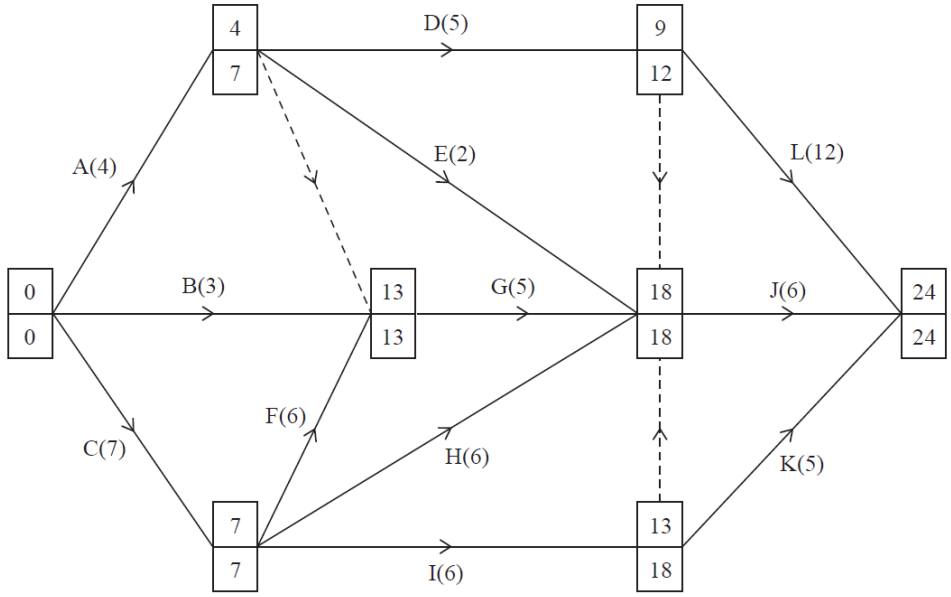
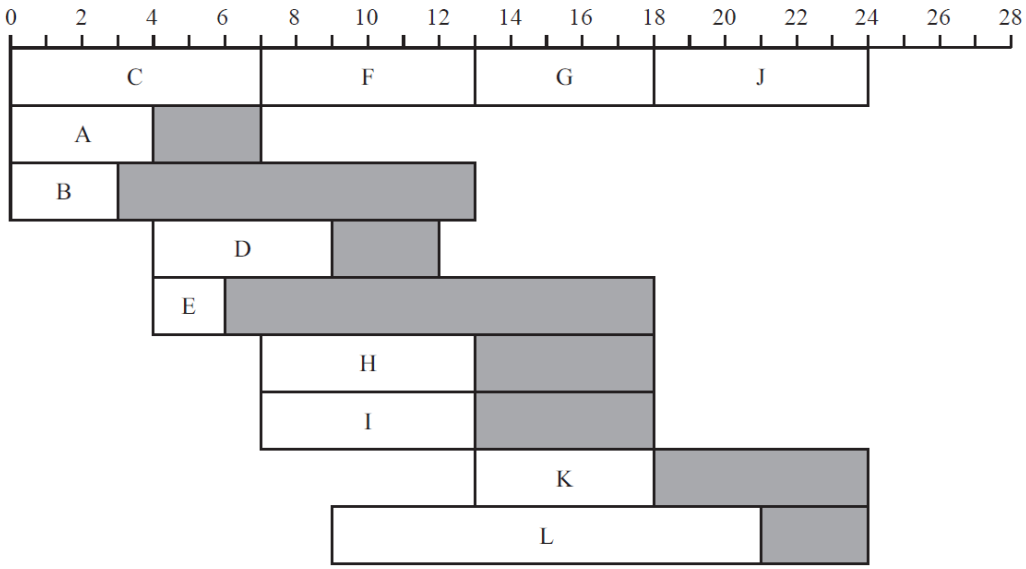
Question Number	Scheme	Marks
1. (a)		M1 A1 M1 A1 **(4)**
(b)	Activity D has a total float of 12 – 4 – 5 = 3 (hours)	B1ft **(1)**
(c)	Lower bound = $\frac{4+3+7+\ldots+5+12}{24}=\frac{67}{24}=2.791\ldots=3$workers	M1 A1 **(2)**
(d)		M1 A1 A1 A1 **(4)**
(e)	Minimum is 4 workers e.g. activities F, H, I and L together with 12 < time < 13	dM1 A1 **(2)**
		13 marks
	Notes for Question 1	
a1M1	**All** top boxes complete, values generally increasing in the direction of the arrows (‘left to right’), condone one rogue	
a1A1	CAO (top boxes)	
a2M1	**All** bottom boxes complete, values generally decreasing in the opposite direction of the arrows (‘right to left’), condone one rogue. Condone missing 0 and/or their 24 (at the end event) for the M mark only	
a2A1	CAO (bottom boxes)	
b1B1ft	Correct calculation for their event times for activity D (all three figures must be seen)	

Question Number	Scheme	Marks
c1M1	Attempt to find lower bound: (a value in the interval [55 – 79] / their finish time) **or** (sum of the activities (12 values) [condone one missing value] / their finish time) **or** (as a minimum) an awrt 2.8	
c1A1	CSO – requires both a **correct** calculation **or** awrt 2.8 seen and 3. An answer of 3 with no working scores no marks	
d1M1	At least eight different activities labelled including at least five floats. A scheduling diagram (so a diagram in which no floats are evident) scores M0	
d1A1	The critical activities dealt with correctly and appearing just once (C, F, G and J) and three non-critical activities dealt with correctly (both duration and total float correct)	
d2A1	Any five non-critical activities correct (this mark is not dependent on the previous A mark)	
d3A1	CSO – completely correct Gantt chart (exactly twelve activities appearing just once)	
e1depM1	Dependent on M mark in (d). Either a statement with the correct number of workers (4) and stating the correct activities (F, H, I and L) with any numerical time stated **or** the correct number of workers (4) and a time in the interval $12 \leqslant t \leqslant 13$ – mark the numerical value only not their use of the words 'day/time' (or equivalent)	
e1A1	A completely correct statement with details of both time **and** activities. Candidates must give a time within the correct interval of $12 < t < 13$, e.g. 12.5 (or 'on/during hour 13') and state the correct activities (F, H, I and L). Project is measured in hours, so a time of (e.g.) 12:30 is acceptable. (Condone use of 'days' instead of 'hours') Please note the strict inequalities for the time interval (e.g. implying a time of 12 is incorrect). Answers given as an interval of time are acceptable provided the time interval stated is correct for all its possible values (e.g. time 12 – 13 or 'between 12 and 13' is A0). A completely correct statement with an additional incorrect statement scores A0 (so do not ignore subsequent working)	

For (d) 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 4 F: 4 to 7
B	0 to 3 F: 3 to 13
C	0 to 7 Critical
D	4 to 9 F: 9 to 12
E	4 to 6 F: 6 to 18

Activity	Duration + Float
F	7 to 13 Critical
G	13 to 18 Critical
H	7 to 13 F: 13 to 18
I	7 to 13 F: 13 to 18
J	18 to 24 Critical

Activity	Duration + Float
K	13 to 18 F: 18 to 24
L	9 to 21 F: 21 to 24