D2: Critical Path Analysis

Past Paper Questions
2006 - 2013

Name:

3 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

A building project is to be undertaken. The table shows the activities involved.

Activity	Immediate Predecessors	Duration (days)	Number of Workers Required
A	—	2	3
B	*A*	4	2
C	*A*	6	1
D	*B*, *C*	8	3
E	*C*	3	2
F	*D*	2	2
G	*D*, *E*	4	2
H	*D*, *E*	6	1
I	*F*, *G*, *H*	2	3

(a) Complete the activity network for the project on **Figure 1**. *(3 marks)*

(b) Find the earliest start time for each activity. *(2 marks)*

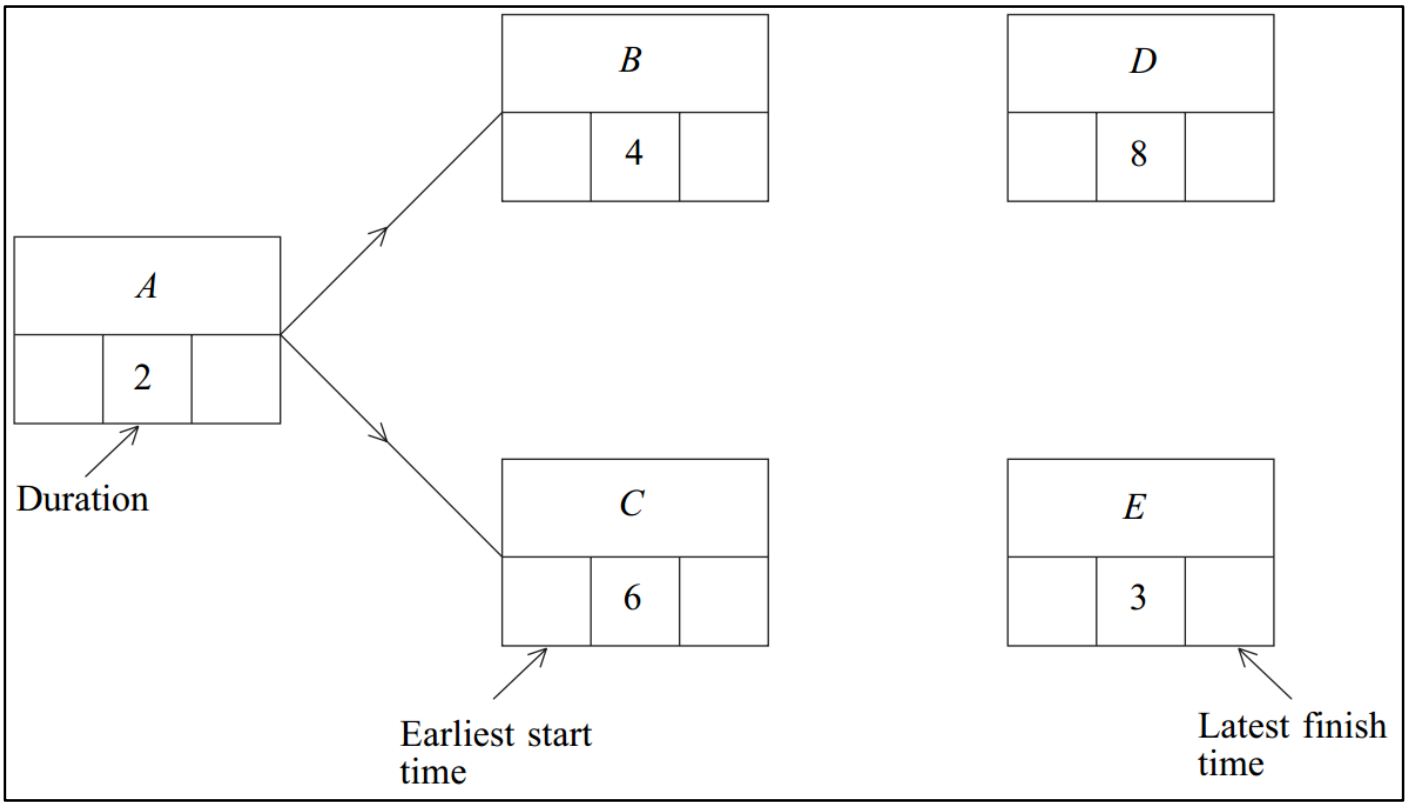
(c) Find the latest finish time for each activity. *(2 marks)*

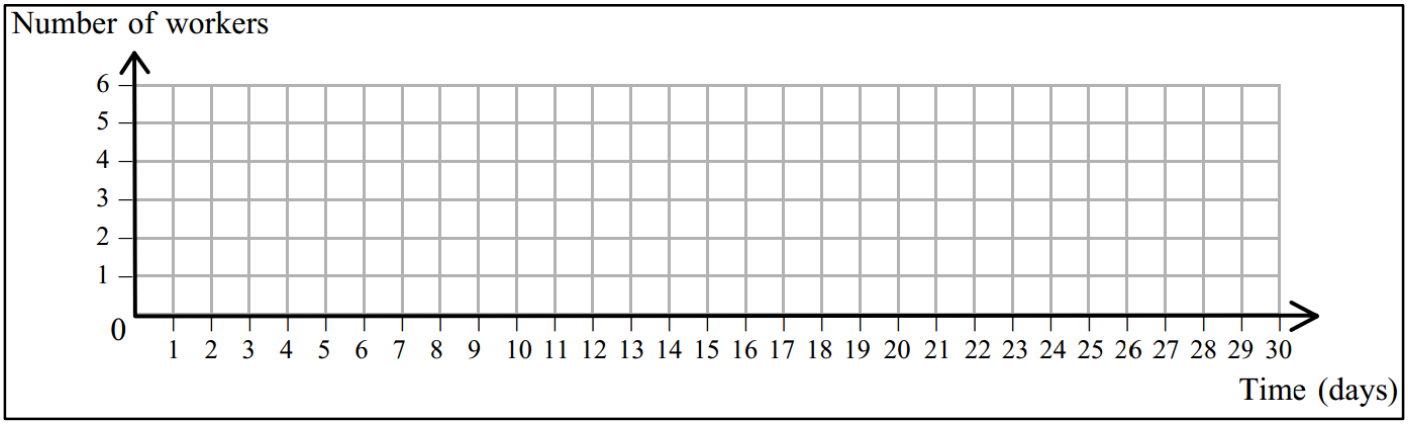
(d) Find the critical path and state the minimum time for completion. *(2 marks)*

(e) State the float time for each non-critical activity. *(2 marks)*

(f) Given that each activity starts as early as possible, draw a resource histogram for the project on **Figure 2**. *(4 marks)*

(g) There are only 3 workers available at any time. Use resource levelling to explain why the project will overrun and state the minimum extra time required. *(3 marks)*


B
4
D
8
A
2
Duration
C
6
E
3
Earliest start time
Latest finish time


Number of workers
6
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (days)

1 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

A construction project is to be undertaken. The table shows the activities involved.

Activity	Immediate Predecessors	Duration (days)
A	–	2
B	*A*	5
C	*A*	8
D	*B*	8
E	*B*	10
F	*B*	4
G	*C*, *F*	7
H	*D*, *E*	4
I	*G*, *H*	3

(a) Complete the activity network for the project on **Figure 1**. *(3 marks)*

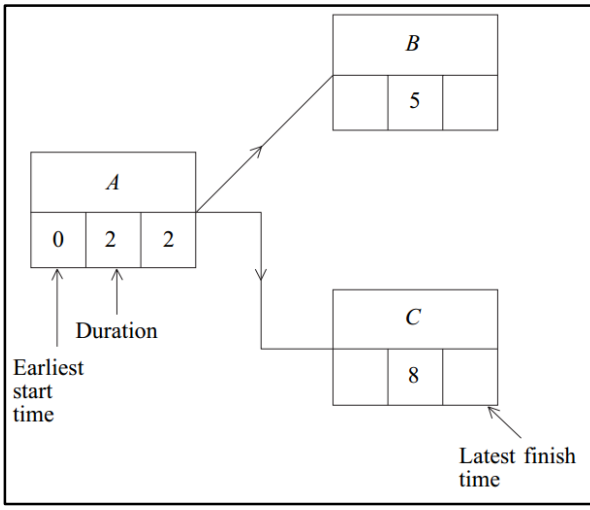
(b) Find the earliest start time for each activity. *(2 marks)*

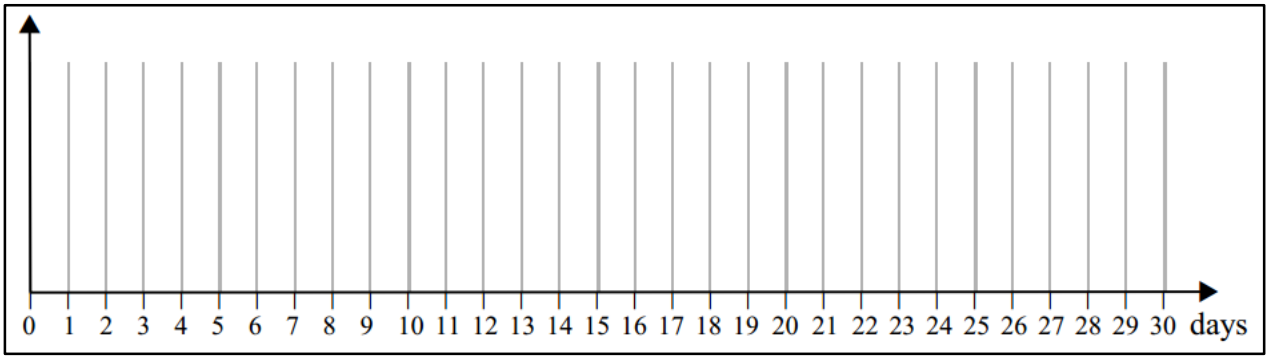
(c) Find the latest finish time for each activity. *(2 marks)*

(d) Find the critical path. *(1 mark)*

(e) State the float time for each non-critical activity. *(2 marks)*

(f) On **Figure 2**, draw a cascade diagram (Gantt chart) for the project, assuming each activity starts as **late** as possible. *(4 marks)*





1 [**Figure 1**, printed on the insert, is provided for use in this question.]

A building project is to be undertaken. The table shows the activities involved.

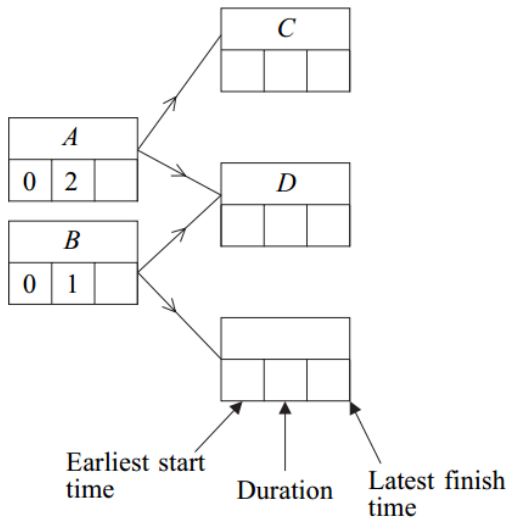
Activity	Immediate Predecessors	Duration (weeks)
A	–	2
B	–	1
C	*A*	3
D	*A*, *B*	2
E	*B*	4
F	*C*	1
G	*C*, *D*, *E*	3
H	*E*	5
I	*F*, *G*	2
J	*H*, *I*	3

(a) Complete an activity network for the project on **Figure 1**. *(3 marks)*

(b) Find the earliest start time for each activity. *(2 marks)*

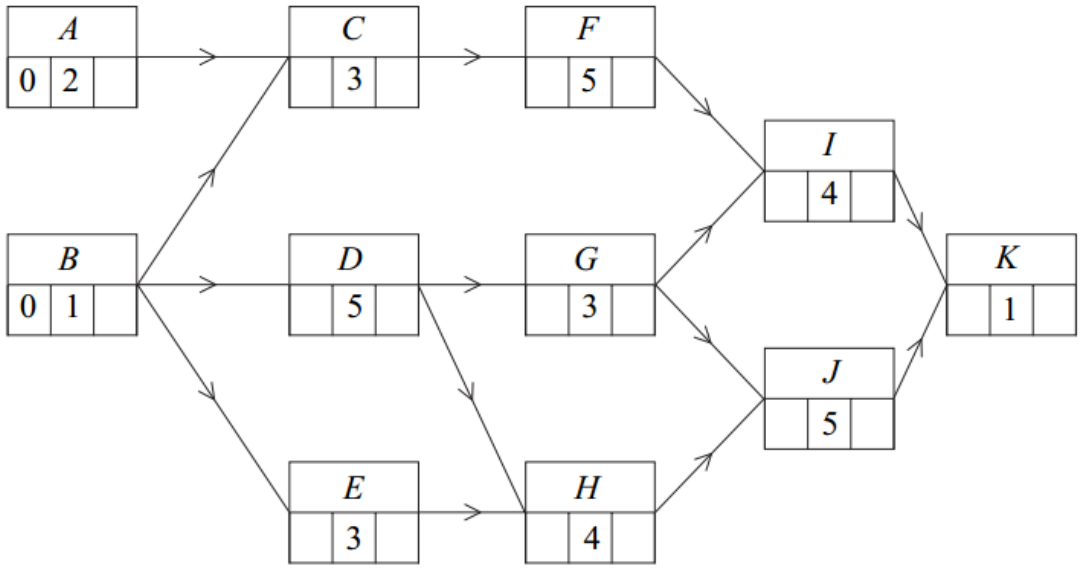
(c) Find the latest finish time for each activity. *(2 marks)*

(d) State the minimum completion time for the building project and identify the critical paths. *(4 marks)*



1 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

The following diagram shows an activity diagram for a building project. The time needed for each activity is given in days.



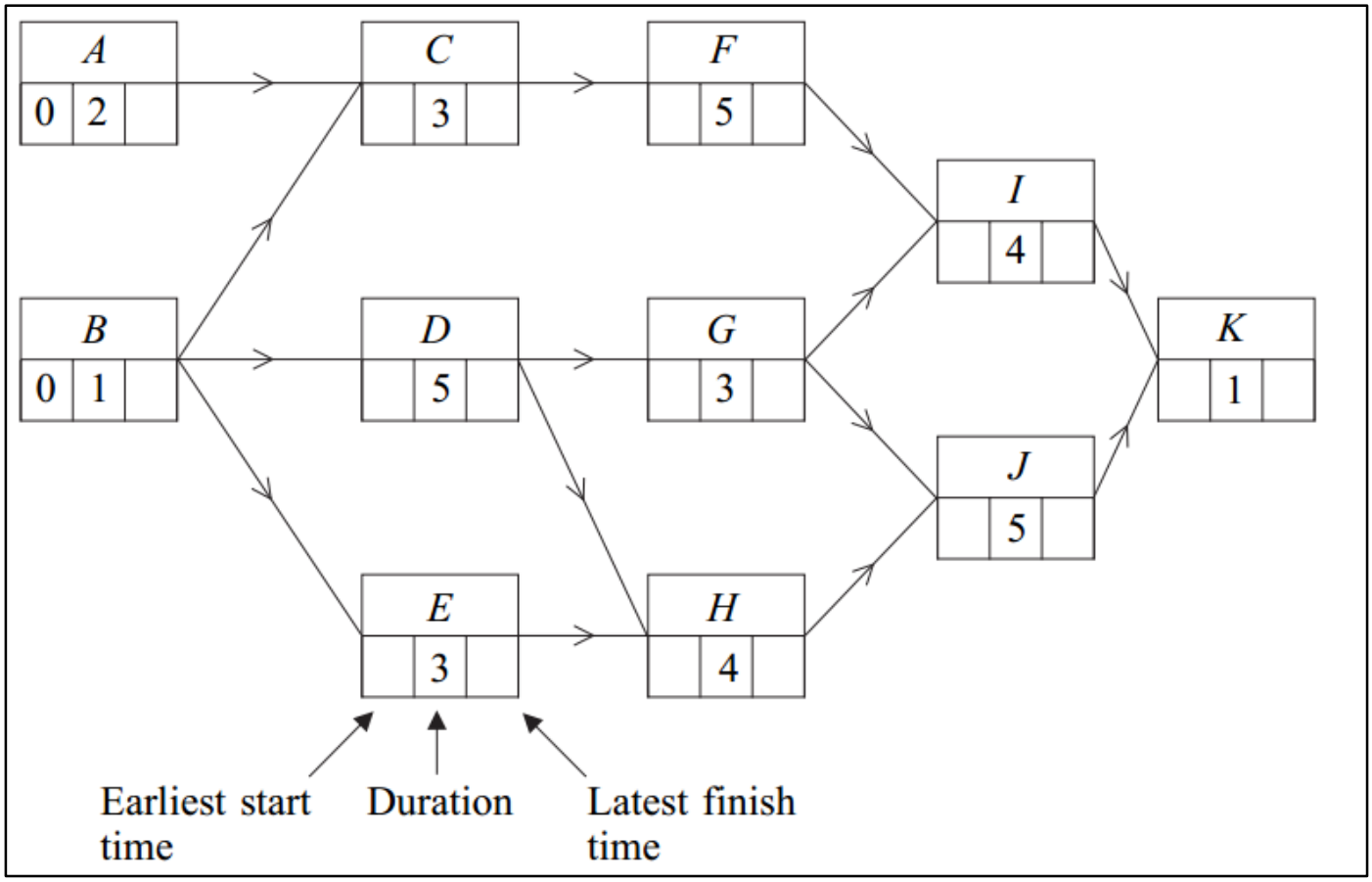
(a) Complete the precedence table for the project on **Figure 1**. *(2 marks)*

(b) Find the earliest start times and latest finish times for each activity and insert their values on **Figure 2**. *(4 marks)*

(c) Find the critical path and state the minimum time for completion of the project. *(2 marks)*

(d) Find the activity with the greatest float time and state the value of its float time. *(2 marks)*

Activity	Immediate Predecessors
A	–
B	–
C	
D	
E	
F	
G	
H	
I	
J	
K	



1 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

A group of workers is involved in a building project. The table shows the activities involved. Each worker can perform any of the given activities.

Activity	Immediate predecessors	Duration (days)	Number of workers required
A	–	3	5
B	*A*	8	2
C	*A*	7	3
D	*B*, *C*	8	4
E	*C*	10	2
F	*C*	3	3
G	*D*, *E*	3	4
H	*F*	6	1
I	*G*, *H*	2	3

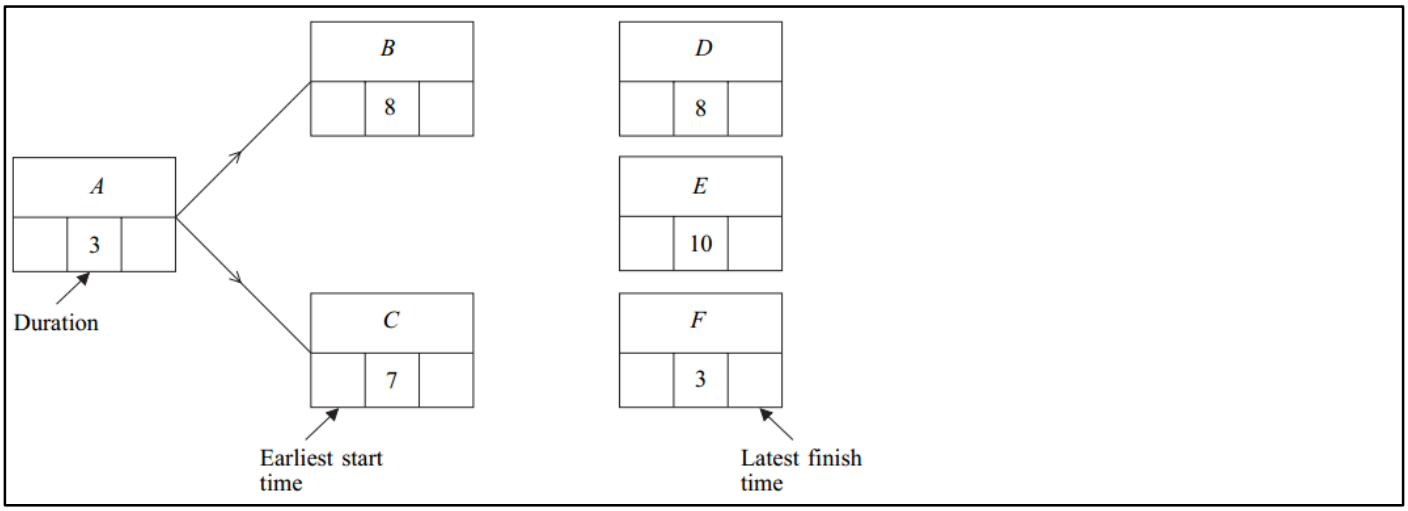
(a) Complete the activity network for the project on **Figure 1**. *(2 marks)*

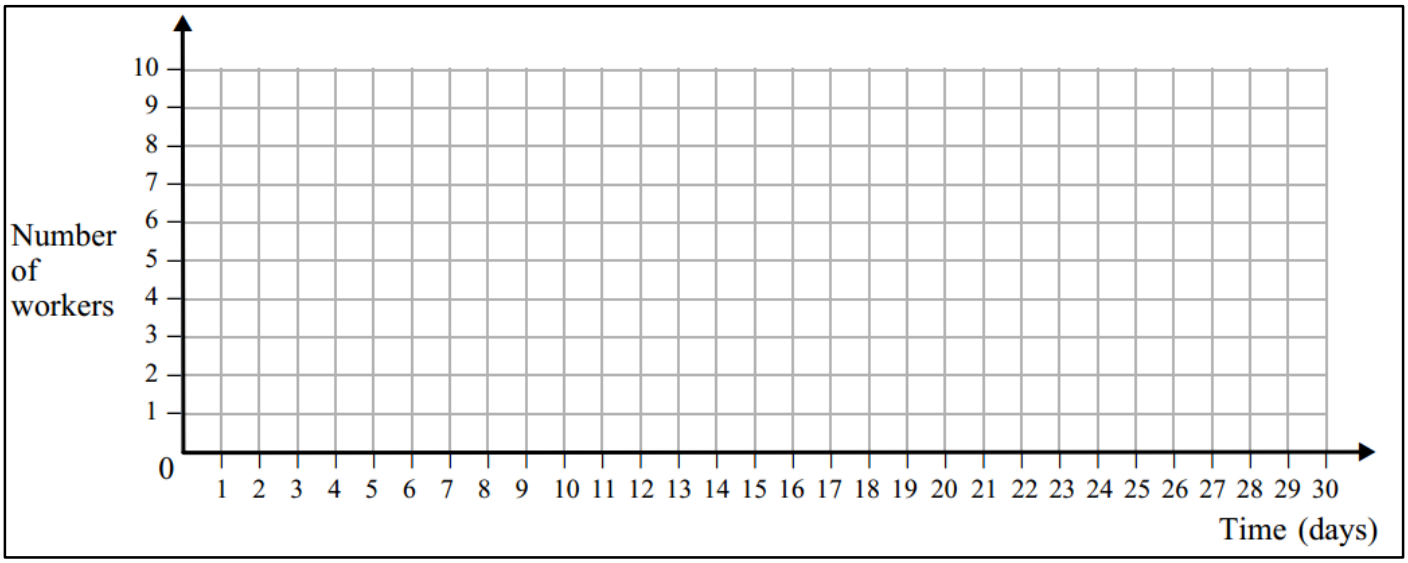
(b) Find the earliest start time and the latest finish time for each activity, inserting their values on **Figure 1**. *(4 marks)*

(c) Find the critical path and state the minimum time for completion. *(2 marks)*

(d) The number of workers required for each activity is given in the table above. Given that each activity starts as early as possible and assuming there is no limit to the number of workers available, draw a resource histogram for the project on **Figure 2**, indicating clearly which activities take place at any given time. *(4 marks)*

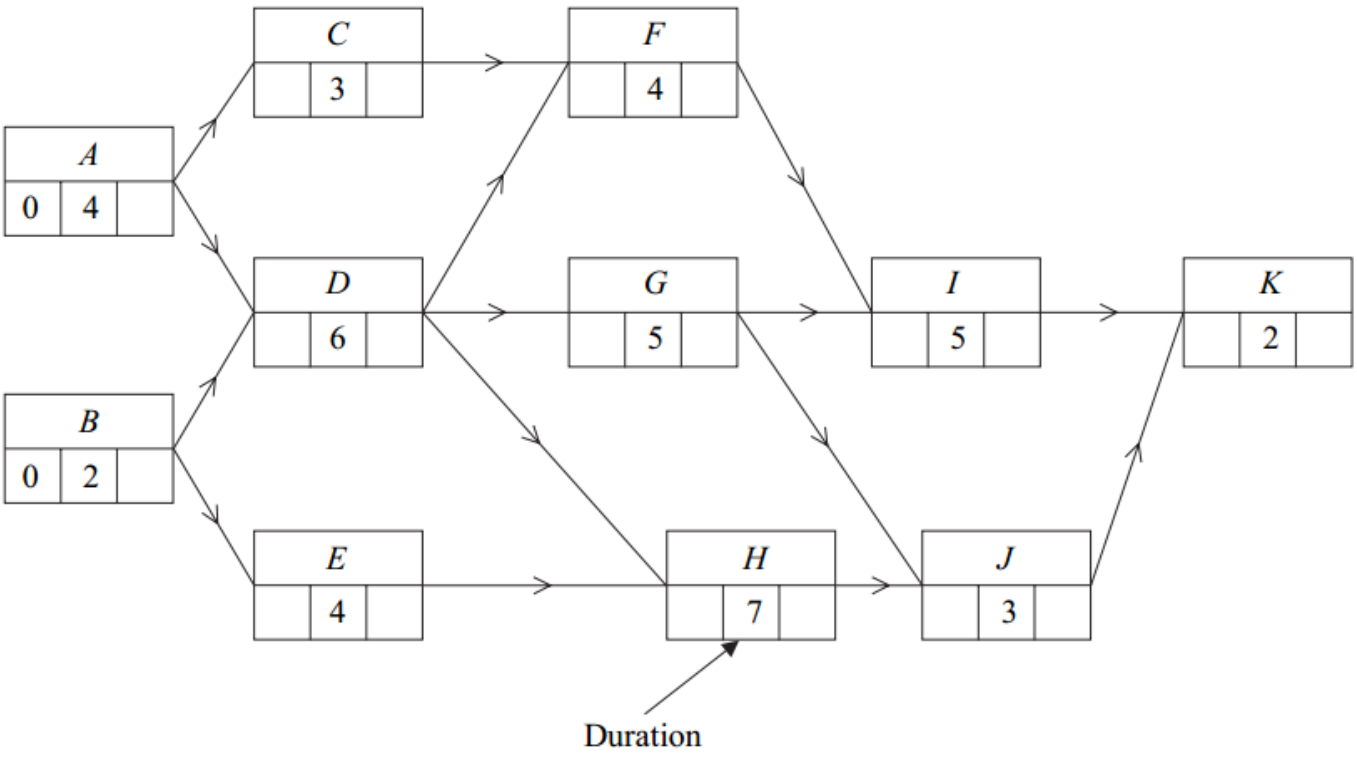
(e) It is later discovered that there are only 7 workers available at any time. Use resource levelling to explain why the project will overrun and indicate which activities need to be delayed so that the project can be completed with the minimum extra time. State the minimum extra time required. *(3 marks)*


A
3
Duration
B
8
C
7
Earliest start time
D
8
E
10
F
3
Latest finish time


Number of workers
0
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (days)

1 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

The following diagram shows an activity network for a project. The time needed for each activity is given in days.

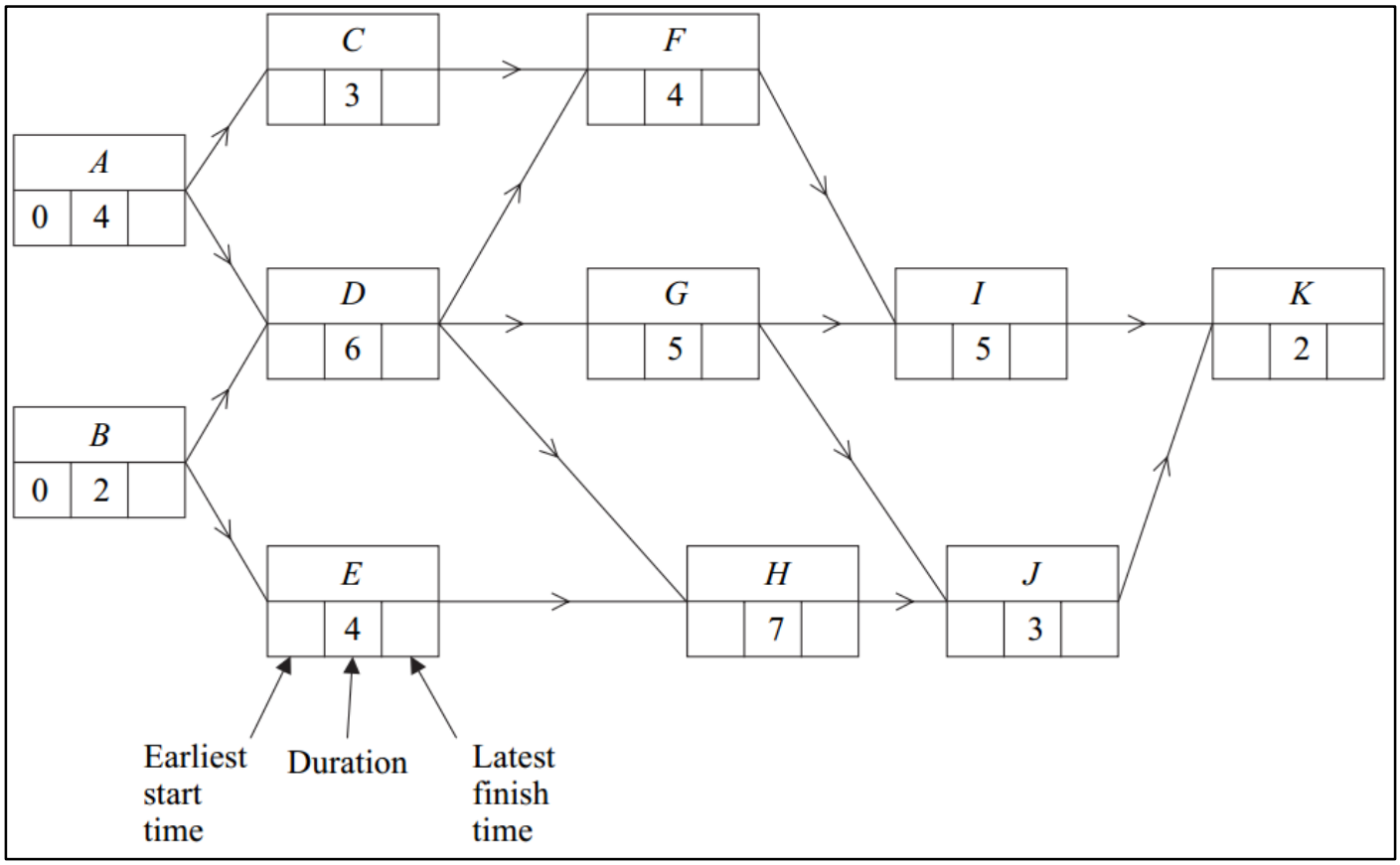


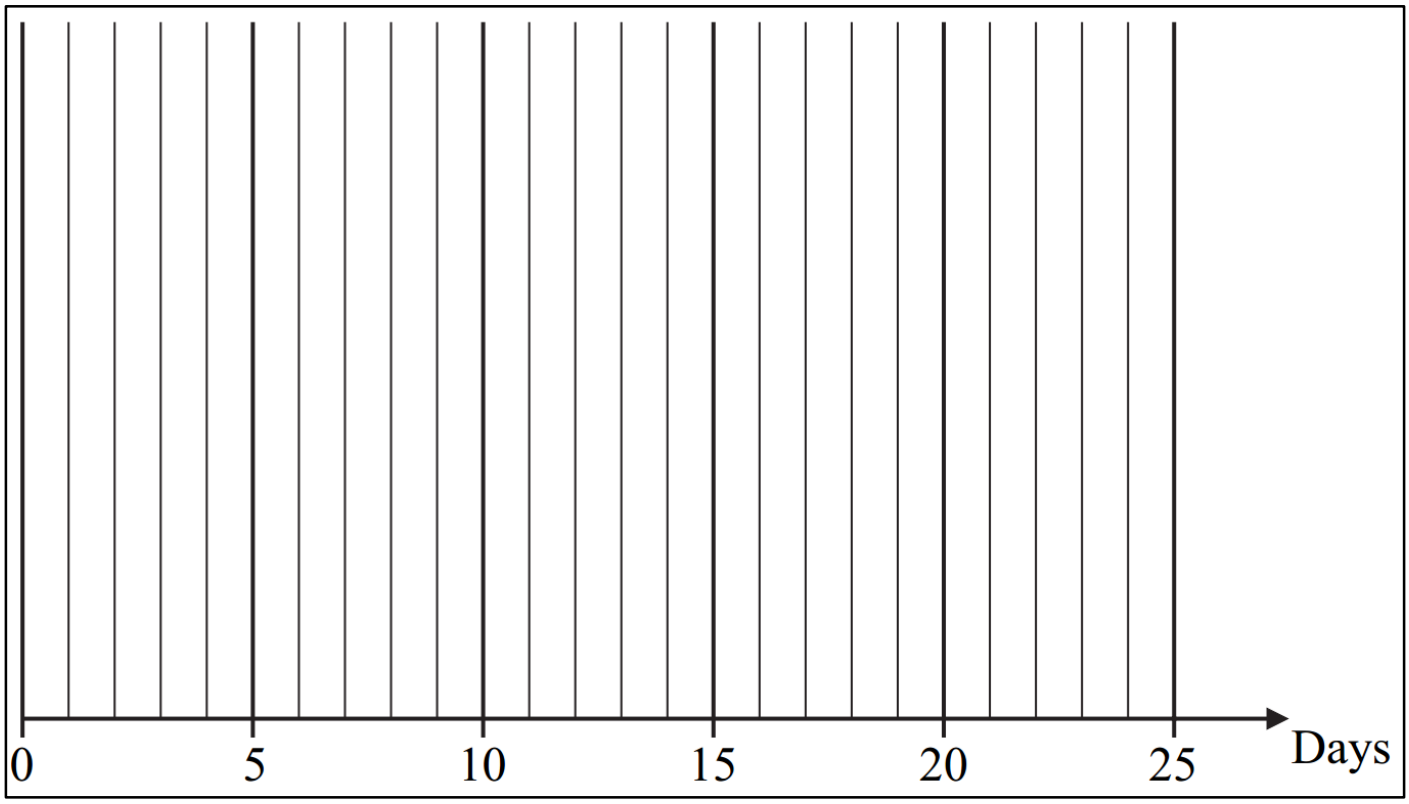
(a) Find the earliest start time and the latest finish time for each activity and insert their values on **Figure 1**. *(4 marks)*

(b) Find the critical paths and state the minimum time for completion. *(3 marks)*

(c) On **Figure 2**, draw a cascade diagram (Gantt chart) for the project, assuming each activity starts as early as possible. *(3 marks)*

(d) Activity *C* takes 5 days longer than first expected. Determine the effect on the earliest start time for other activities and the minimum completion time for the project. *(2 marks)*


A
0
4
B
0
2
C
3
D
6
E
4
F
4
G
5
H
7
I
5
J
3
K
2
Earliest start time
Duration
Latest finish time


0
5
10
15
20
25
Days

2 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

Figure 1 shows the activity network and the duration in days of each activity for a particular project.

(a) On **Figure 1**:

(i) find the earliest start time for each activity; *(2 marks)*

(ii) find the latest finish time for each activity. *(2 marks)*

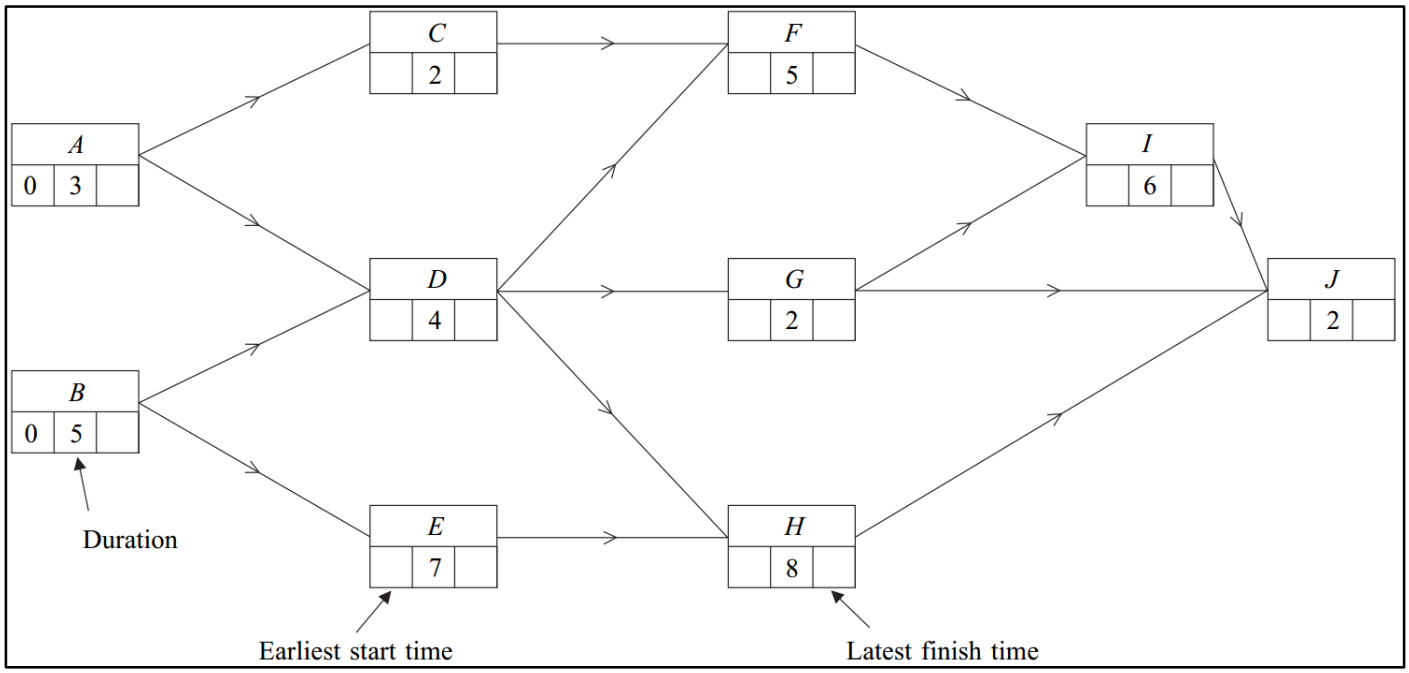
(b) Find the critical paths and state the minimum time for completion. *(3 marks)*

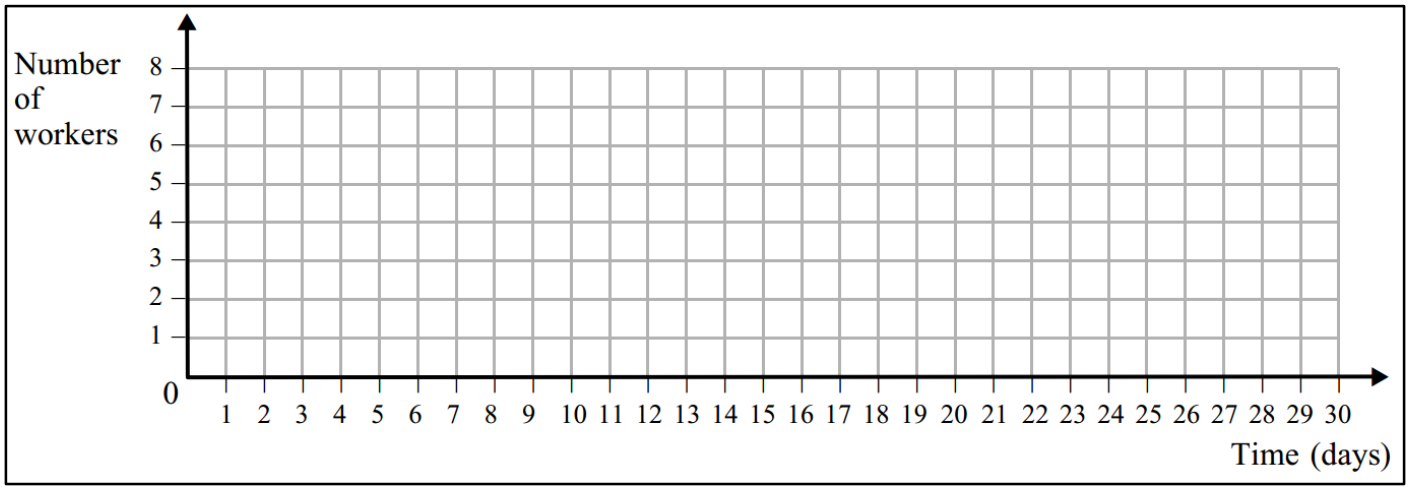
(c) The number of workers required for each activity is shown in the table.

Activity	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
Number of workers required	3	3	4	2	3	4	1	2	2	5

(i) Given that each activity starts as early as possible and assuming that there is no limit to the number of workers available, draw a resource histogram for the project on **Figure 2**, indicating clearly which activities take place at any given time. *(4 marks)*

(ii) It is later discovered that there are only 6 workers available at any time. Explain why the project will overrun, and use resource levelling to indicate which activities need to be delayed so that the project can be completed with the minimum extra time. State the minimum extra time required. *(3 marks)*


C
2
F
5
A
0
3
I
6
D
4
G
2
J
2
B
0
5
Duration
E
7
H
8
Earliest start time
Latest finish time


Number of workers
0
1
2
3
4
5
6
7
8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (days)

June 2009

1 [**Figure 1**, printed on the insert, is provided for use in this question.]

A decorating project is to be undertaken. The table shows the activities involved.

Activity	Immediate Predecessors	Duration (days)
A	–	5
B	–	3
C	–	2
D	*A*, *B*	4
E	*B*, *C*	1
F	*D*	2
G	*E*	9
H	*F*, *G*	1
I	*H*	6
J	*H*	5
K	*I*, *J*	2

(a) Complete an activity network for the project on **Figure 1**. *(3 marks)*

(b) On **Figure 1**, indicate:

(i) the earliest start time for each activity; *(2 marks)*

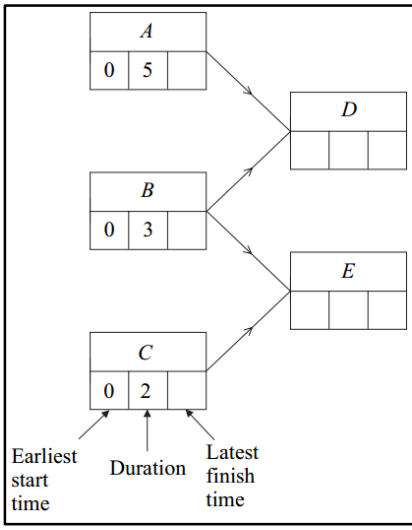
(ii) the latest finish time for each activity. *(2 marks)*

(c) State the minimum completion time for the decorating project and identify the critical path. *(2 marks)*

(d) Activity *F* takes 4 days longer than first expected.

(i) Determine the new earliest start time for activities *H* and *I*. *(2 marks)*

(ii) State the minimum delay in completing the project. *(1 mark)*



January 2010

1 [**Figures 1 and 2**, printed on the insert, are provided for use in this question.]

Figure 1 shows the activity network and the duration, in days, of each activity for a particular project.

(a) On **Figure 1**:

(i) find the earliest start time for each activity; *(2 marks)*

(ii) find the latest finish time for each activity. *(2 marks)*

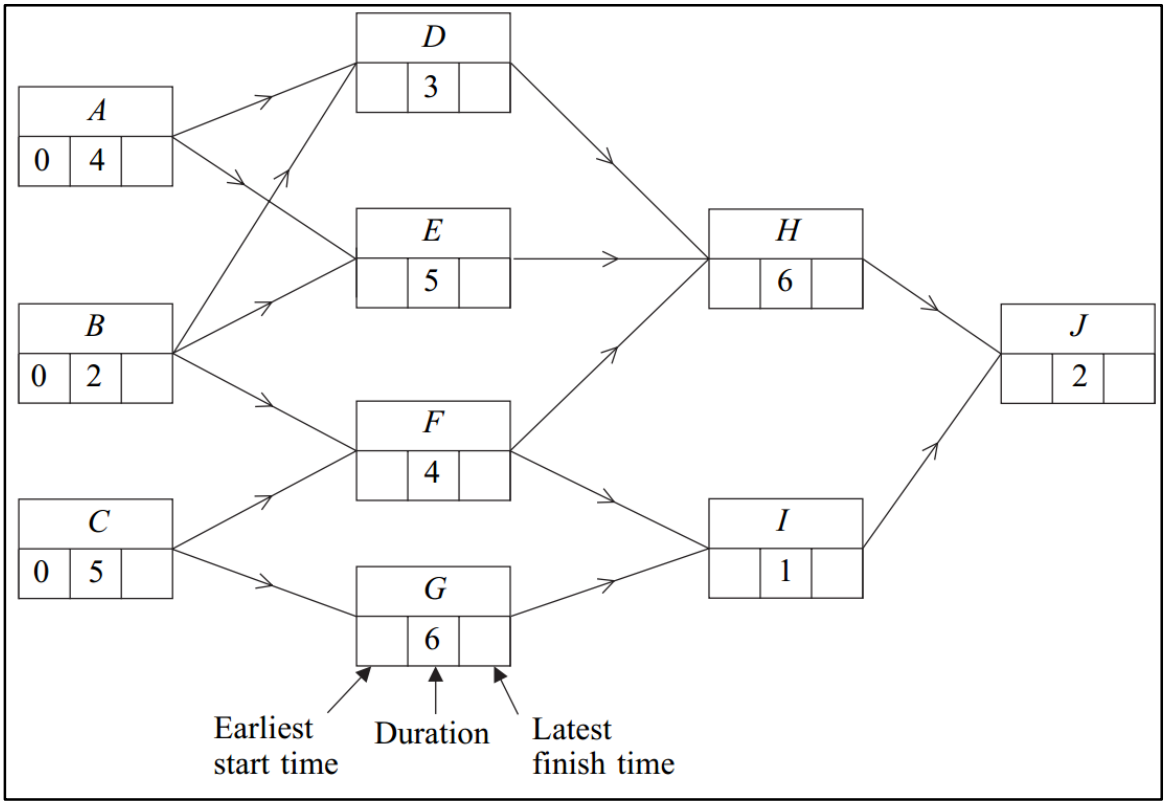
(b) Find the float for activity *G*. *(1 mark)*

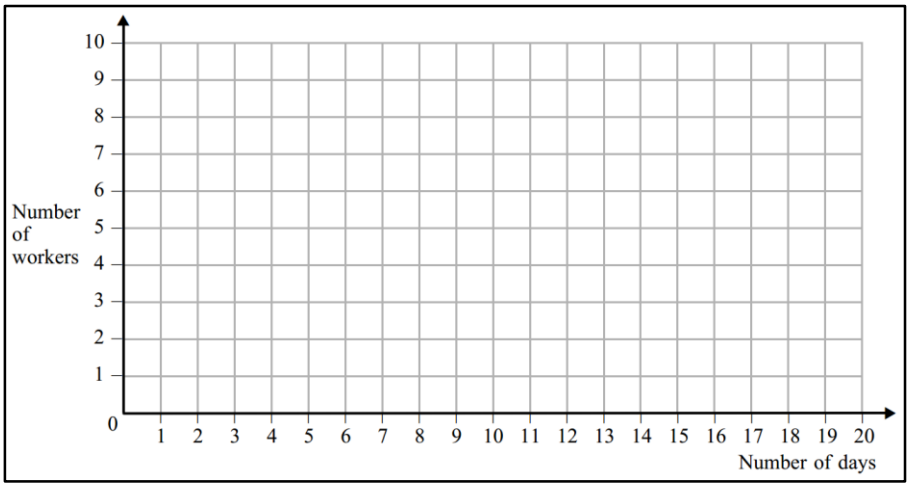
(c) Find the critical paths and state the minimum time for completion. *(3 marks)*

(d) The number of workers required for each activity is shown in the table.

Activity	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
Number of workers required	2	2	3	2	3	2	1	3	5	2

Given that each activity starts as **late** as possible and assuming that there is no limit to the number of workers available, draw a resource histogram for the project on **Figure 2**, indicating clearly which activities take place at any given time. *(5 marks)*





1 **Figure 1** below shows an activity diagram for a construction project. The time needed for each activity is given in days.

(a) Find the earliest start time and latest finish time for each activity and insert their values on **Figure 1**. *(4 marks)*

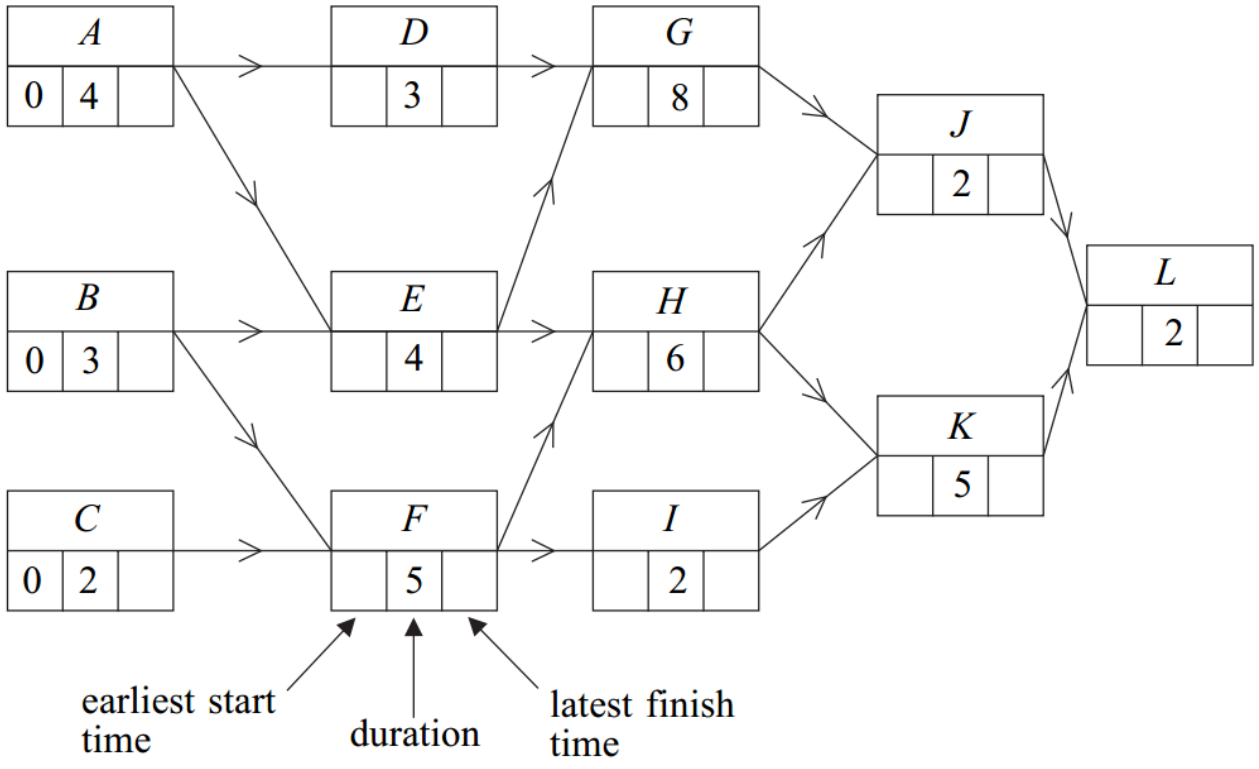
(b) Find the critical paths and state the minimum time for completion of the project. *(3 marks)*

(c) On **Figure 2** opposite, draw a cascade diagram (Gantt chart) for the project, assuming that each activity starts as early as possible. *(3 marks)*

(d) A delay in supplies means that Activity *I* takes 9 days instead of 2 .

(i) Determine the effect on the **earliest** possible starting times for activities *K* and *L*. *(2 marks)*

(ii) State the number of days by which the completion of the project is now delayed. *(1 mark)*



Critical paths are .....

.....

Minimum completion time is ..... days.

1 A group of workers is involved in a decorating project. The table shows the activities involved. Each worker can perform any of the given activities.

Activity	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*
Duration (days)	2	5	6	7	9	4	3	2	3	2	3	1
Number of workers required	6	3	5	2	5	2	4	4	5	3	2	4

The activity network for the project is given in **Figure 1** below.

(a) Find the earliest start time and the latest finish time for each activity, inserting their values on **Figure 1**. *(4 marks)*

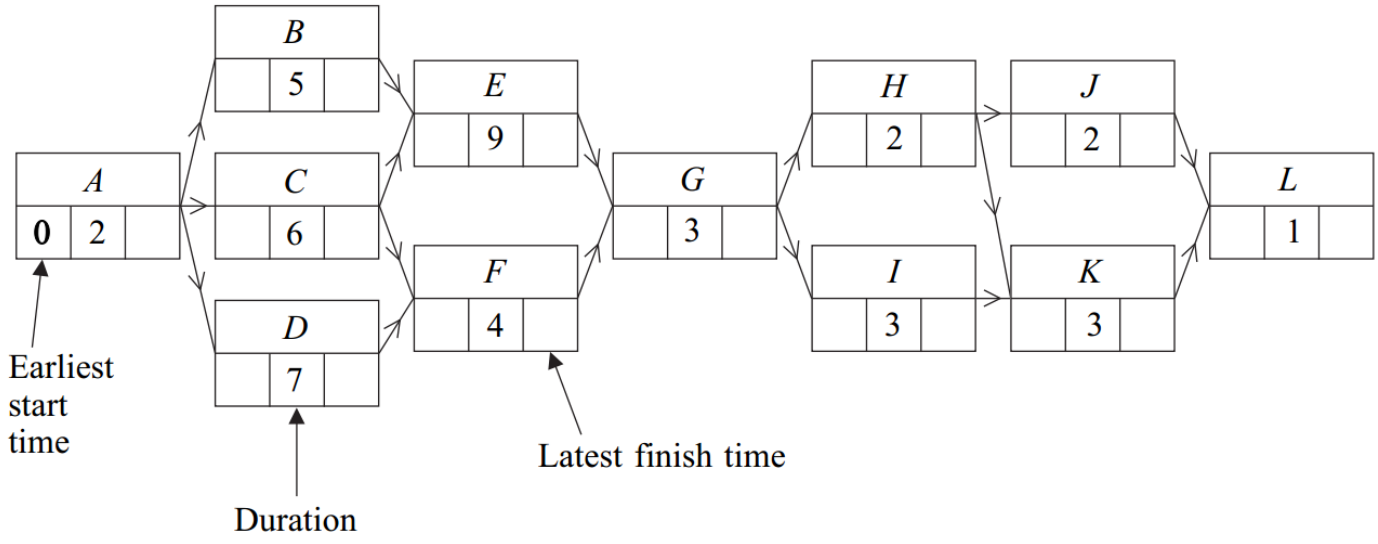
(b) Hence find:

(i) the critical path;

(ii) the float time for activity *D*. *(3 marks)*

(a)

Figure 1



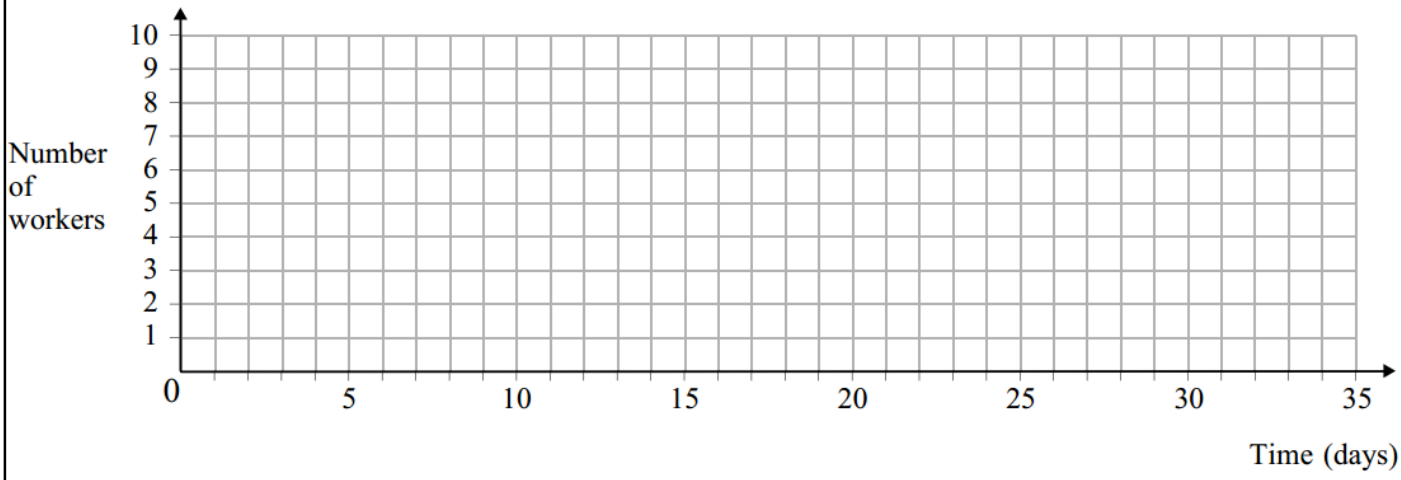
(b) (i) The critical path is .....

(ii) The float time for activity *D* is .....

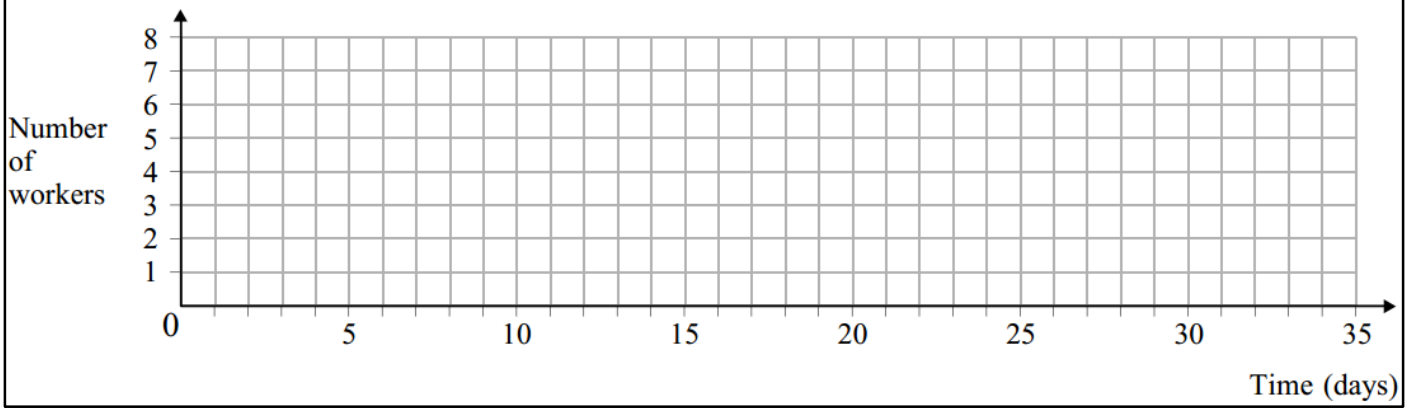
(c) Given that each activity starts as early as possible and assuming that there is no limit to the number of workers available, draw a resource histogram for the project on **Figure 2** below, indicating clearly which activities are taking place at any given time. *(4 marks)*

(d) It is later discovered that there are only 8 workers available at any time. Use resource levelling to construct a new resource histogram on **Figure 3** below, showing how the project can be completed with the minimum extra time. State the minimum extra time required. *(3 marks)*

(c) **Figure 2**



(d) **Figure 3**



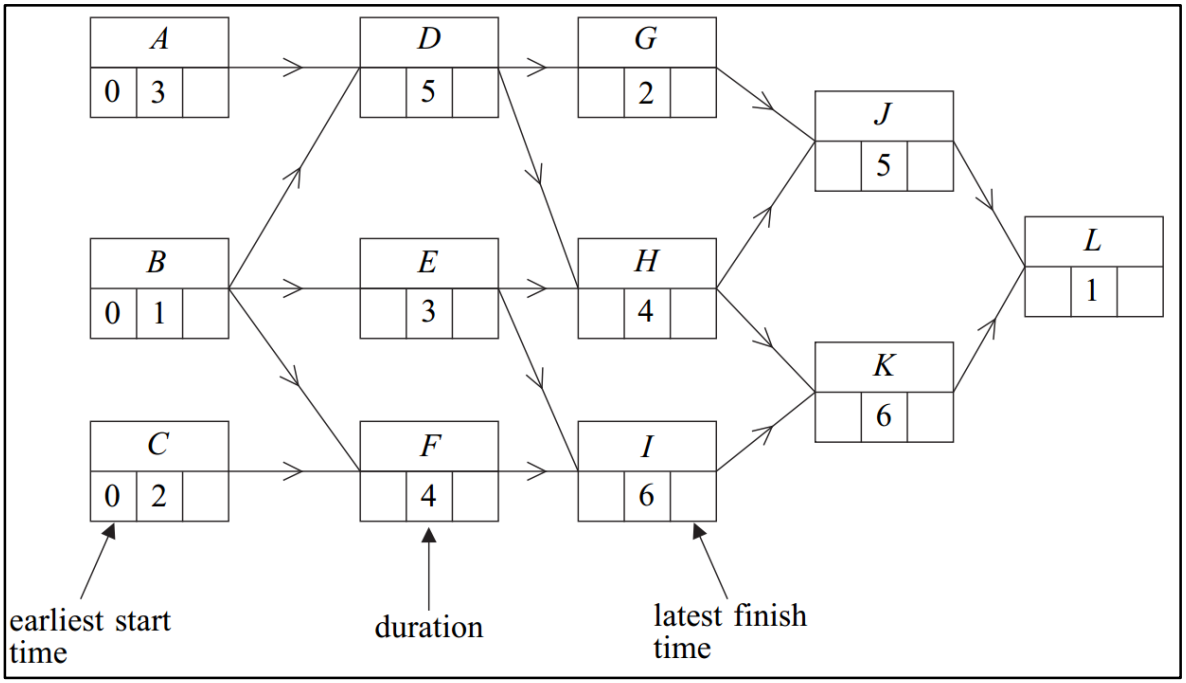
1 **Figure 1** below shows an activity diagram for a cleaning project. The duration of each activity is given in days.

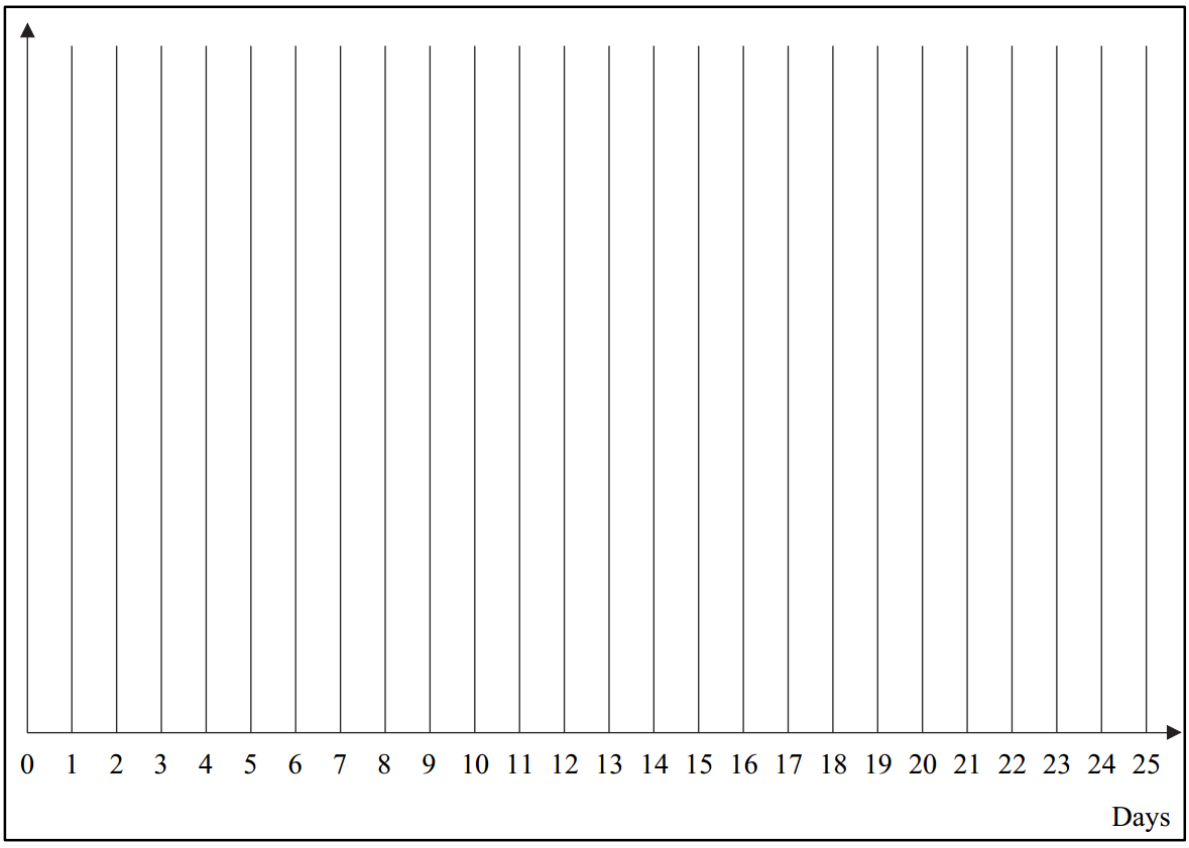
(a) Find the earliest start time and the latest finish time for each activity and insert their values on **Figure 1**. *(4 marks)*

(b) Find the critical paths and state the minimum time for completion of the project. *(3 marks)*

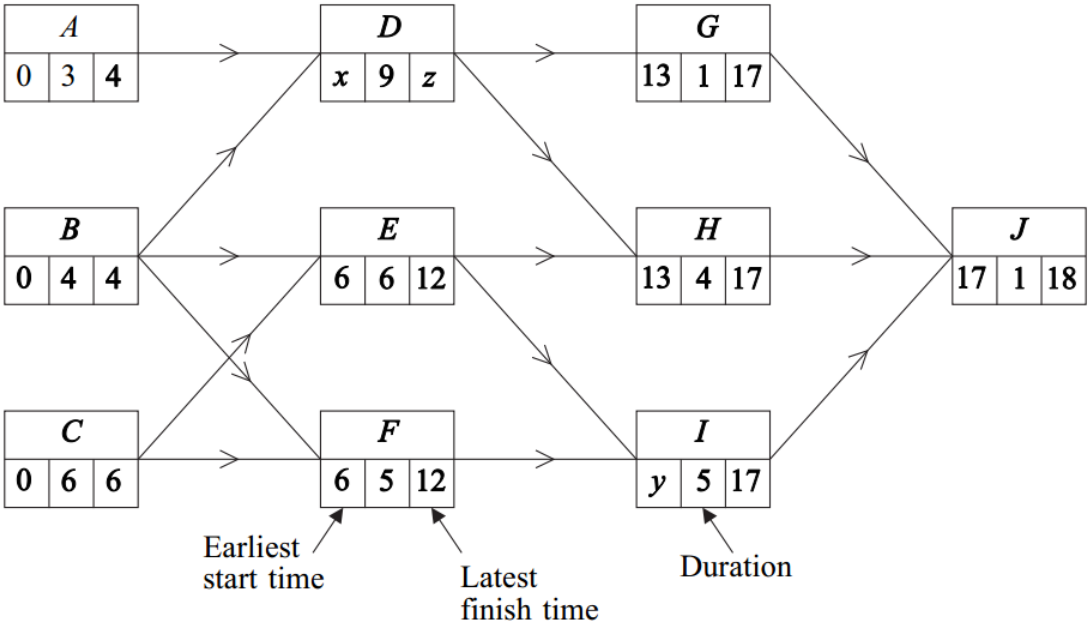
(c) Find the activity with the greatest float time and state the value of its float time. *(2 marks)*

(d) On **Figure 2** opposite, draw a cascade diagram (Gantt chart) for the project, assuming that each activity starts as **late** as possible. *(4 marks)*





1 The diagram shows the activity network and the duration, in days, of each activity for a particular project. Some of the earliest start times and latest finish times are shown on the diagram.



(a) Find the values of the constants x, y and z. *(3 marks)*

(b) Find the critical paths. *(2 marks)*

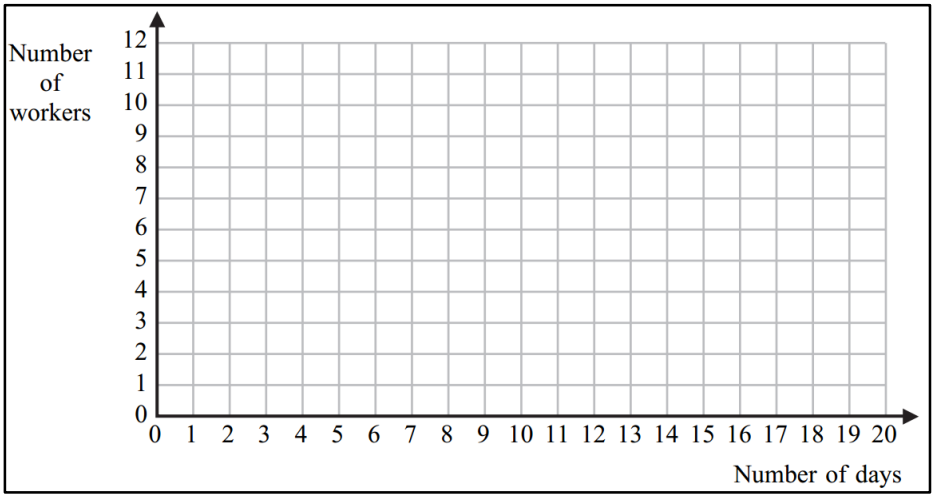
(c) Find the activity with the largest float and state the value of this float. *(2 marks)*

(d) The number of workers required for each activity is shown in the table.

Activity	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
Number of workers required	4	2	3	4	2	4	3	3	5	6

Given that each activity starts as **early** as possible and assuming that there is no limit to the number of workers available, draw a resource histogram for the project on **Figure 1** below, indicating clearly which activities are taking place at any given time. *(5 marks)*

(e) It is later discovered that there are only 9 workers available at any time. Use resource levelling to find the new earliest start time for activity J so that the project can be completed with the minimum extra time. State the minimum extra time required. *(2 marks)*



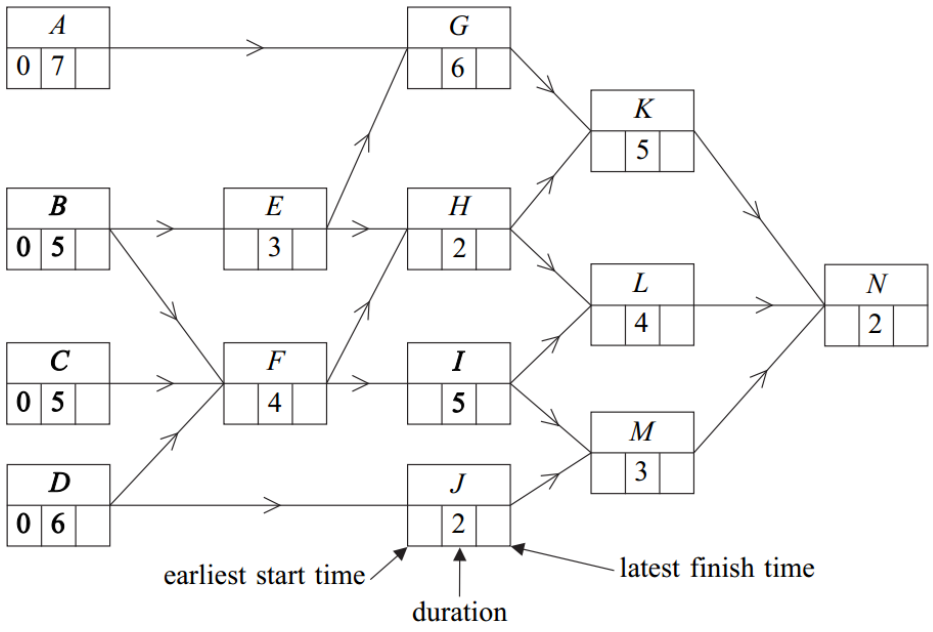
1 **Figure 1** below shows an activity diagram for a construction project. The time needed for each activity is given in days.

(a) Find the earliest start time and the latest finish time for each activity and insert their values on **Figure 1**. *(4 marks)*

(b) Find the critical paths and state the minimum time for completion of the project. *(3 marks)*

(c) On **Figure 2** opposite, draw a cascade diagram (Gantt chart) for the project, assuming that each activity starts as early as possible. *(5 marks)*

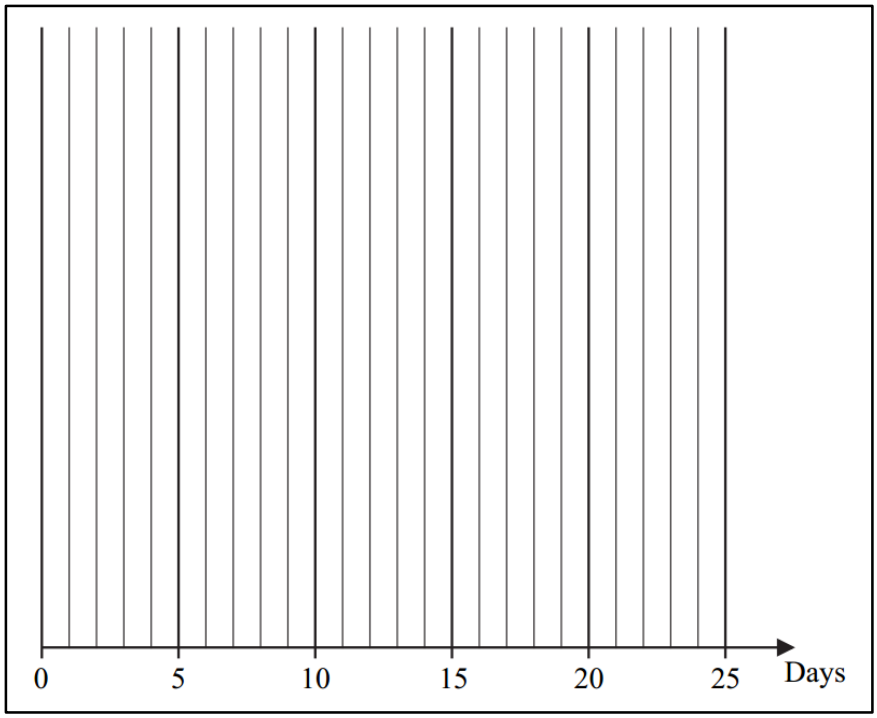
(d) Activity J takes longer than expected so that its duration is x days, where $x \geqslant 3$. Given that the minimum time for completion of the project is unchanged, find a further inequality relating to the maximum value of x. *(2 marks)*



Critical paths are .....

.....

Minimum completion time is ..... days.



1 **Figure 1** below shows an activity diagram for a project. Each activity requires one worker. The duration required for each activity is given in hours.

(a) Find the earliest start time and the latest finish time for each activity and insert their values on **Figure 1**. *(4 marks)*

(b) On **Figure 2** opposite, complete the precedence table. *(2 marks)*

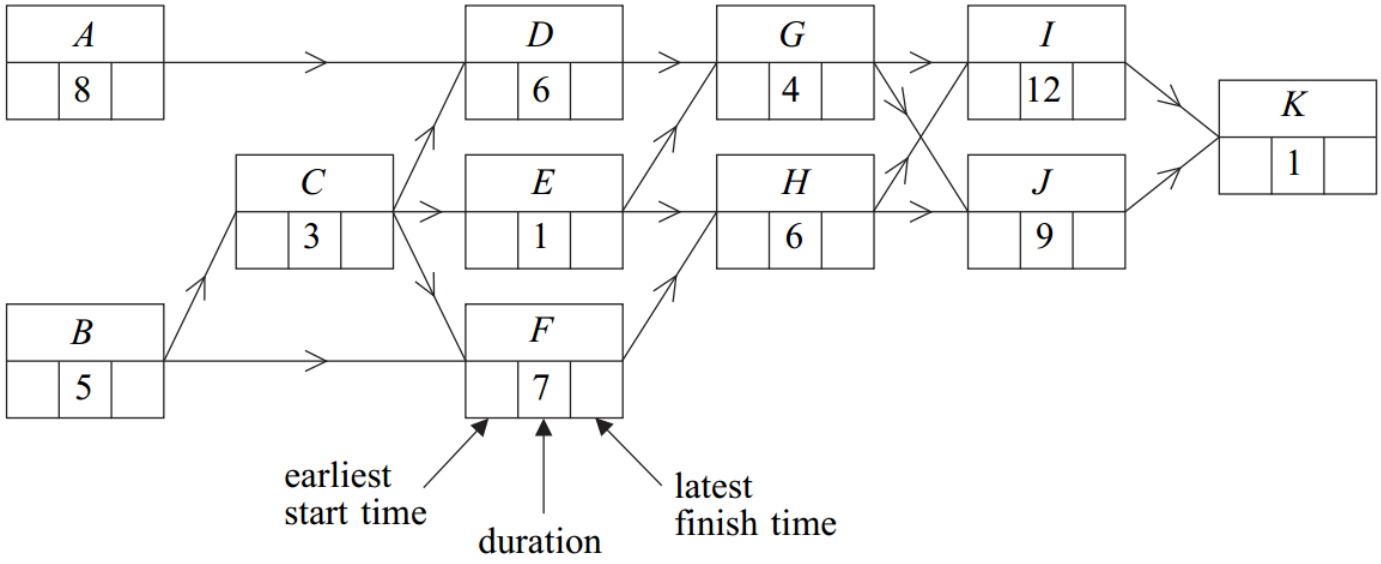
(c) Find the critical path. *(1 mark)*

(d) Find the float time of activity *E*. *(1 mark)*

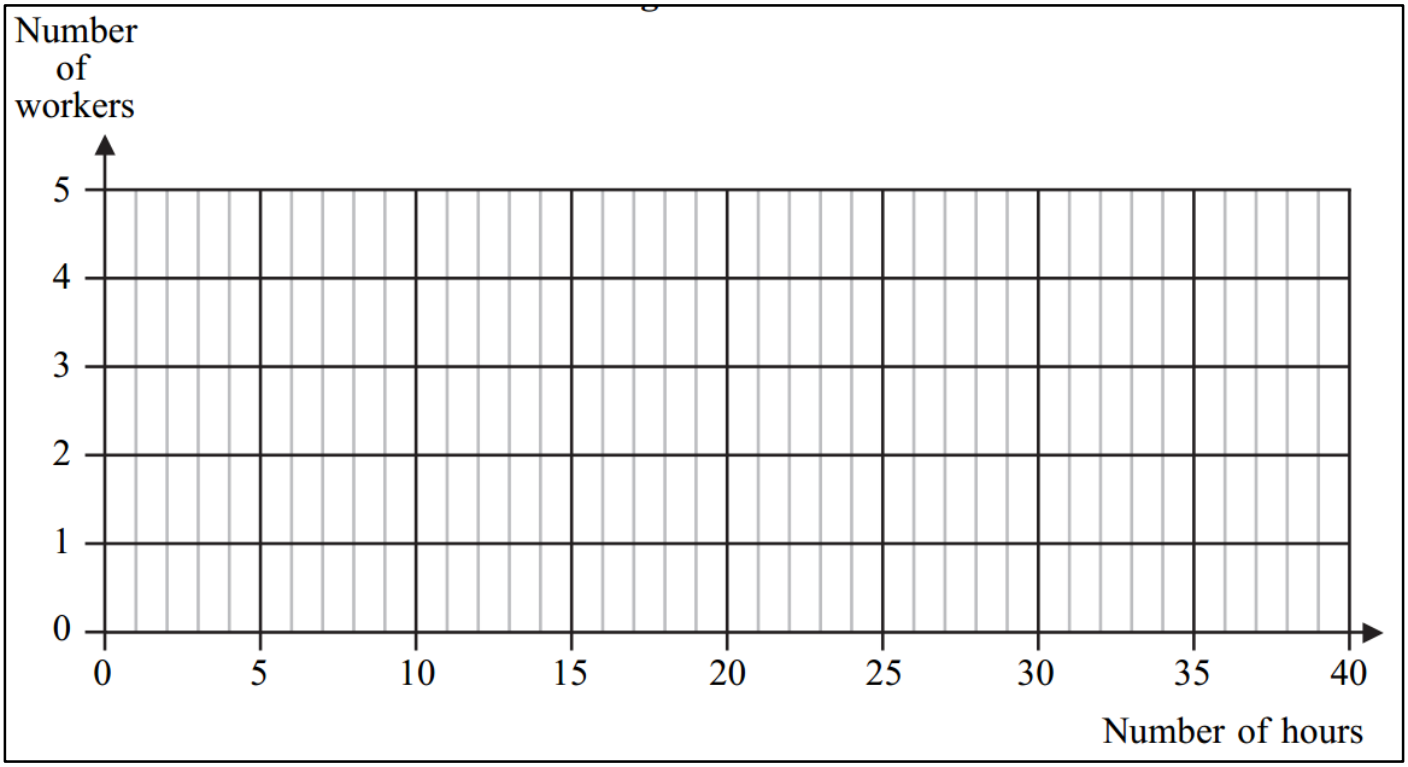
(e) Using **Figure 3** on page 5, draw a resource histogram to illustrate how the project can be completed in the minimum time, assuming that each activity is to start as early as possible. *(3 marks)*

(f) Given that there are two workers available for the project, find the minimum completion time for the project. *(1 mark)*

(g) Given that there is only one worker available for the project, find the minimum completion time for the project. *(1 mark)*



Activity	Immediate predecessor(s)
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	



1 **Figure 1** opposite shows an activity diagram for a project. The duration required for each activity is given in hours. The project is to be completed in the minimum time.

(a) Find the earliest start time and the latest finish time for each activity and insert their values on **Figure 1**. *(4 marks)*

(b) Find the critical path. *(1 mark)*

(c) Find the float time of activity *E*. *(1 mark)*

(d) Given that activities *H* and *K* will both overrun by 10 hours, find the new minimum completion time for the project. *(3 marks)*