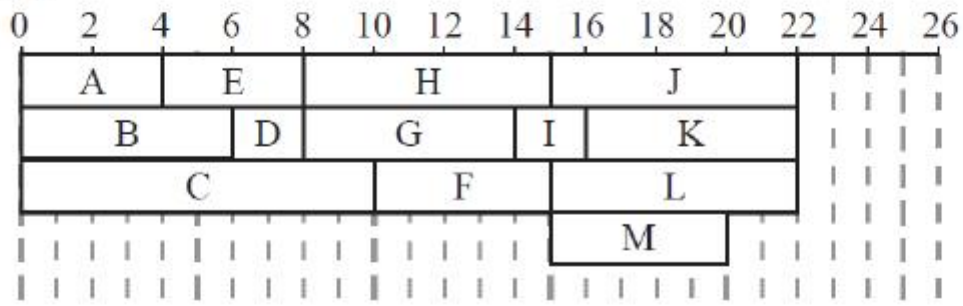
(c)

B1: Explains that all critical paths must contain 5 activities (oe method e.g., attempting a forward and backward pass with each activity having the same duration)

B1: cao that D cannot be critical with mention of all paths through D only contain 4 activities (oe method e.g., showing that the total float on activity D is not zero)

SCB1 – stating or implying that D has a float of 1 (oe) by considering a forward pass (which may or may not be done mathematically) up to at least activity D

Q8.

Question	Scheme	Marks	AOs
(a)		M1 A1 M1 A1	2.1 1.1b 1.1b 1.1b
		(4)	
(b)	$\frac{71}{22} = \ldots$	M1	1.1b
	…= 3.22… therefore 4 workers	A1	2.2a
		(2)	
(c)	e.g. 	M1 A1 A1	2.1 1.1b 1.1b
		(3)	
			(9 marks)

Notes:

(a)

M1: All top boxes completed, number generally increasing L to R (condone one "rogue")

A1: cao - top boxes (including zero at the source node)

M1: All bottom boxes completed, numbers generally decreasing R to L (condone one "rogue")

A1: cao - bottom boxes (including zero at the sink node)

(b)

M1: Attempt to find the lower bound (71 ± 10) / their completion time (a value of 3.2… seen with no working can imply this mark)

A1: cso - correct calculation seen or 3.2 followed by 4. An answer of 4 with no working scores **M0A0**

(c)

M1: Not a cascade chart, 4 'workers' used at most and at least 9 different activities placed

A1: 4 workers. All 13 activities present (just once – so if an activity appears for two different workers and is happening at the same time this is A0). Condone at most two errors. An activity can give rise to at most three errors; one on duration, one on time interval and only one on IPA

A1: 4 workers. All 13 activities present (just once). No errors

Activity	Duration	Time Interval	IPA
A	4	0 – 4	-
B	6	0 – 8	-
C	10	0 – 15	-
D	2	4 – 9	A
E	4	4 – 8	A
F	5	8 – 15	B, E
G	6	8 – 15	B, D, E
H	7	8 – 15	B, E
I	2	8 – 16	B, E
J	7	15 – 22	G, H
K	6	13 – 22	C, F, I
L	7	13 – 22	C, F
M	5	13 – 22	C, F

(**Q02 9FM0/03D, Oct 2021**)