



Crashing

Year 12 General Maths
Units 3 and 4

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Learning Objectives

By the end of the lesson I hope that you understand and can apply the following to a range of questions from the Unit 3 and 4 Further Mathematics course.

- Understand that we can alter completion times
- Understand the concept of crashing
- Understand that we can crash with cost



Recap of past learning

This is the last part of this course and builds on the last section we looked at - scheduling problems. When we perform a complex task – such as building a house – the individual tasks do not need to be performed in a linear way. Some of them can be performed at the same time as other tasks. This reduces the completion time of the project.

We looked at an example of a scheduling problem below.

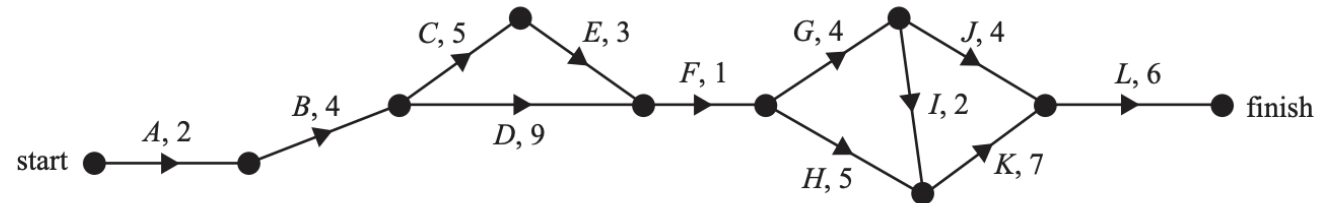
We are now going to look at what happens when we shorten the time taken to do one (or more!) of the tasks.

Question 3 (6 marks)

Fencedale High School is planning to renovate its gymnasium.

This project involves 12 activities, *A* to *L*.

The directed network below shows these activities and their completion times, in weeks.



Critical path again!

We know that the tasks or activities which fall on the critical path define the minimum completion time of the project.

Hence, it makes sense that if we change the times of the activities on the critical path, the minimum completion times **might** change.

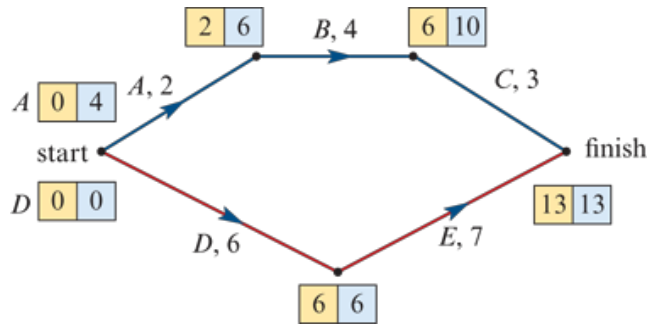
Why the bold?

Well, we need to be careful. In changing the times along the critical path, we might stop it from being the critical path and make a new one through the network!



An example (simple but nice!)

Look at the following diagram which I'm going to redraw using my box method being above the letters and not at each vertex.



We can see the time taken for the critical path to be completed is 13 weeks. The time for the other tasks to be completed will be 9 weeks. Hence, we can reduce the length of the tasks on the critical path by 13-9 weeks (4 weeks) before it stops being the critical path and we make a new critical path.



Why do we care about crashing?

Cost! Plain and simple.

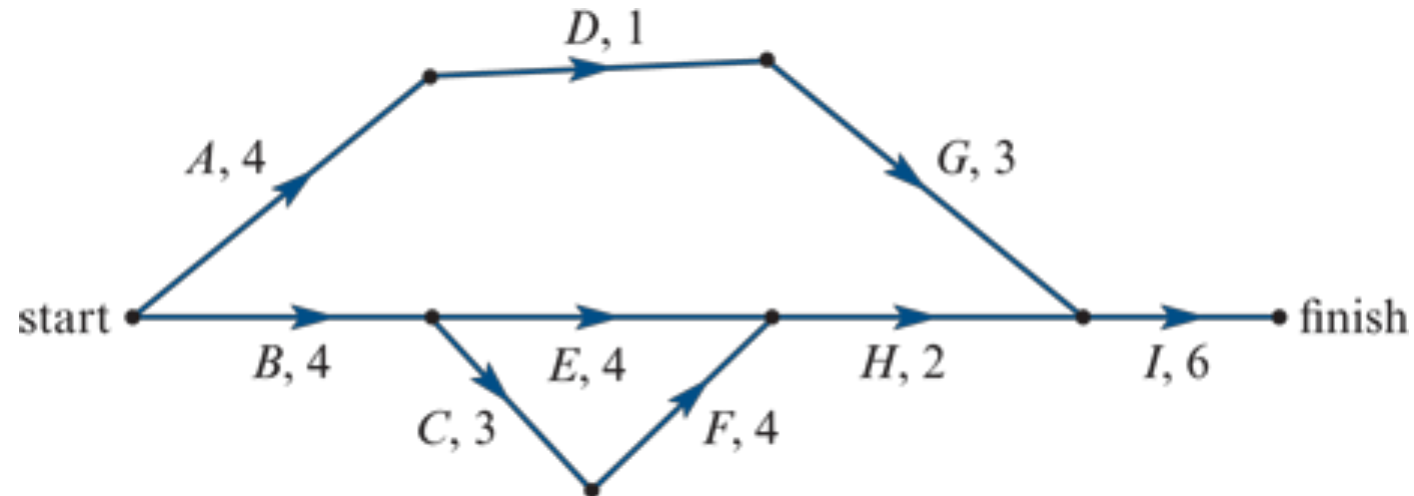
When building something it costs money. The quicker we can do something, the less it's going to cost. So, we can add costs to the concept of crashing to see by how much we can reduce the cost of something



Example

A community centre is to be built on a new housing estate. Nine activities have been identified for this building project. The activity network shown on the right shows the activities and their completion times in weeks.

- Determine the minimum time, in weeks, to complete this project.
- Determine the slack time, in weeks, for activity D .
- Write down the critical path of this project.



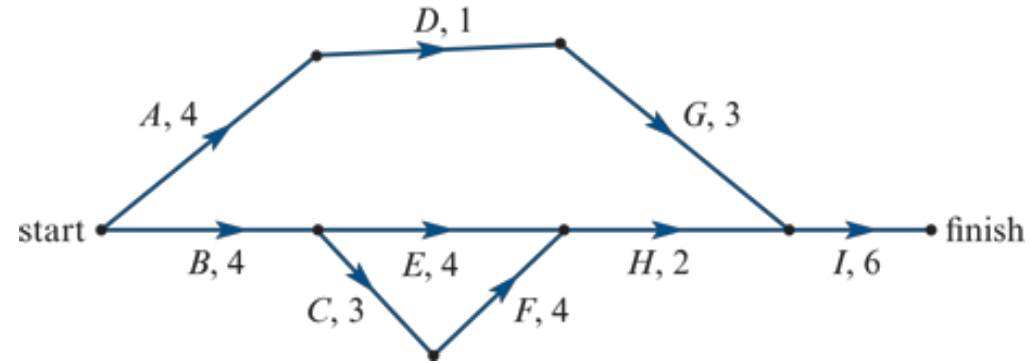
Example

The builders of the community centre are able to speed up the project.

Some of the activities can be reduced in time at an additional cost.

The activities that can be reduced in time are A , C , E , F and G .

- Which of these activities, if reduced in time individually, would not result in an earlier completion of the project?



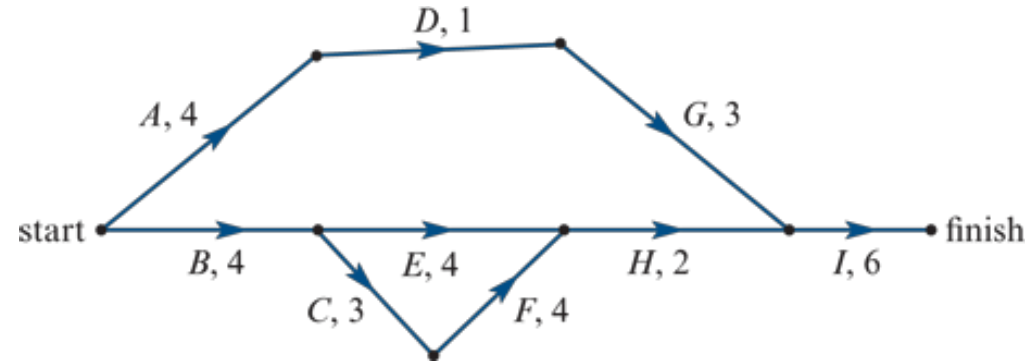
Example

The owner of the estate is prepared to pay the additional cost to achieve early completion.

The cost of reducing the time of each activity is \$5000 per week.

The maximum reduction in time for each one of the five activities, A , C , E , F and G is 2 weeks.

- Determine the minimum time, in weeks, for the project to be completed now that certain activities can be reduced in time.
- Determine the minimum additional cost of completing the project in this reduced time.



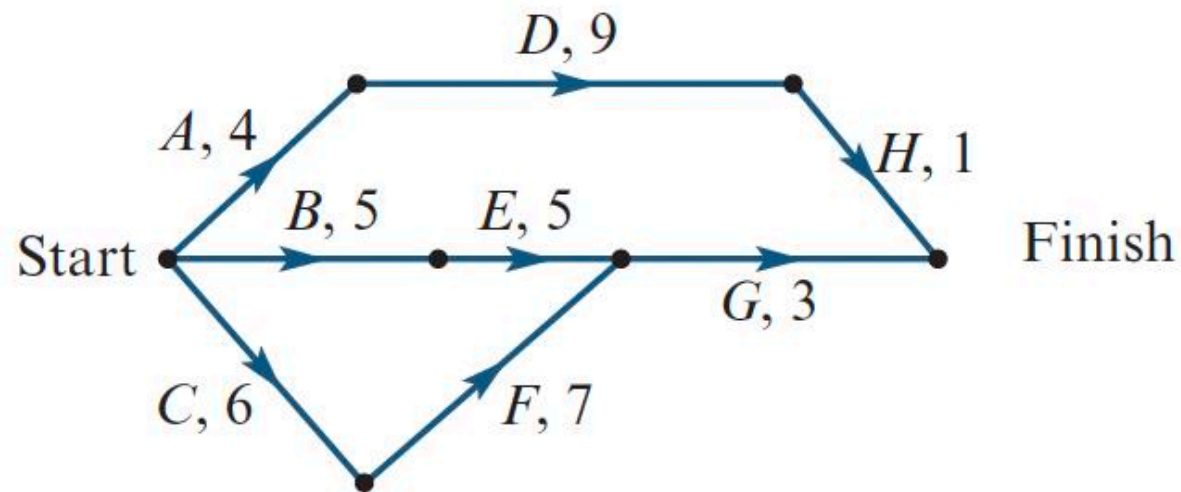
Example

The directed network below shows the sequence of 8 activities that are needed to complete a project. The time, in days, that it takes to complete each activity is also shown.

- a** Write down the critical path for this project.
- b** What is the minimum completion time for the project?

Activity F can be reduced by a maximum of 3 days at a cost of \$100 per day.

- c** What is the new minimum completion time for the project?
- d** What is the minimum cost that will achieve the greatest reduction in time taken to complete the project?

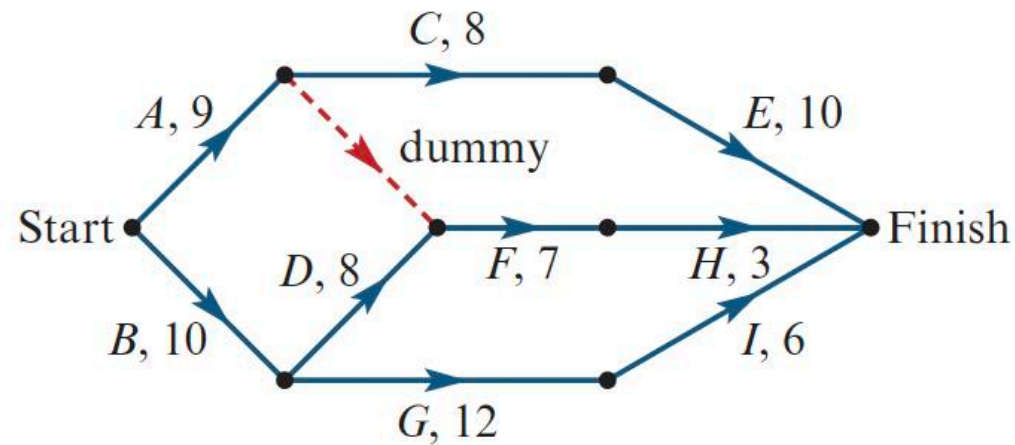


Example

The directed network below shows the sequence of 9 activities that are needed to complete a project. The time, in days, that it takes to complete each activity is also shown.

The minimum completion time for the project is 28 days. It is possible to reduce the completion time for activities B , E , G , H and I . The completion time for each of these five activities can be reduced by a maximum of two days.

a What is the new minimum completion time, in days, that the project could take?



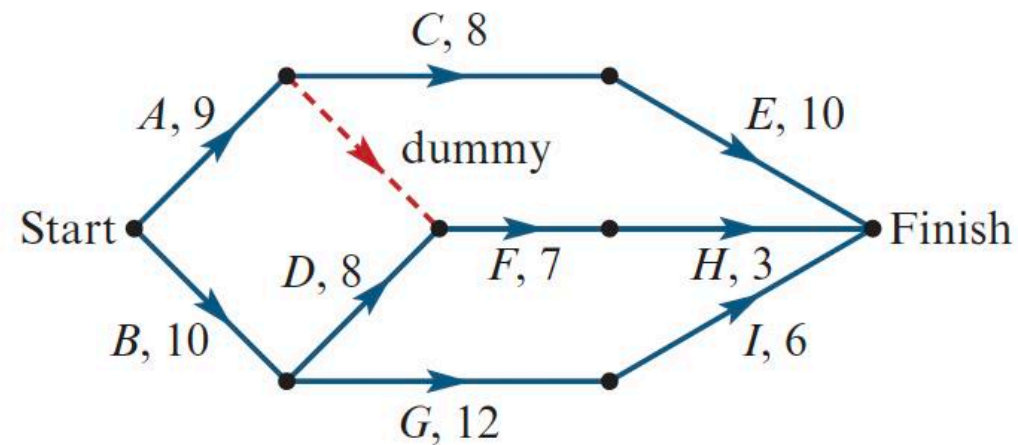
Example

The directed network below shows the sequence of 9 activities that are needed to complete a project. The time, in days, that it takes to complete each activity is also shown.

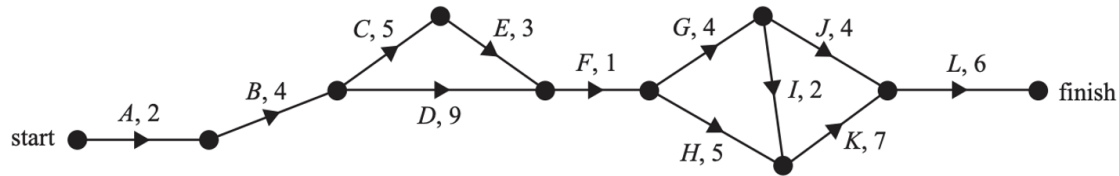
The reduction in completion time for each of these five activities will incur an additional cost. The table opposite shows the five activities that can have their completion times reduced and the associated daily cost, in dollars.

Activity	Daily cost(\$)
<i>B</i>	1500
<i>E</i>	2000
<i>G</i>	700
<i>H</i>	900
<i>I</i>	800

- b** What is the minimum cost that will achieve the greatest reduction in time taken to complete the project?



Challenging VCAA example



Question 3 (6 marks)

Fencedale High School is planning to renovate its gymnasium.

This project involves 12 activities, *A* to *L*.

The directed network below shows these activities and their completion times, in weeks.

It is possible to reduce the completion time for activities *C*, *D*, *G*, *H* and *K* by employing more workers.

- d. The completion time for each of these five activities can be reduced by a maximum of two weeks.

What is the minimum time, in weeks, that the renovation project could take?

1 mark



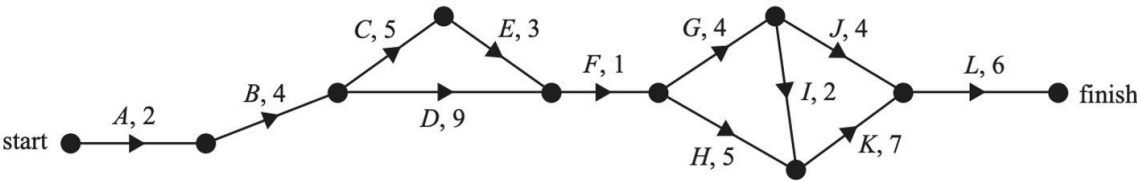
Challenging VCAA example

Question 3 (6 marks)

Fencedale High School is planning to renovate its gymnasium.

This project involves 12 activities, *A* to *L*.

The directed network below shows these activities and their completion times, in weeks.



- e. The reduction in completion time for each of these five activities will incur an additional cost to the school.

The table below shows the five activities that can have their completion times reduced and the associated weekly cost, in dollars.

Activity	Weekly cost (\$)
<i>C</i>	3000
<i>D</i>	2000
<i>G</i>	2500
<i>H</i>	1000
<i>K</i>	4000

The completion time for each of these five activities can be reduced by a maximum of two weeks.

Fencedale High School requires the overall completion time for the renovation project to be reduced by four weeks at minimum cost.

Complete the table below, showing the reductions in individual activity completion times that would achieve this.

2 marks

