Resource histograms and scheduling

A-level Decision Mathematics 1 | Edexcel 9FM0 | 12 questions, 87 marks

Further Maths topic practice

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Name: _____ **Date:** _____ **Score:** _____ **/ 87**

1 A café in Leeds is being refurbished. The table shows the ten activities involved and the time, in hours, each one takes.

Activity	A	B	C	D	E	F	G	H	I	J
Time (hours)	4	7	5	6	3	8	5	9	6	8

The minimum completion time of the project is 23 hours. Each activity requires one worker.

a. Calculate a lower bound for the number of workers needed to complete the project in the minimum time. You must make your method clear.

b. Explain why the project cannot be completed in 23 hours by two workers.

(3 marks)

Answer _____

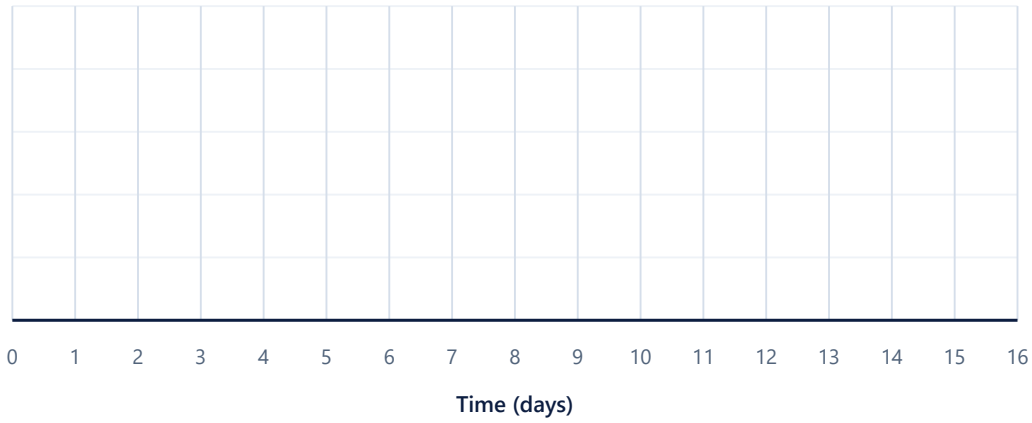
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2 Kemi is planning the landscaping of a garden. The table shows each activity, its duration in days, its earliest start time and its latest finish time. The minimum completion time is 16 days.

Activity	Duration (days)	Earliest start time	Latest finish time
A	4	0	4
B	4	0	7
C	3	4	7
D	5	4	10
E	4	7	11
F	1	9	11
G	4	9	16
H	5	11	16

a. Find the total float of each activity and hence state the critical activities.

b. On the grid below, draw a cascade (Gantt) chart for the project. Show the critical activities on the top row and the float of each other activity as a dashed box.



(5 marks)

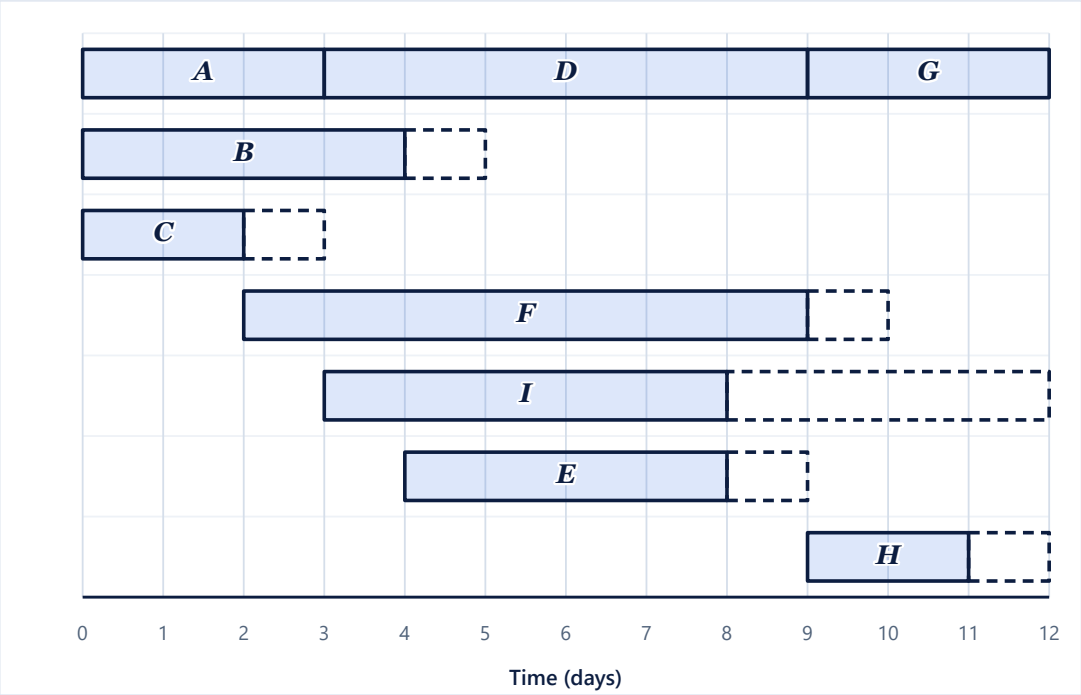
Answer

3 A pop-up shop is being set up in Bristol. The cascade (Gantt) chart below shows the activities, A to I, with times in days. The critical activities are on the top row and the dashed boxes show float.

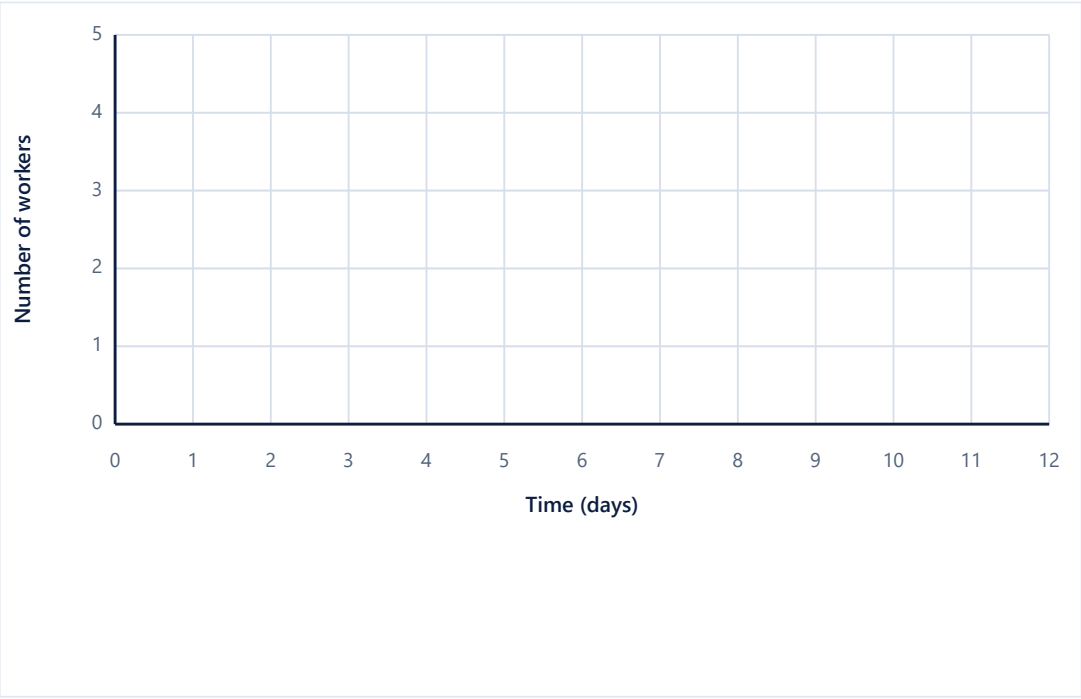
Each activity requires one worker and each activity starts at its earliest start time.

a. On Grid 1, draw a resource histogram for the project.

b. State the greatest number of workers needed at any time, and when this happens.



Cascade chart



Grid 1

(4 marks)

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Answer

4 A charity is having a new website built. The activity network below shows the activities, A to J, with their durations in days in brackets. Each activity requires one worker and the project is to be completed in the minimum time.

a. Complete the diagram to show the early event time and the late event time at each event.

b. State the minimum completion time and the critical activities.

c. Calculate a lower bound for the number of workers needed to complete the project in the minimum time. You must make your method clear.

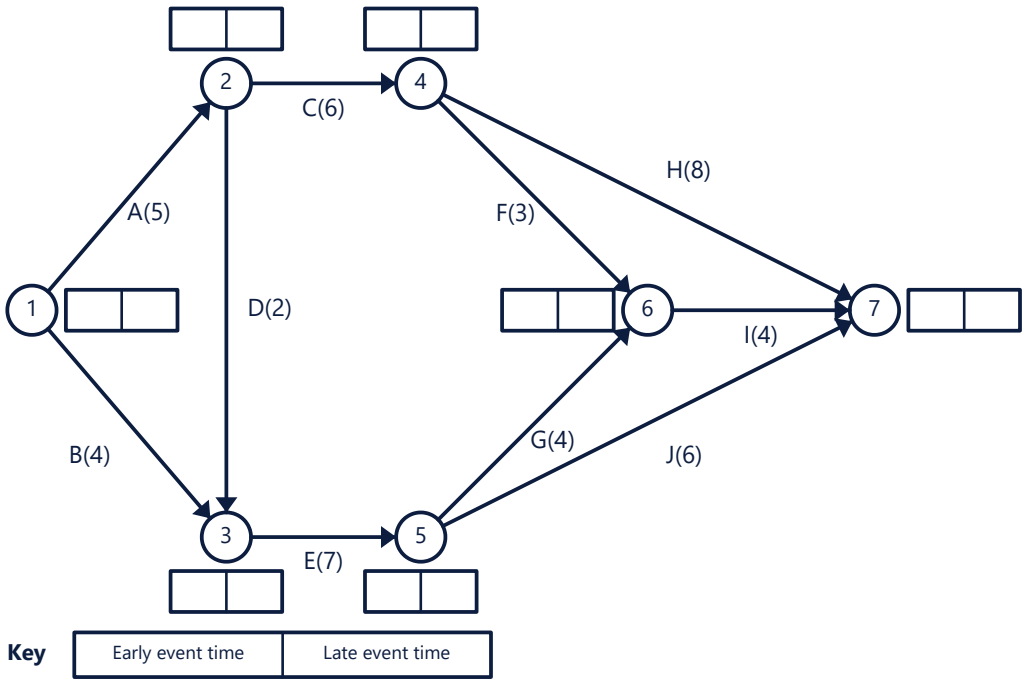


Diagram NOT accurately drawn

(6 marks)

Answer

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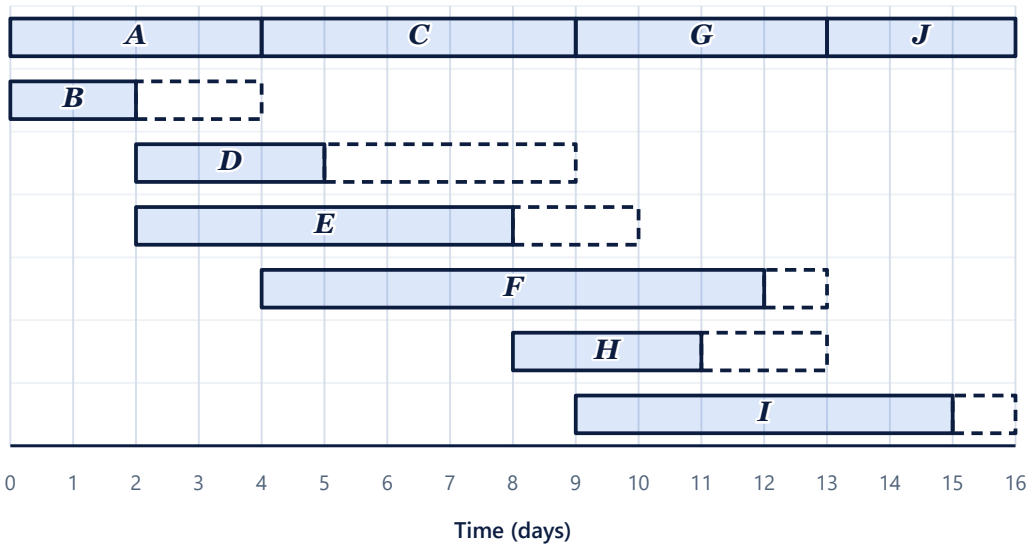
5 A community centre in Belfast is being renovated. The cascade (Gantt) chart below shows the activities, A to J, with times in days. The critical activities are on the top row and the dashed boxes show float. Each activity requires one worker.

a. State the activities that must be happening at time 5.5 days, and the activities that could be happening at that time.

b. State the activities that must be happening at time 10.5 days.

c. Calculate a lower bound for the number of workers needed to complete the project in the minimum time.

d. Use your answer to part (b) to explain why the project cannot be completed in the minimum time using the number of workers found in part (c).



(7 marks)

Answer

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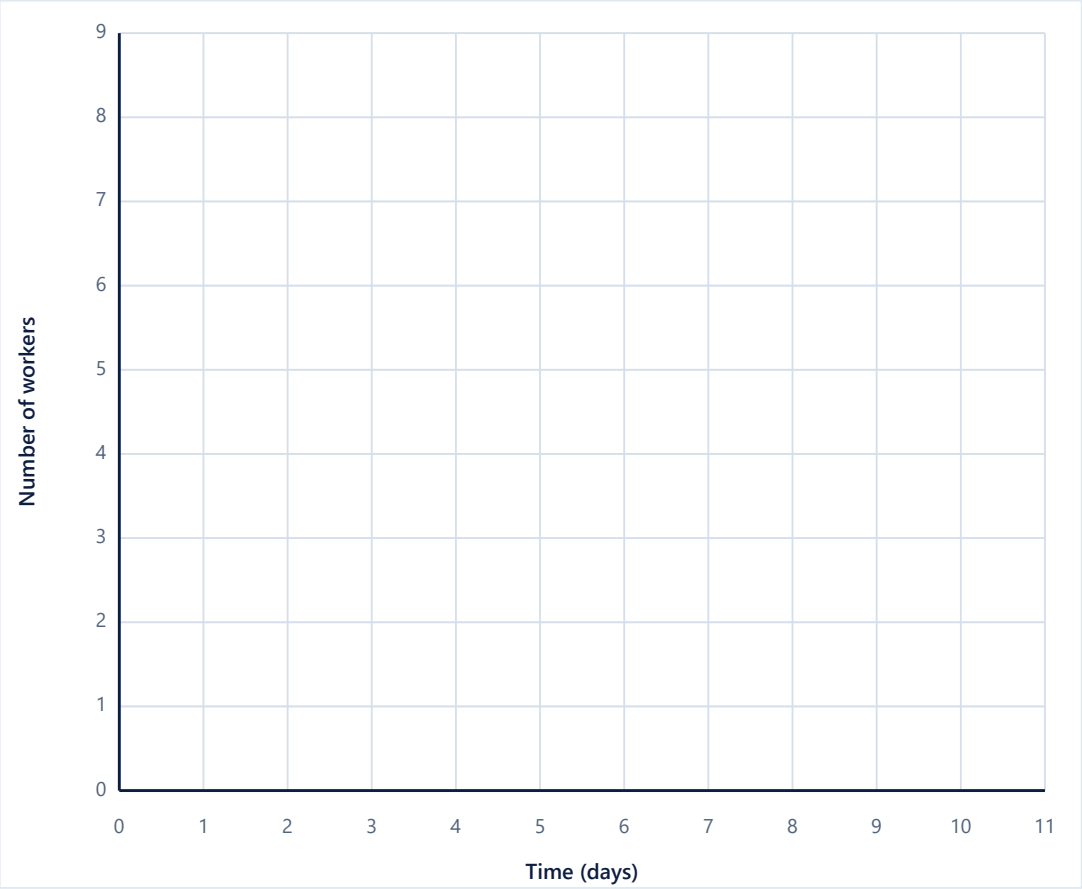
6 Solar panels are being fitted to a primary school in Norwich. The table shows each activity, its duration in days, the number of workers it needs, its earliest start time and its latest finish time. The minimum completion time is 11 days. Once an activity has started it continues until it is finished.

Activity	Duration (days)	Number of workers	Earliest start time	Latest finish time
A	4	2	0	4
B	2	2	0	5
C	3	1	0	6
D	4	3	4	8
E	3	2	2	8
F	2	2	3	8
G	6	1	2	11
H	3	2	8	11

a. On Grid 1, draw a resource histogram for the project, given that every activity starts at its earliest start time.

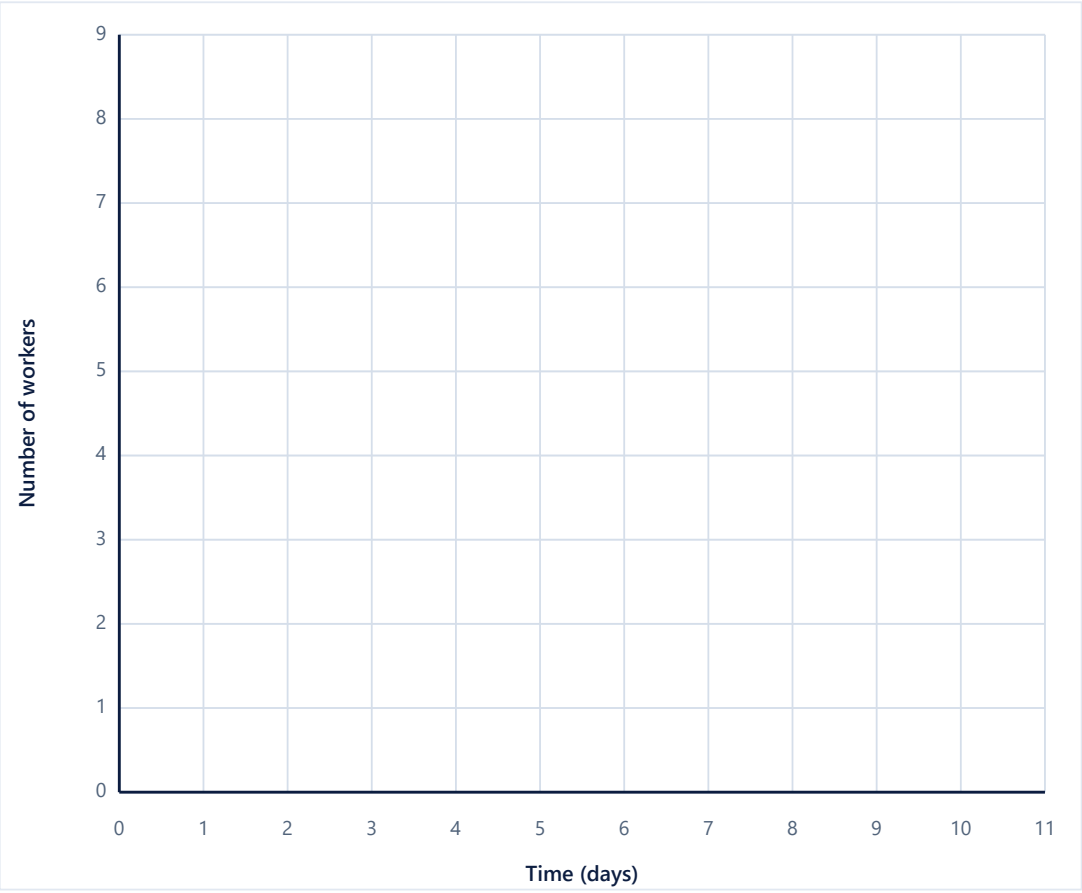
b. The contractor can provide only 6 workers on any one day. By delaying one activity within its float, draw on Grid 2 a resource histogram showing how the project can be completed in 11 days using no more than 6 workers at any time. State the new start time of the activity you delay.

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Grid 1

(7 marks)



Grid 2

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Answer

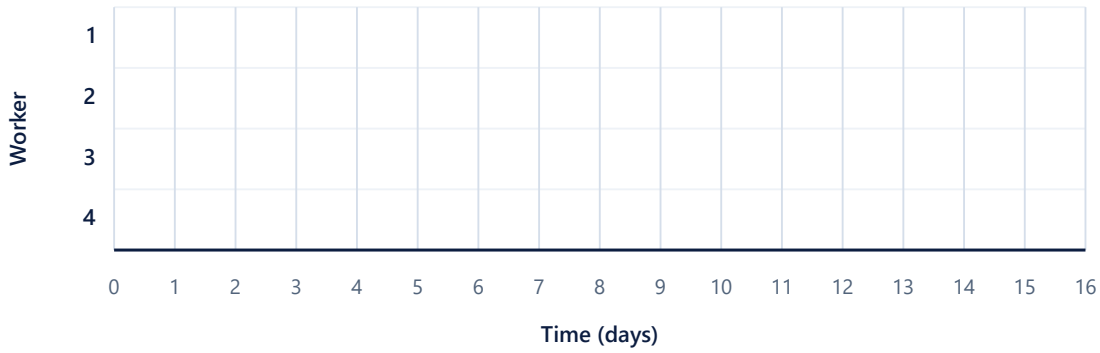
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7 The table gives the activities needed to set up a wedding fair in York, with durations in days, earliest start times and latest finish times. Each activity requires one worker. The project is to be completed in the minimum time of 16 days.

Activity	Immediately preceding activities	Duration (days)	Earliest start time	Latest finish time
A	–	3	0	6
B	–	5	0	5
C	–	4	0	9
D	A	6	3	12
E	B	2	5	12
F	B	7	5	12
G	C	3	4	12
H	D, E	4	9	16
I	F, G	4	12	16

a. Calculate a lower bound for the number of workers needed to complete the project in the minimum time.

b. Schedule the activities on the grid below, using the number of workers found in part (a), so that the project is completed in 16 days.



(7 marks)

Answer

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8 A bathroom in a flat in Swansea is being refitted. The network below shows the activities, with durations in days in brackets. Each activity requires one worker.

a. Complete the diagram to show the early event time and the late event time at each event.

b. On Grid 1, draw a resource histogram for the project, given that each activity starts at its earliest start time.

c. Show that a lower bound for the number of workers needed to complete the project in 13 days is 3, and explain why the project cannot in fact be completed in 13 days by 3 workers.

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(8 marks)

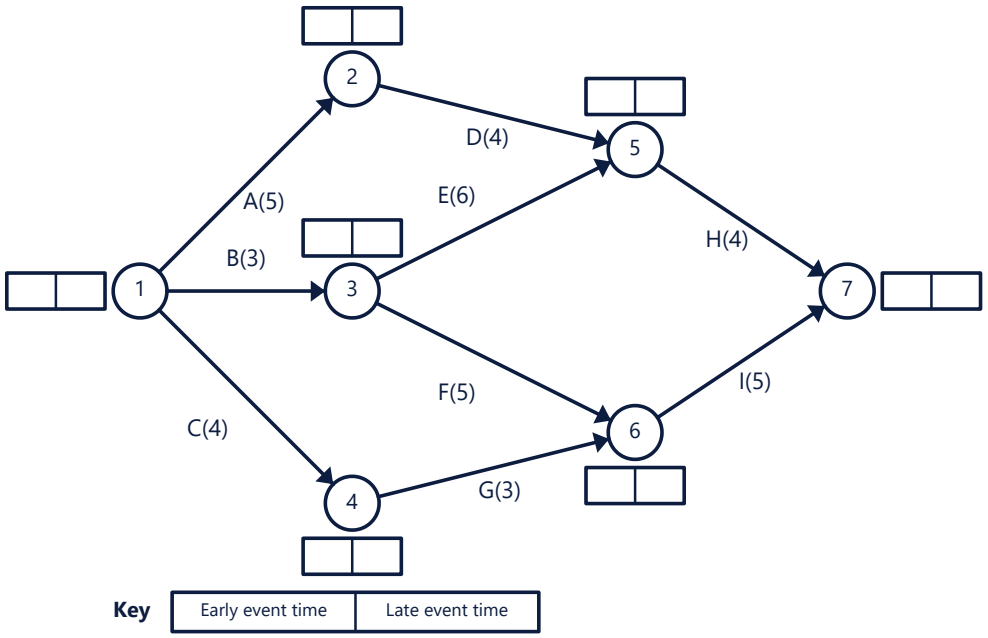
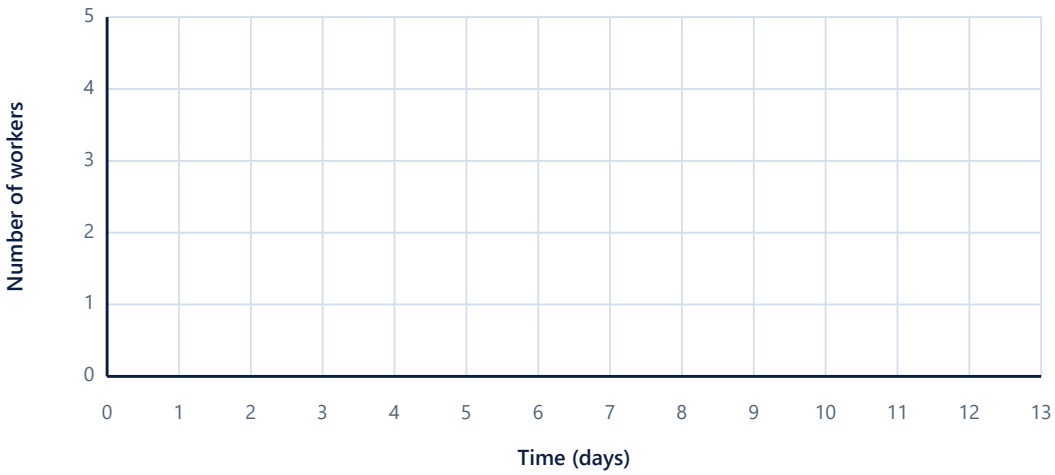


Diagram NOT accurately drawn

Activity network



Grid 1

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Answer

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9 Volunteers are preparing a village fete in Devon. The network below shows the activities, with durations in hours in brackets. Each activity requires one worker.

a. Complete the diagram to show the early event time and the late event time at each event, and state the minimum completion time.

b. Calculate a lower bound for the number of workers needed to complete the project in the minimum time.

c. Only two volunteers, Ffion and Ravi, are available. On Grid 1, draw a schedule for the two workers that completes the project in the shortest possible time, and state this time.

d. Explain why the project cannot be completed by the two workers in less time than your answer to part (c).

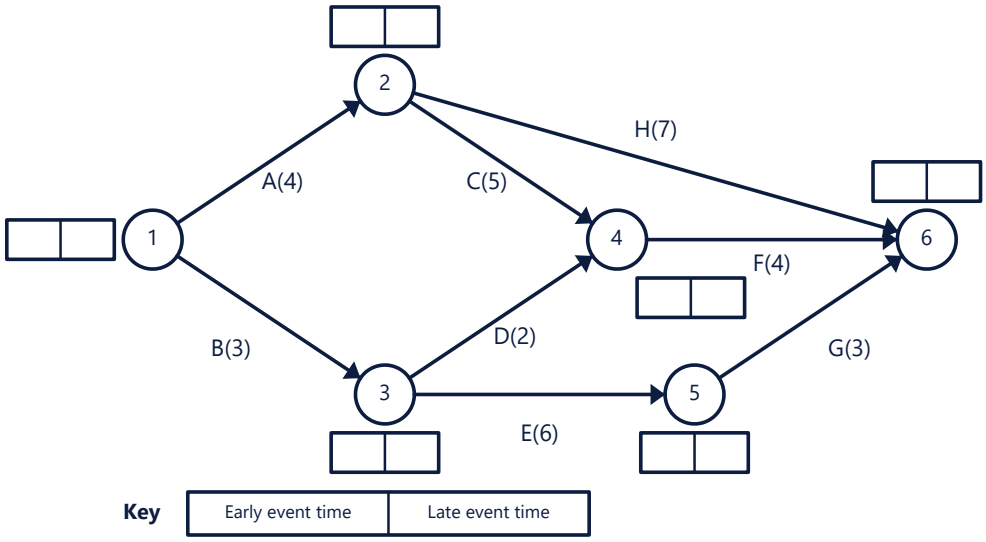


Diagram NOT accurately drawn

Activity network



Grid 1

(9 marks)

Answer

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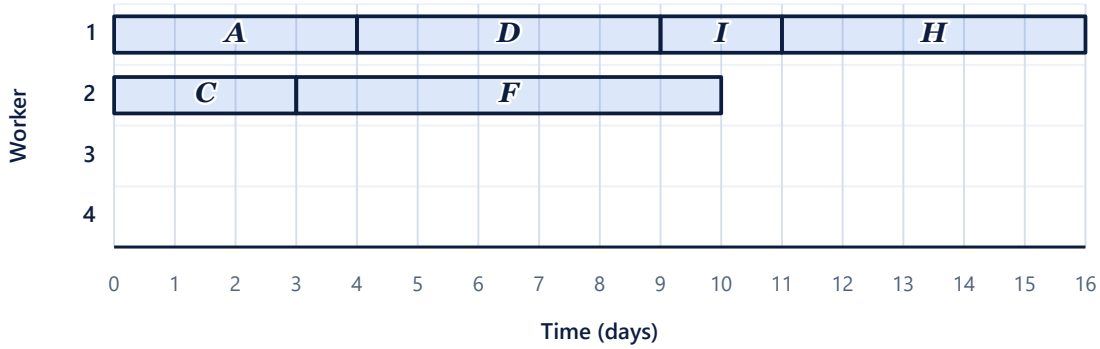
10 Mehmet is building a garden office. The precedence table shows the activities, with durations in days. Each activity requires one worker.

Activity	Immediately preceding activities	Duration (days)
A	–	4
B	–	6
C	–	3
D	A	5
E	A, B	4
F	C	7
G	D	6
H	E, F, I	5
I	D	2

a. Find the earliest start time and the latest finish time of each activity.

b. State the minimum completion time of the project and the critical activities.

c. Three workers are available. The grid below shows a partly completed schedule, with six of the activities already placed. Complete the schedule so that the project is finished in the minimum time.



(9 marks)

Answer _____

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11 A crew is building a stage for a music festival in Glasgow. The network below shows the activities, with durations in hours in brackets. The table gives the number of workers each activity needs. Once an activity has started it must continue until it is finished.

Activity	A	B	C	D	E	F	G	H
Number of workers	3	2	2	3	1	2	2	1

a. Complete the diagram to show the early event time and the late event time at each event, and state the minimum completion time.

b. On Grid 1, draw a resource histogram for the project, given that each activity starts at its earliest start time.

c. Only five workers are available at any time. Given that the project cannot now be completed in less than 14 hours, draw on Grid 2 a resource histogram showing how the project can be completed in 14 hours using no more than five workers at any time. State the start time of each activity.

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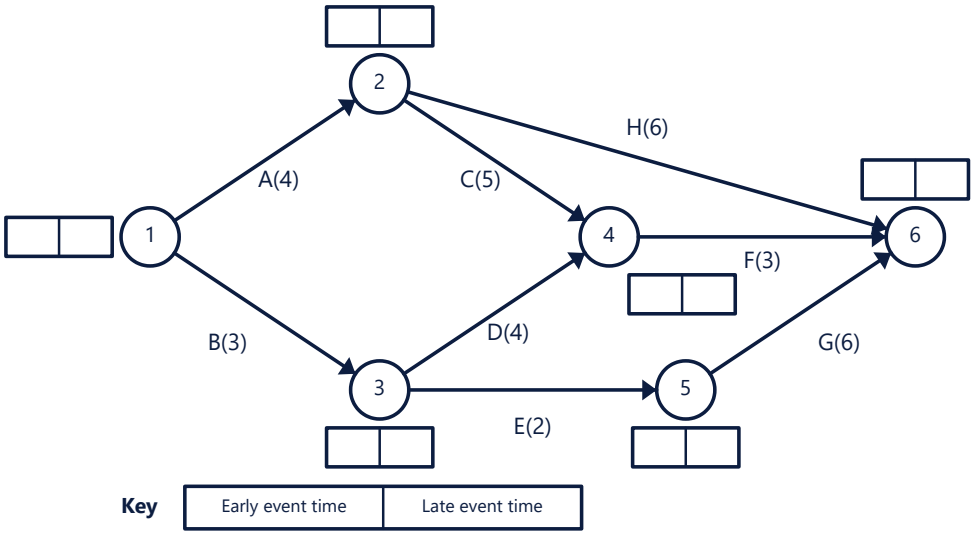
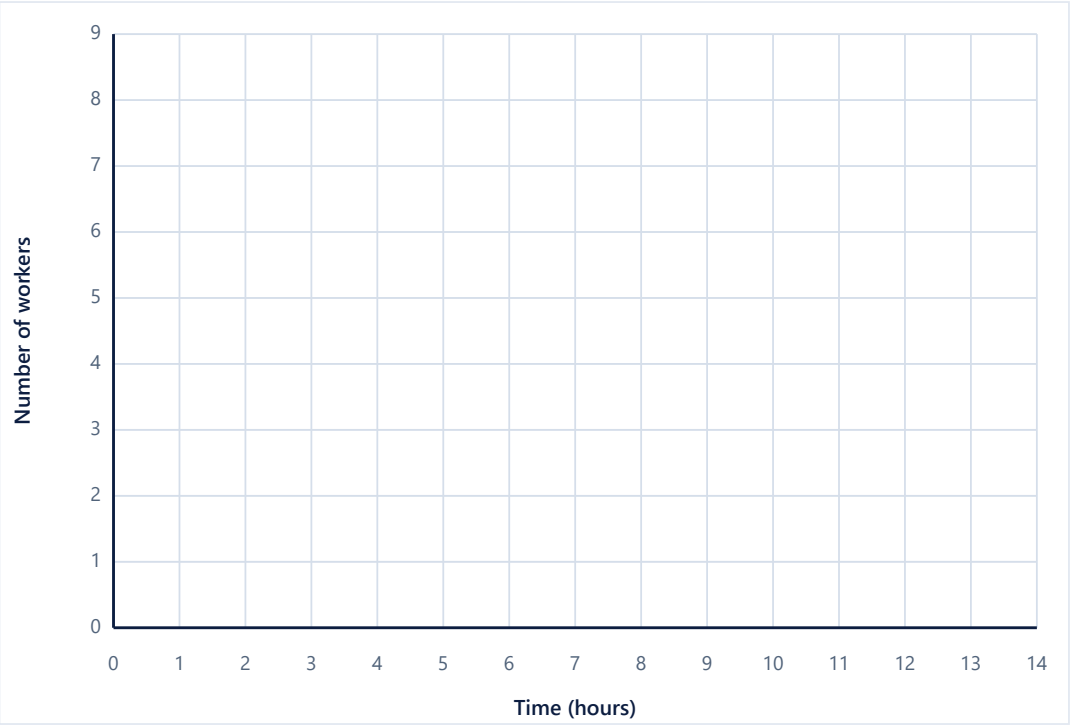


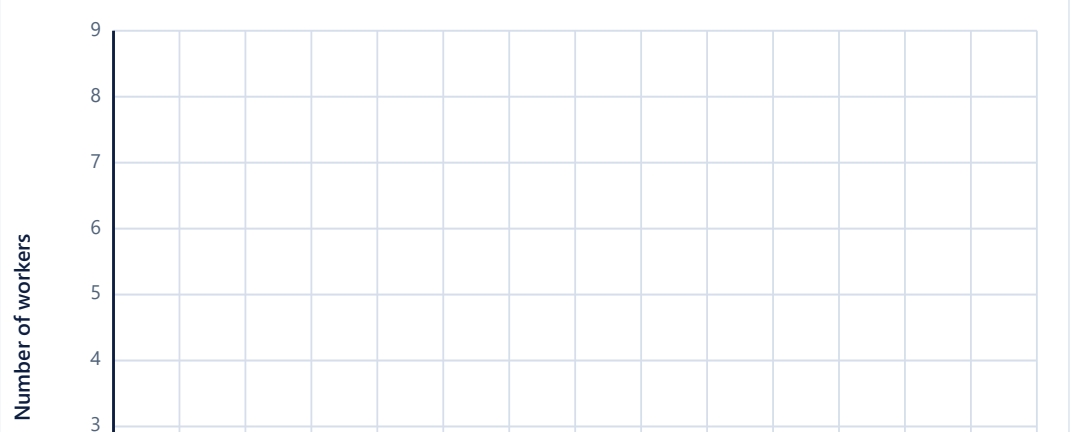
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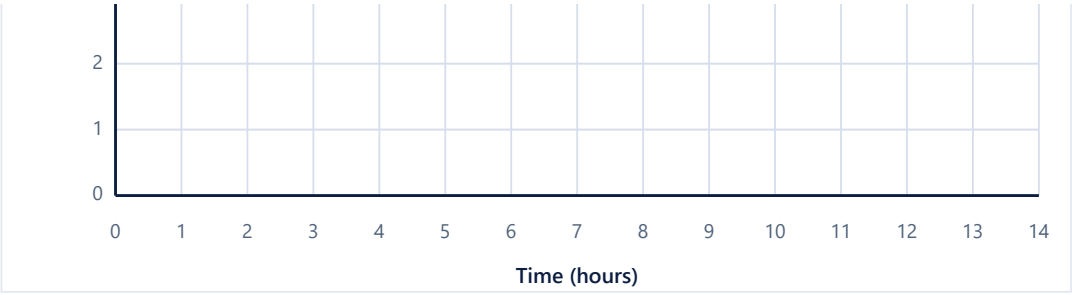
Activity network

(10 marks)



Grid 1





Grid 2

Answer _____

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12 A house extension in Birmingham is being built. The activity network below shows the activities, with durations in days in brackets. Each activity requires one worker and the project is to be completed in the shortest possible time.

a. Complete the diagram to show the early event time and the late event time at each event.

b. On Grid 1, draw a cascade (Gantt) chart for the project, with the critical activities on the top row.

c. Calculate a lower bound for the number of workers needed to complete the project in the shortest possible time.

d. On Grid 2, schedule the activities using the number of workers found in part (c) so that the project is completed in the shortest possible time.

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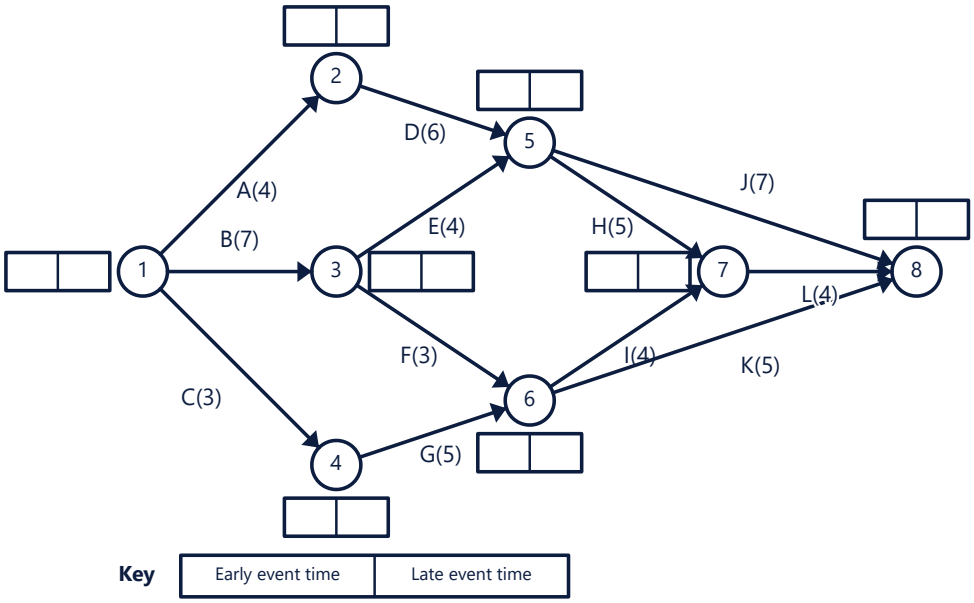
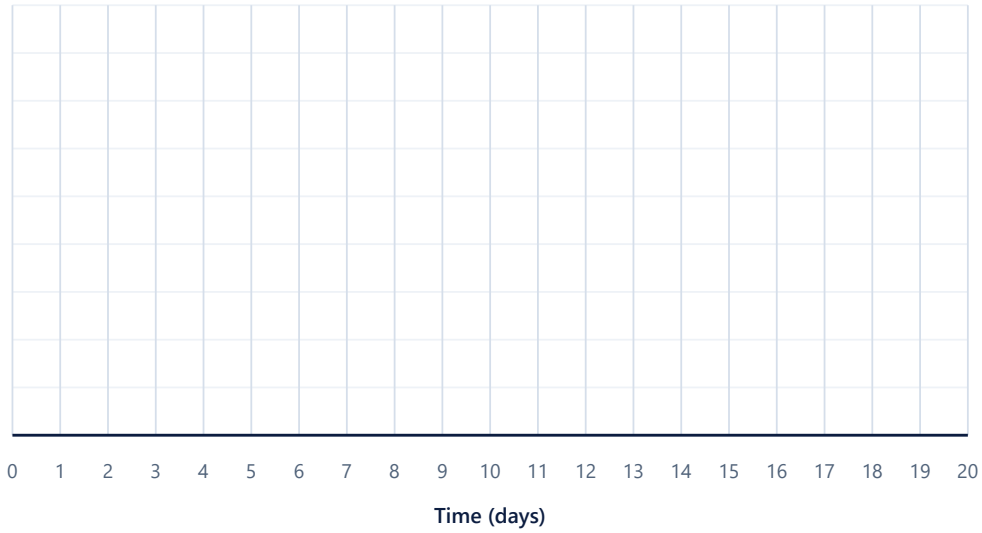


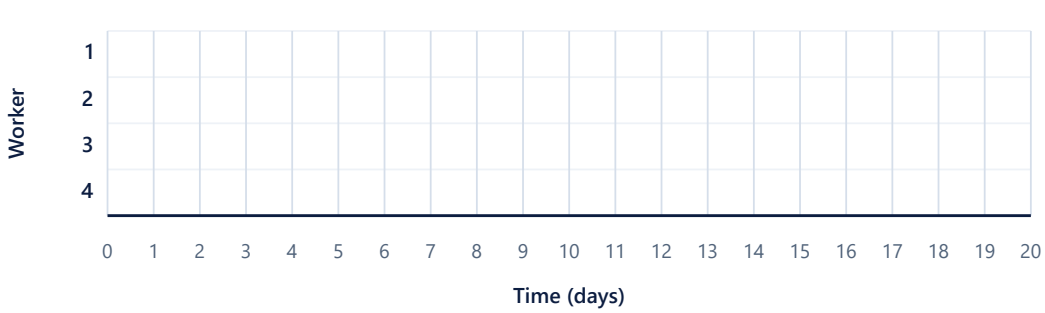
Diagram NOT accurately drawn

Activity network

(12 marks)



Grid 1



Grid 2

Answer _____

End of questions | Total 87 marks

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