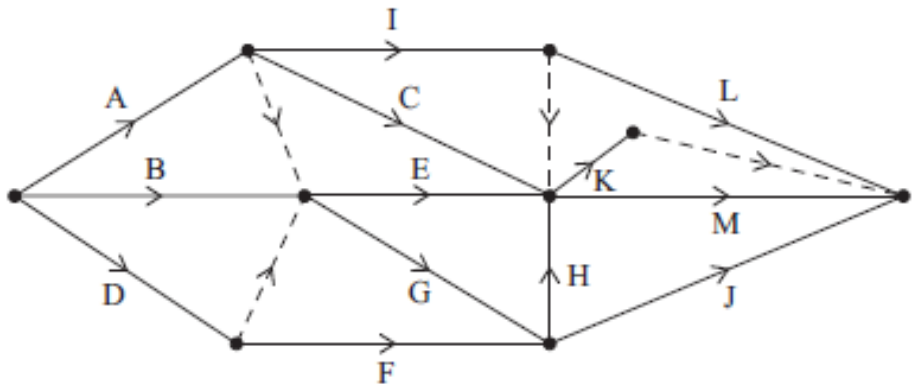
Question Number	Scheme	Marks
5.(a)	$\frac{1}{2}(x+y+z) \leqslant y \quad (\Rightarrow x-y+z \leqslant 0)$	M1
	$\frac{3}{20}(x+y+z) \geqslant z \quad (\Rightarrow 3x+3y-17z \geqslant 0)$	M1
	$2x = 5z$	B1
	$5x+12y+15z \leqslant 834$	B1
	Eliminating z from the objective $x + y + z$ and at least one correct constraint or states the objective and eliminates z from at least two correct constraints	M1
	Maximise (P =) $1.4x + y$ subject to $11x+12y \leqslant 834$ $7x-5y \leqslant 0$ $19x-15y \leqslant 0$ $(x \geqslant 0,\ y \geqslant 0)$	A1 A1 **(7)**
(b)(i)	Substitute y = 42 into LP gives $x \leqslant 30,\ x \leqslant 30,\ x \leqslant \frac{630}{19}$ which implies that $x = 30$	M1
	Total number of reams ordered is $1.4(30)+42=84$	A1
(b)(ii)	12 reams of graph paper ordered	A1 **(3)**
		10 marks
	Notes for Question 5	
a1M1	$\frac{1}{2}(x+y+z) \bullet y$ where $\bullet$ is any inequality or equals sign (accept any equivalent form)	
a2M1	$\frac{3}{20}(x+y+z) \bullet z$ where $\bullet$ is any inequality or equals sign (accept any equivalent form)	
a1B1	Correct relationship between x and z (accept any equivalent form)	
a2B1	CAO ($5x+12y+15z \leqslant 834$)	
a3M1	Either eliminating z (using either $2x = 5z$ or $2z = 5x$ oe) from the correct objective and at least one correct constraint or states objective in the form (P =) $x + y + z$ and eliminates z from at least two correct constraints	
a1A1	Either two correct inequalities in x and y only **or** one correct inequality and the correct objective (but do not need 'maximise' or 'max') in x and y only – note the correct inequality must have integer coefficients (accept equivalent forms for the objective e.g. $5P = 7x + 5y$ (**must include 5*P* =**) if $P = 7x + 5y$ stated do not ISW)	
a2A1	Correct LP formulation in x and y including 'maximise' or 'max' with objective (condone if previously stated) – note that all constraints must have integer coefficients (condone lack of $x \geqslant 0,\ y \geqslant 0$). Do not ISW if any incorrect simplifications seen.	
bi1M1	Substituting y = 42 into at least two of their constraints (must only be in terms of x and y) leading to a value of x (if they over simplify and assume that 42 is exactly ½ of the total number of reams, they must still substitute into at least 2 constraints)	
bi1A1	CAO (84) – must come from correct working	
bii1A1	CAO (12) – must come from correct working	

Question Number	Scheme	Marks
6.(a)	e.g.  	M1 A1 (A B D I C F) A1 (E G H J) A1 (K L M) A1 **(5)**
(b)	Activities B, G, H and M are critical	B1 **(1)**
(c)	At time 9.5, activities G, C, E and I must all be happening therefore a minimum of 4 workers is required	M1 A1 **(2)**
(d)	$2 \leqslant x \leqslant 6$	B2, 1, 0 **(2)**
		10 marks

Notes for Question 6

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. 'J dealt with correctly' requires the correct precedences for this activity, i.e. F and G labelled correctly and leading into the same node and J starting from that node but do not consider the end event for J. **Activity on node is M0**

If an arc is not labelled, for example, if the arc for activity F 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 missing arrows on the activities for the first four marks only**

a1M1	Nine activities (labelled on arc), one start and at least two dummies placed
a1A1	Activities A, B, D, 1st two dummies (including correct arrows), I, C and F dealt with correctly
a2A1	Activities E, G, H and J dealt with correctly
a3A1	Activities K, L and M dealt with correctly (so dummy at the end of I required + arrow)
a4A1	CSO – all arrows correctly placed for each activity with one finish and exactly four dummies (so uniqueness dummy for K/M required)

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

b1B1	CAO (B, G, H and M and no others)
c1M1	Either a statement with the correct number of workers (4) and stating the correct activities (G, C, E and I) with any numerical time stated **or** the correct number of workers (4) and a time in the interval $9 \leqslant t \leqslant 10$ – mark the numerical value only not their use of the words 'day/time' (or equivalent)
c1A1	A completely correct statement with details of both time **and** activities. Candidates must give a time within the correct interval of $9 < t < 10$, e.g. 9.5 (or 'on/during hour 10') and state the correct activities (G, C, E and I). Please note the strict inequalities for the time interval (e.g. implying a time of 10 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 9 – 10 or 'between 9 and 10' is A0). A completely correct statement with an additional incorrect statement scores A0 (so do not ignore subsequent working)
d1B1	For either $x \geqslant 2$ or $x \leqslant 6$ (must be x not L)
d2B1	CAO ($2 \leqslant x \leqslant 6$) – SC in (d) B1B0 for $2 < x < 6$