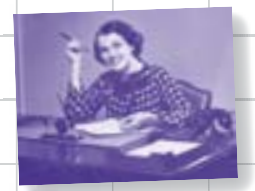
A Brain-Friendly Guide

Head First PMP

Load the exam concepts right into your brain

A Learner's Companion to Passing the Project Management Professional Exam

Use risk management to avoid embarrassing project problems



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Head First PMP

by Jennifer Greene, PMP and Andrew Stellman, PMP

Printed in the United States of America.

Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.

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Printing History:

March 2007: First Edition.

No dogs, rabbits, or bears were harmed in the making of this book. Okay, maybe one bear… but he'll get over it.

ISBN-10: 0-596-10234-8

ISBN-13: 978-0-596-10234-0

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Praise for Head First PMP

"I have been doing project management for over 30 years and am considered a subject matter expert in the PMBOK(r) Guide –Third Edition primarily because I am the Project Manager who led the team that developed this edition. As a consultant I was hired to review and evaluate eight of the top selling PMP Exam Preparation books for their accuracy in following the PMBOK® Guide – Third Edition. I have developed and taught a PMP Exam Prep course for a leading R.E.P., and taught PMP Exam preparation classes for PMI Chapters. **I can honestly say that Head First PMP is by far the best PMP Exam Preparation book of all I have reviewed in depth.** It is the very best basic education and training book that I have read that presents the processes for managing a project, which makes it a great resource for a basic project management class for beginners as well as a tool for practitioners who want to pass the PMP exam. The graphical story format is unique, as project management books go, which makes it both fun and easy to read while driving home the basics that are necessary for preparing someone is just getting started and those who want to take the exam."

— Dennis Bolles, PMP DLB Associates, LLC
Lead Author and Project Manager for PMBOK® Guide, Third Edition
co-author of *The Power of Enterprise-Wide Project Management*

"This looks like too much fun to be a PMP study guide! Behind the quirky humor and nutty graphics lies an excellent explanation of the project management processes. Not only will this book make it easier to pass the exam, you'll learn a lot of good stuff to use on the job too."

— Carol Steuer, PMP
***PMBOK® Guide*, Third Edition Leadership Team**

"This is the best thing to happen to PMP since, well, ever. You'll laugh, learn, pass the exam, and become a better project manager all at the same time."

— Scott Berkun, author of *The Art of Project Management* and *The Myths of Innovation*

"I love this format! Head First PMP covers everything you need to know to pass your PMP exam. The sound-bite format combined with the whimsical images turns a dry subject into entertainment. The organization starts with the basics then drills into the details. The in-depth coverage of complex topics like Earned Value and Quality Control are presented in an easy to understand format with descriptions, pictures, and examples. This book will not only help you pass the PMP, it should be used as an daily reference for practicing project managers. I sure wish I had this when I was studying for the exam."

— Mike Jenkins, PMP, MBA

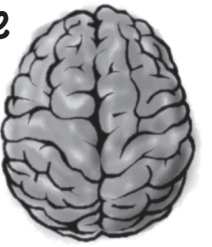
"I think that under the fonts and formalized goofiness, the book has a good heart (intending to cover basic principles in an honest way rather than just to pass the test). Head First PMP attempts to educate potential project managers instead of being a mere "how to pass the PMP exam" book filled with test taking tips. This is truly something which sets it apart from the other PMP certification exam books."

— Jack Dahlgren, Project Management Consultant

"Head First PMP is a great tool to help make sense of the Project Management Body of Knowledge for the everyday Project Manager."

—Mark Poinelli, PMP

Critical path method drill—boost your PMP exam score



We spend a lot of time talking to people who are preparing for the PMP exam, and one concept that comes up over and over is using the Critical Path Method. It's a somewhat tricky thing to study. Project managers preparing for the exam often have trouble with it, because it's not just something you can memorize. Which is a shame—because once you understand the ideas behind it, it's really useful... and a quick way to get some extra points on the exam. (Not to mention that it can help you in real life too, by helping you find the activities in your project that have the most risk.)

But even though this material is important, it's often neglected in PMP preparation materials. We've found that a lot of people don't understand it very well, and take the exam anyway. And it's not surprising. When we were studying for the PMP exam ourselves, both of us were disappointed with the lack of a good guide to really help you learn these concepts. It's one thing to memorize a bunch of stuff for test day. But if you really want to get it, you need two things: a good understanding of the real ideas behind critical path analysis, and a lot of practice. That's what's in these pages. We'll take you through the concepts and their applications, and drill you on your knowledge. By the time you finish this, you'll have a good handle on it... and you'll definitely do better on the exam!

Here's a tip:

If you're reading this PDF on your monitor, it looks best if you view it in "Two-Up" or "Book" mode, so the pages are side by side. This page should be on the left!

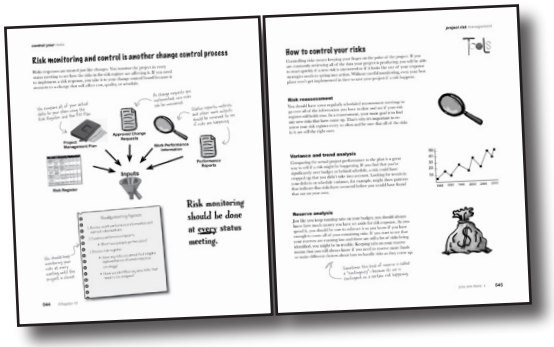
Our partners at O'Reilly have set up a free online PMP study forum to help you learn and connect with other people studying for the exam. You can join the forums at the Head First Labs web site at **http://www.headfirstlabs.com/PMP/** (just click on "Forums"). We both read the forums, and do our best to respond to all of the questions and take part in the discussions. If you've got questions about the PMBOK® Guide, the exam, or any of the material, please don't hesitate to post a question about it. If you still have questions about finding the critical path or calculating early or late start and finish—or questions about anything else on the exam—that's a great place to post them. And when you're ready to test your knowledge, we've put together a free 200-question practice PMP exam: **http://www.headfirstlabs.com/PMP/free_exam/**

One other thing: we're software project managers, and we write about software development in our weblog, Building Better Software. We also regularly post PMP study tips. You can read it at **http://www.stellman-greene.com**, and we'd love to hear your comments there as well.

Good luck with the exam!

Jennifer Greene, PMP and Andrew Stellman, PMP
Authors of *Head First PMP*

Looking for more help studying for the PMP exam? Go to http://www.headfirstlabs.com/PMP/ and download the chapter on Risk Management from Head First PMP for free!

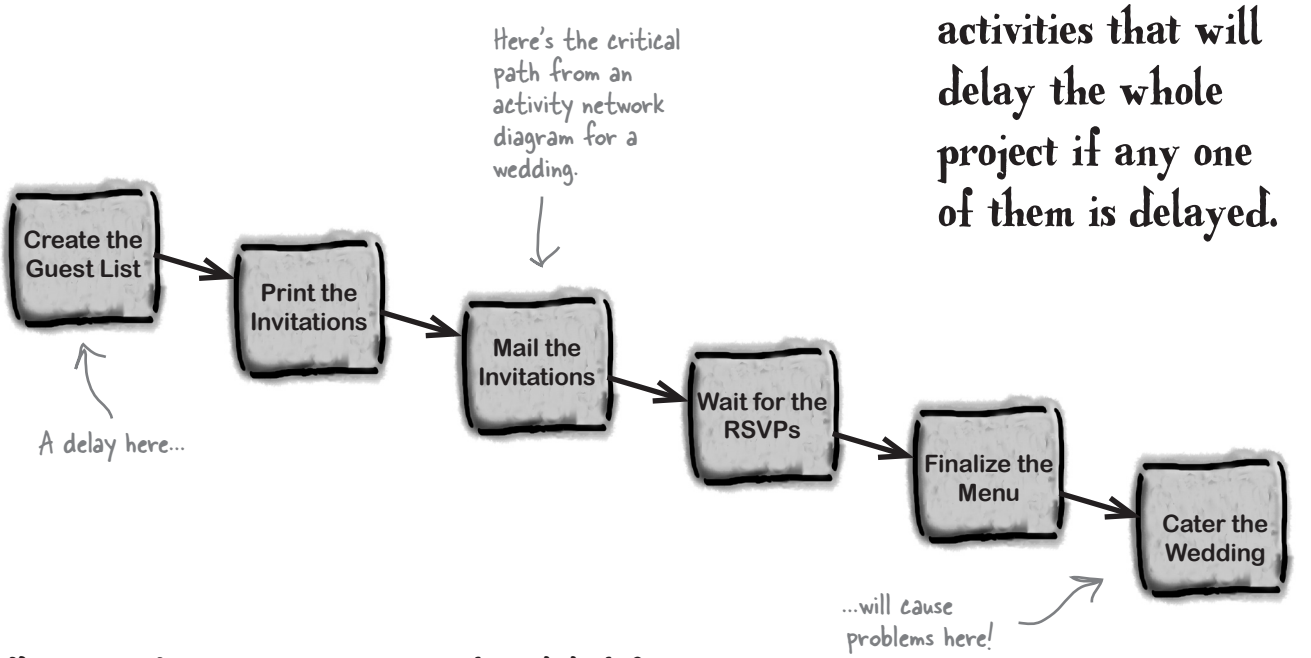


Use the Critical Path Method to avoid big problems

The **Critical Path Method** is an important tool for keeping your projects on track. Every network diagram has something called the **critical path**. It's the string of activities that, if you add up all of the durations, is longer than any other path through the network. It usually starts with the first activity in the network and usually ends with the last one.

The reason that the critical path is, well, *critical*, is that every single activity on the path must finish on time in order for the project to come in on time. A ***delay in any one of the critical path activities*** will cause the **entire project to be delayed**.

The Critical Path is the string of activities that will delay the whole project if any one of them is delayed.



How does knowing your critical path help?

Knowing where your critical path is can give you a lot of freedom. If you know an activity is *not* on the critical path, then you know a delay in that activity may not *necessarily* delay the project.

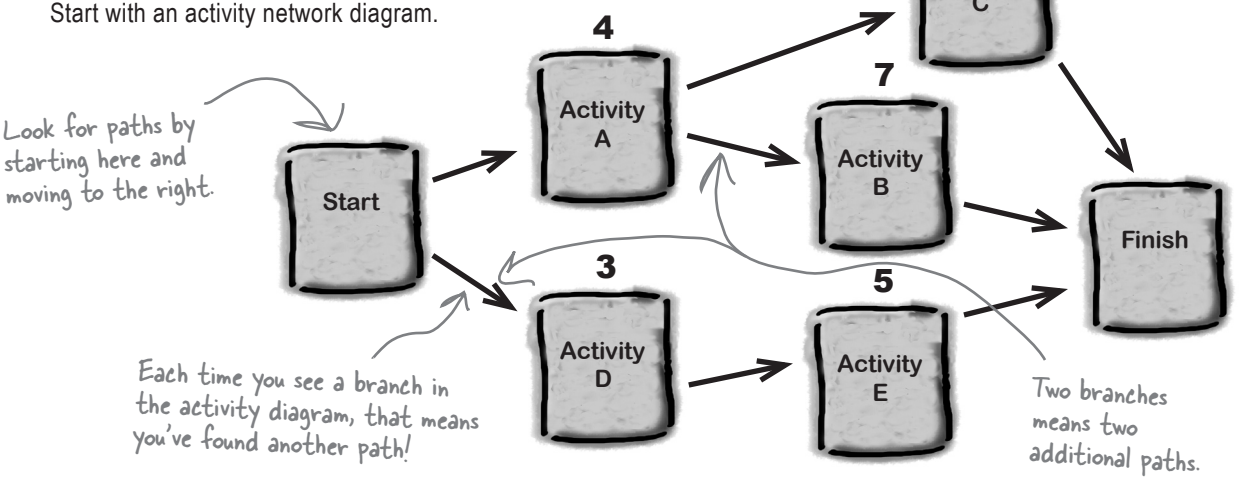
This can really help you handle emergency situations. Even better, it means that if you need to bring your project in earlier, you know that adding resources to the critical path will be much more effective than adding them elsewhere.

How to find the critical path

It's easy to find the critical path in any project! With a little practice, you'll get the hang of it. Of course, on a large project with dozens or hundreds of tasks, you'll probably use software like Microsoft Project to find the critical path for you. But when it does, it's following the same exact steps that you'll follow here.

You'll usually write the duration above each node in the diagram.

1 Start with an activity network diagram.



2 Find all of the paths in the diagram. A path is any string of activities that goes from the start of the project to the end.

Start → Activity A → Activity B → Finish

Start → Activity A → Activity C → Finish

Start → Activity D → Activity E → Finish

3 Find the duration of each path by adding up the durations of each of the activities on the path.

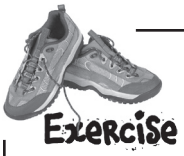
Start → Activity A → Activity B → Finish = 4 + 7 = **11**

Start → Activity A → Activity C → Finish = 4 + 2 = **6**

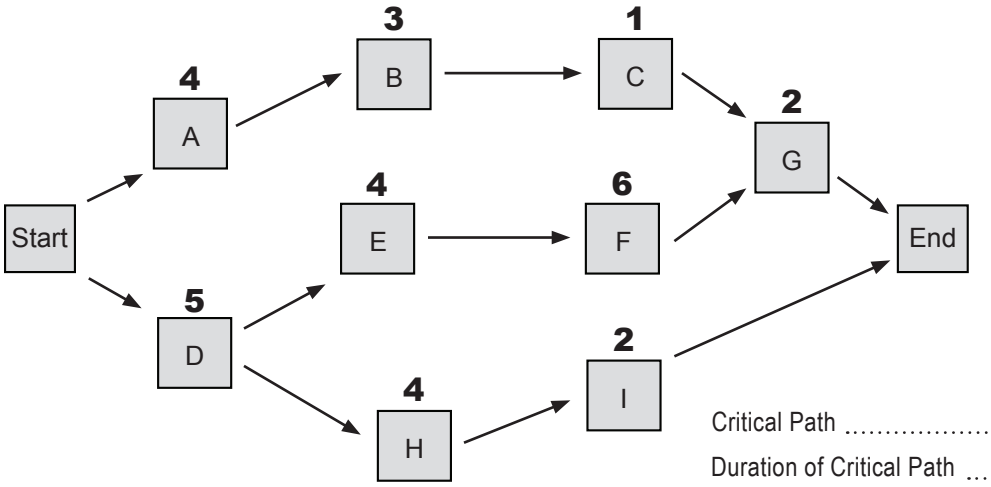
Start → Activity D → Activity E → Finish = 3 + 5 = **8**

This path has a duration of 11, which is longer than the other two (6 and 8). So it's the critical path!

The critical path is the one with the longest duration!



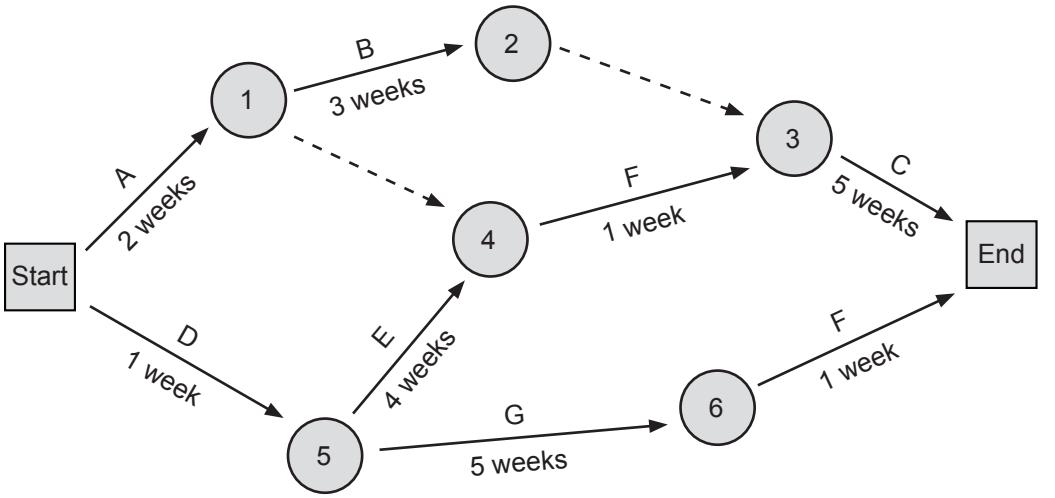
You may get questions on the exam asking you to identify the critical path in a network diagram. Here's some practice for doing that! Find the critical path and duration for this PDM and ADM.



Critical Path .....

Duration of Critical Path .....

Total Number of Paths .....



Critical Path .....

Duration of Critical Path .....

Total Number of Paths .....

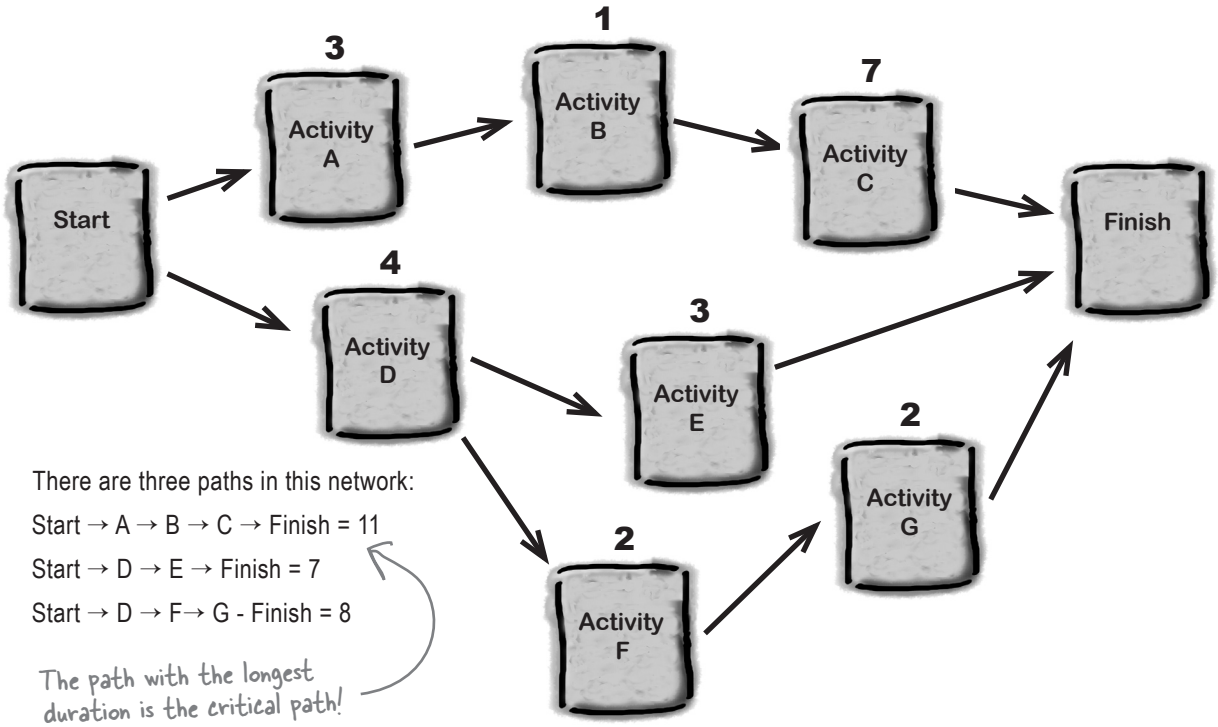
Answers on page 18.

Finding the float for any activity

Once you've figured out the critical path, there's all sorts of useful stuff you can do with it. One of the most useful things you can do is calculate the **float**. The float for any activity is the amount of time that it can slip before it causes your project to be delayed. You might also see the word "slack" – it's the same thing.

Luckily, it's not hard to figure out the float for any activity in a network diagram. First you write down the list of all of the paths in the diagram, and you identify the critical path. The float for every activity in the critical path is zero.

The goal is to find the float for each activity. We're not really concerned with finding a total float for each path—we're looking at the activities independently.



1. There are three paths in this network:

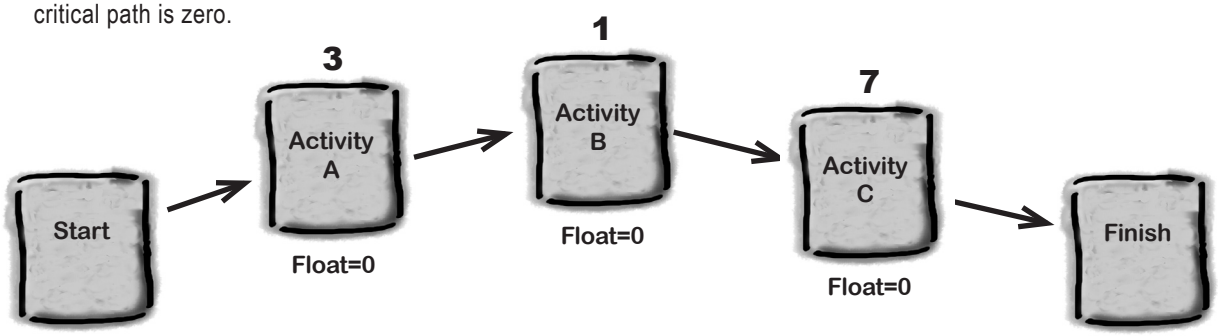
   Start → A → B → C → Finish = 11

   Start → D → E → Finish = 7

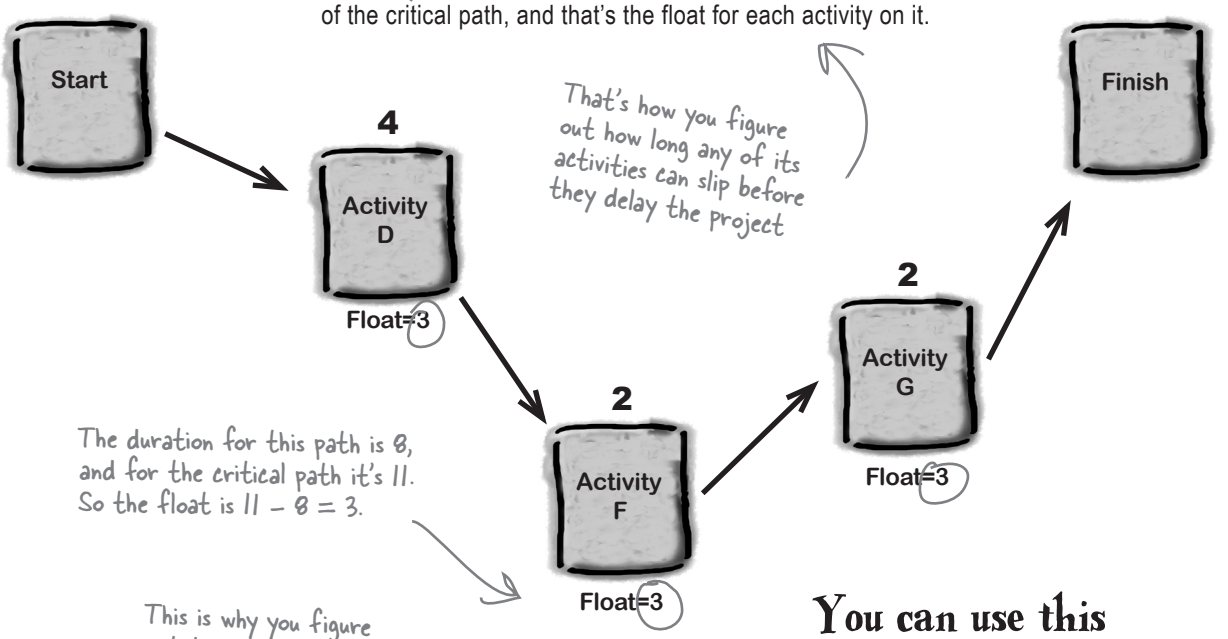
   Start → D → F→ G - Finish = 8

   The path with the longest duration is the critical path!

2. The float for each of the activities on the critical path is zero.

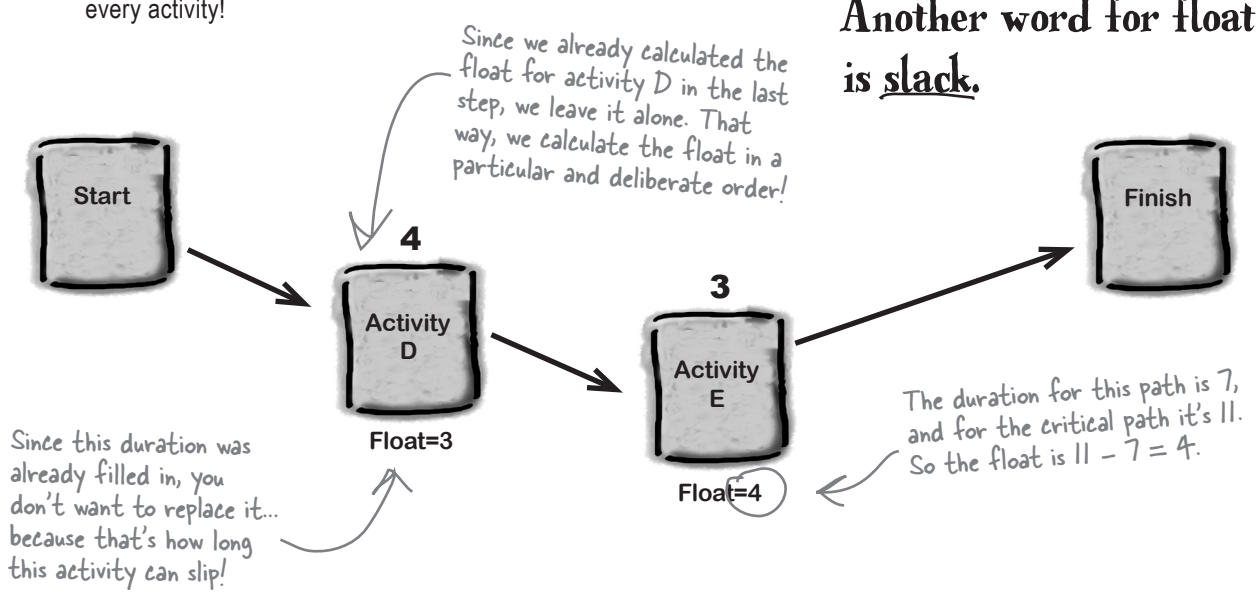


3 Find the **next longest path.** Subtract its duration from the duration of the critical path, and that's the float for each activity on it.



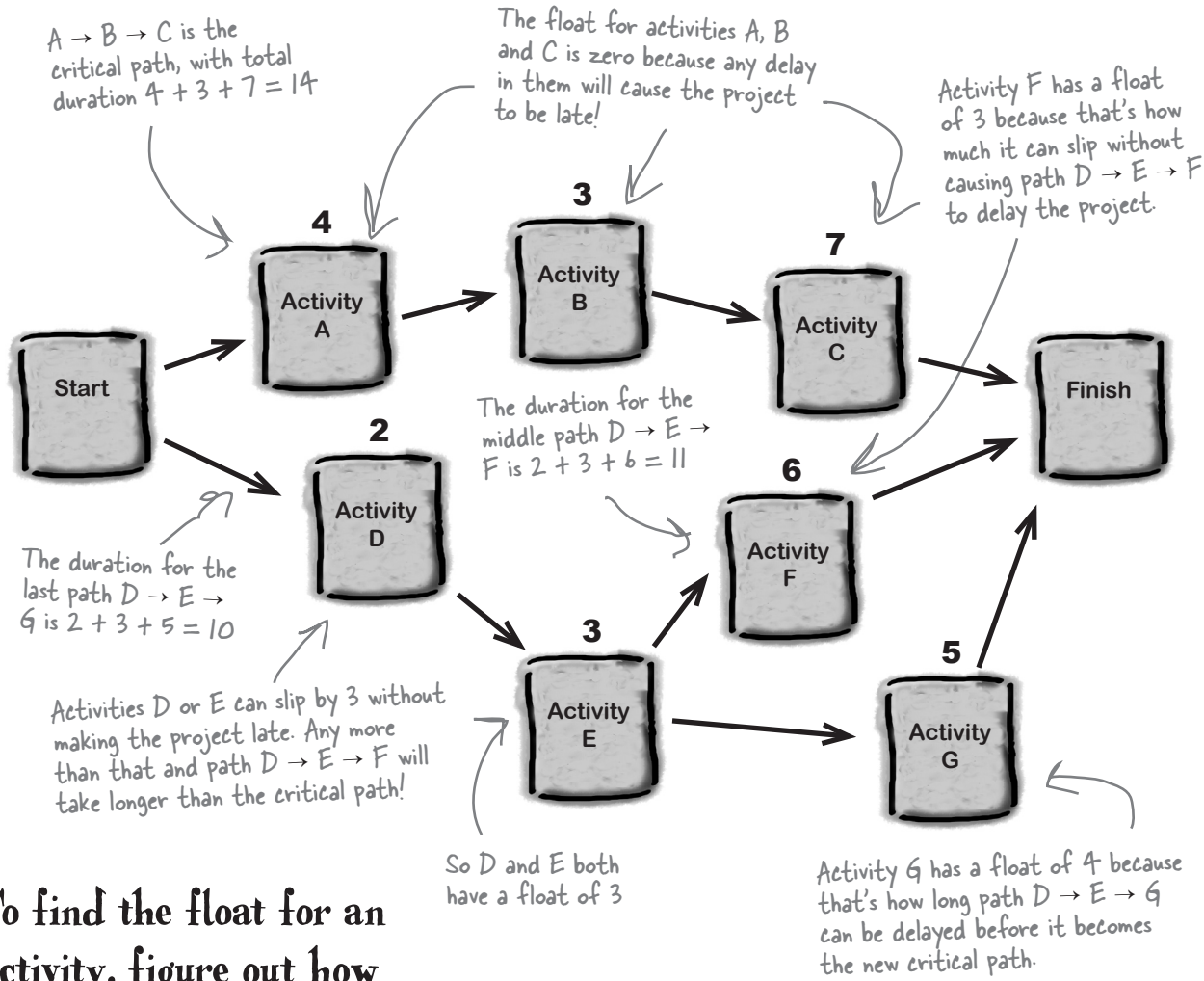
4 Do the same for the **next longest path,** and so on through the rest of the network diagram. Pretty soon, you'll fill in the float for every activity!

You can use this method to find the float for every activity in a network diagram. Another word for float is slack.

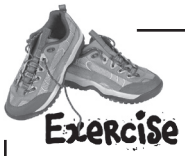


Float tells you how much extra time you have

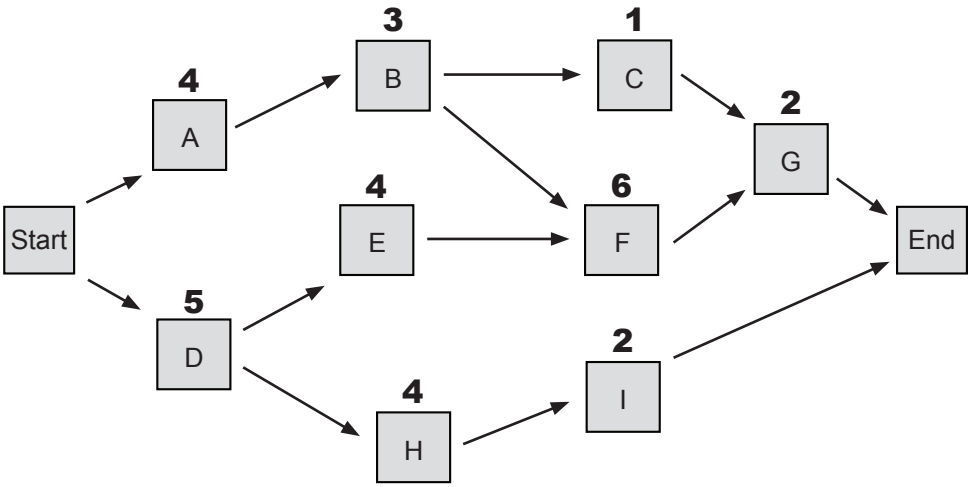
Once you know the float, you know how much play you have in your schedule. If an activity has a float of 2 days, it can slip by that much without affecting the end date.



To find the float for an activity, figure out how much it can slip before it makes the project late. The float for any activity on the critical path is ZERO!



You'll need to be able to calculate the float of an activity in a network diagram for the exam. Take another look at this PDM from the last exercise. Can you calculate the float for each activity?



1. What is the float for each activity on the critical path? .....

2. What is the total duration for path A → B → C → G? .....

3. What is the total duration for path A → B → F → G? .....

4. What is the total duration for path D → E → F → G? .....

5. What is the total duration for path D → H → I? .....

6. Which path is the critical path? ..... → ..... → ..... → .....

7. Write down the float for each activity:

A..... B..... C..... D..... E.....

F G H I

Hint: First fill in the float for the critical path activities. Then move on to the next-longest path, and then the next-longest one, filling in any float that hasn't been filled in yet.

Answers on page 19.

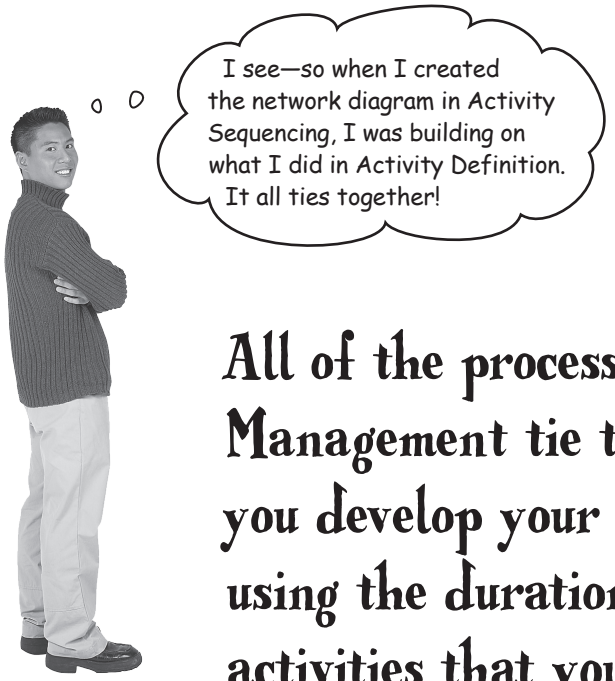
there are no Dumb Questions

Q: Where do the duration numbers come from on each activity?

A: A lot of people ask that question. It's easy to forget that everything you do in Activity Sequencing builds on the stuff you did in the other Time Management processes. Remember the estimates that you came up with Activity Duration Estimating? You used techniques like Three Point Estimates, Analogous Estimating, and Parametric Estimating to come up with an estimate for each activity. Those are the estimates that you use on your network diagrams!

Q: What if there's a path that's not critical, but where even a small slip in one activity would delay the project?

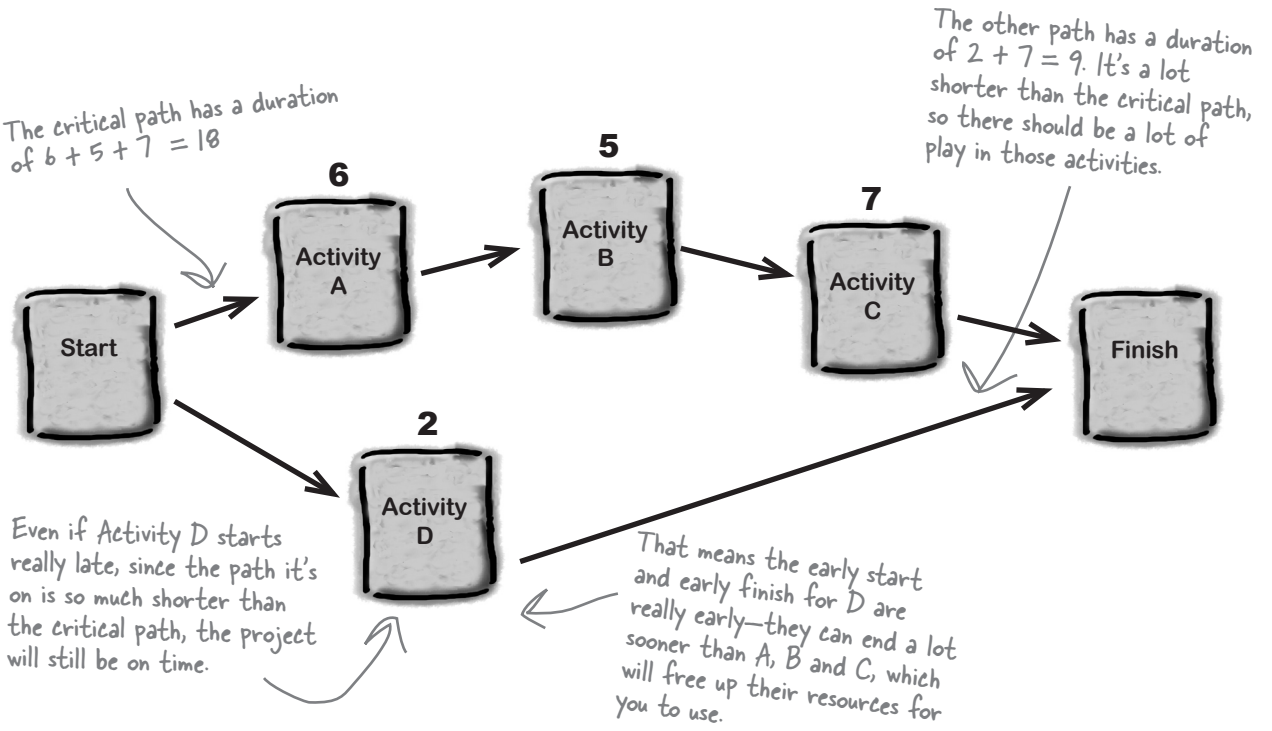
A: This is exactly why it's important to know the float for each of your activities. When you're managing your project, it's not enough to just pay attention to the activities on the critical path. You need to look for any activity with a low float. And don't forget that there may be some activities that aren't on the critical path but still have a float of zero! These are the ones where you really want to pay attention and watch out for potential resource problems.



All of the processes in Time Management tie together! When you develop your schedule, you're using the durations for your activities that you came up with in Activity Duration Estimating.

Figure out the early start and early finish

Coming up with the float for each activity is useful, but you can actually do better! When you have a long critical path, but the other paths in your network diagram are short, then you have a lot of freedom in when you can start and finish each of the activities that are not on the critical path. You can use **early start** and **early finish** to get a handle on exactly how much freedom you have in your schedule.



Early start

Is the earliest time that an activity can start. An activity near the end of the path will only start early if all of the previous activities in the path also started early. If one of the previous activities in the path slips, that will push it out.

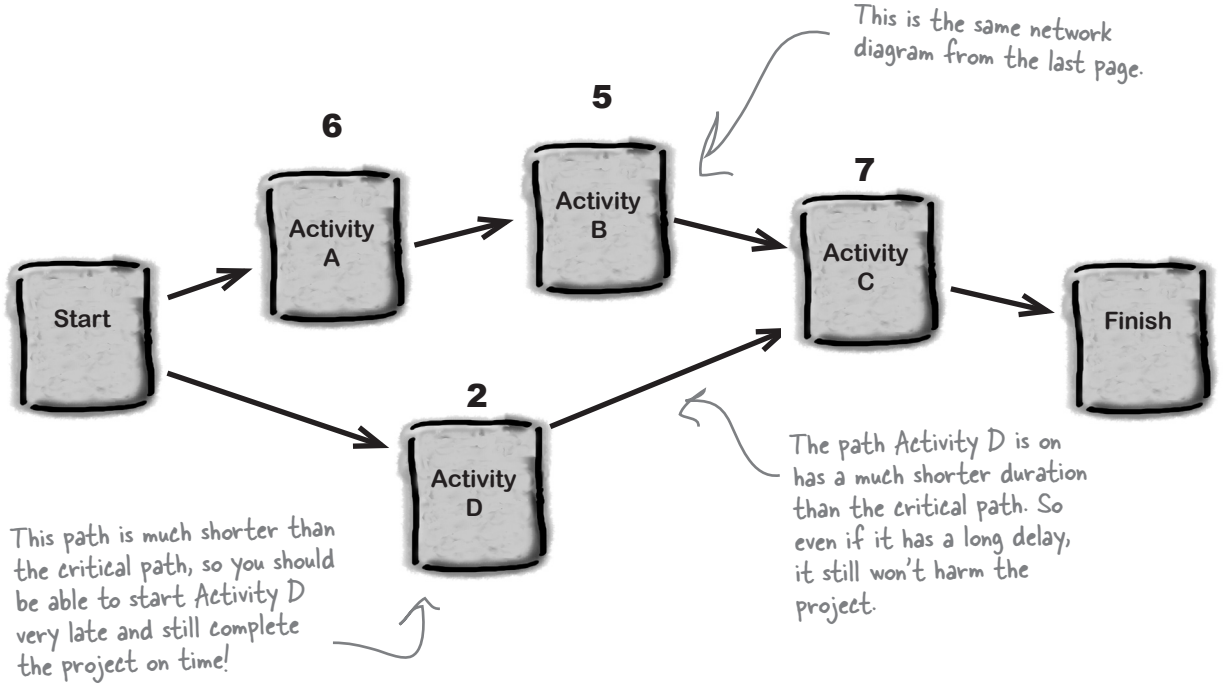
Early finish

Is the earliest time that an activity can finish. It's the date that an activity will finish if all of the previous activities started early and none of them slipped.

When you find the early start and early finish for each task, you know exactly how much freedom you have to move the start dates for those activities around without causing problems.

Figure out the latest possible start and finish

It's also important to know how late any activity can run before it delays the project. That's what **late start** and **late finish** are for! They let you figure out how late you can start a certain task and how much it can slip before it delays your project.



Late start

Is the latest time that an activity can start. If an activity is on a path that's much shorter than the critical path, then it can start very late without delaying the project – but those delays will add up quickly if other activities on its path also slip!

Late finish

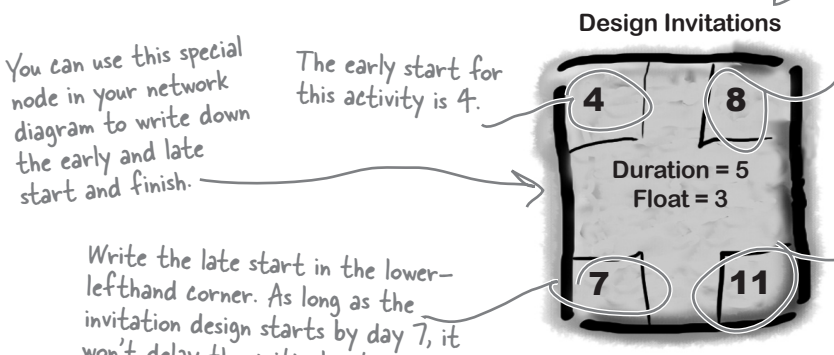
Is the latest time that an activity can finish. If an activity is on a short path and all of the other activities on that path start and finish early, then it can finish very late without causing the project to be late.

Figuring out the late start and late finish will help you see how much "play" you have in your schedule. An activity with a large late start or late finish means you have more options.

Add early and late durations to your diagrams

You can use a method called **forward pass** to add the early start and finish to each path in your network diagram. Once you've done that, you can use **backward pass** to add the late start and finish. It makes your network diagrams look a little more complicated, but it gives you a lot of valuable information.

Early start and finish go in the upper corners. Write the name of the activity above it, and the duration and float inside the box.



You can use this special node in your network diagram to write down the early and late start and finish.

The early start for this activity is 4.

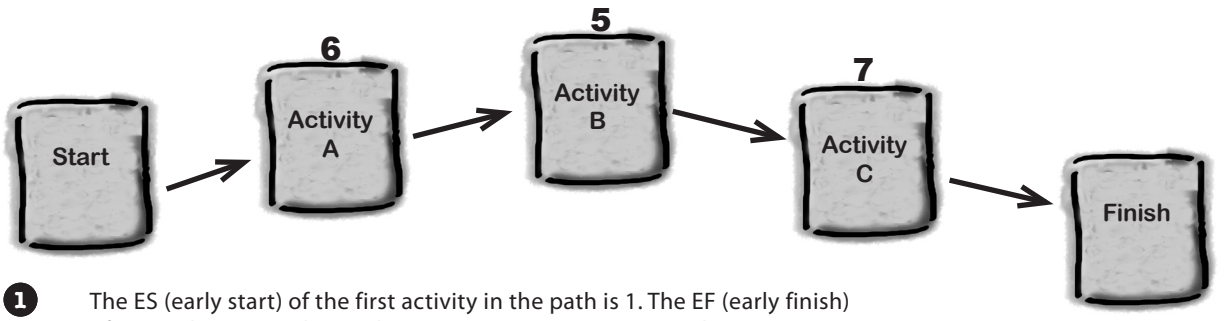
The early finish for this activity is 8. There's no way it can end before day 8.

The late finish for the Design Invitations activity is 11, which means the latest it can finish without delaying the schedule is on day #11. If it hasn't finished by then, the project manager should worry!

Write the late start in the lower-lefthand corner. As long as the invitation design starts by day 7, it won't delay the critical path.

Take a forward pass through the network diagram.

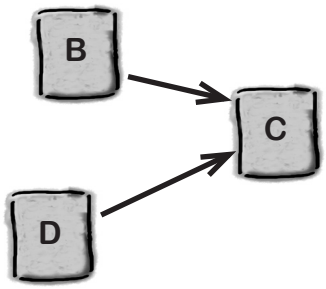
Start at the beginning of the critical path and move forward through each activity. Follow these three steps to figure out the early start and early finish!



1. The ES (early start) of the first activity in the path is 1. The EF (early finish) of any task is its ES plus its duration minus one. So start with Activity A. It's the first in the path, so ES = 1, and EF = 1 + 6 - 1 = 6.

2. Now move forward to the next activity in the path, which is Activity B in this diagram. To figure out ES, take the EF of the previous task and add one. So for Activity B, you can calculate ES = 6 + 1 = 7, and EF = 7 + 5 - 1 = 11.

3. **Uh-oh! Activity C has two predecessors.** Which one do you use to calculate EF? Since C can't start until both B and D are done, use **the one with the latest EF**. That means you need to figure out the EF of Activity D (its ES is 1, so its EF is 1 + 2 - 1 = 2). Now you can move forward to Activity C and calculate its EF. The EF of Activity D is 2, which is smaller than B's EF of 11, so for Activity C the ES = 11 + 1 = 12, and EF = 12 + 7 - 1 = 18.

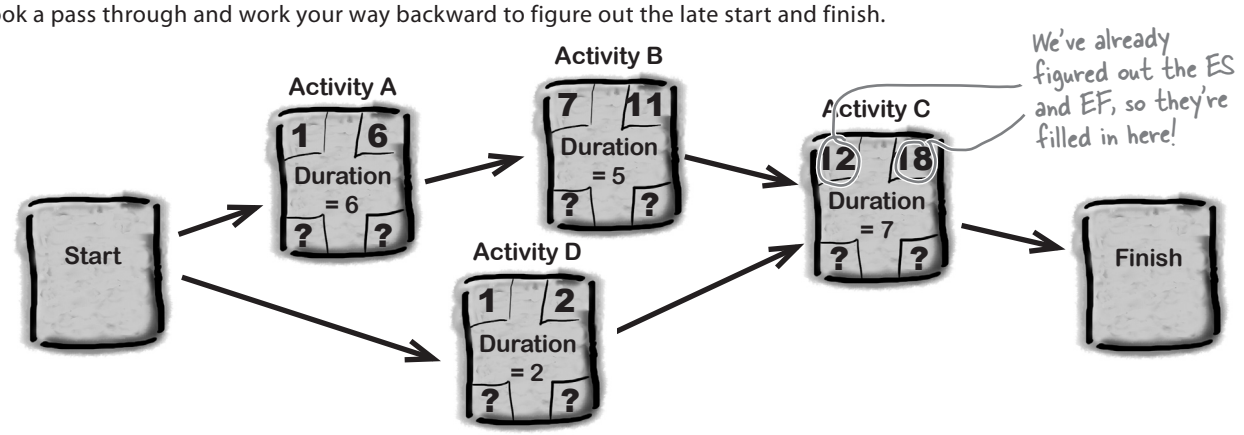


Take a backward pass to find late start and finish

You can use a **backward pass** to figure out the late finish and start for each activity.

Now take a backward pass through the same network diagram.

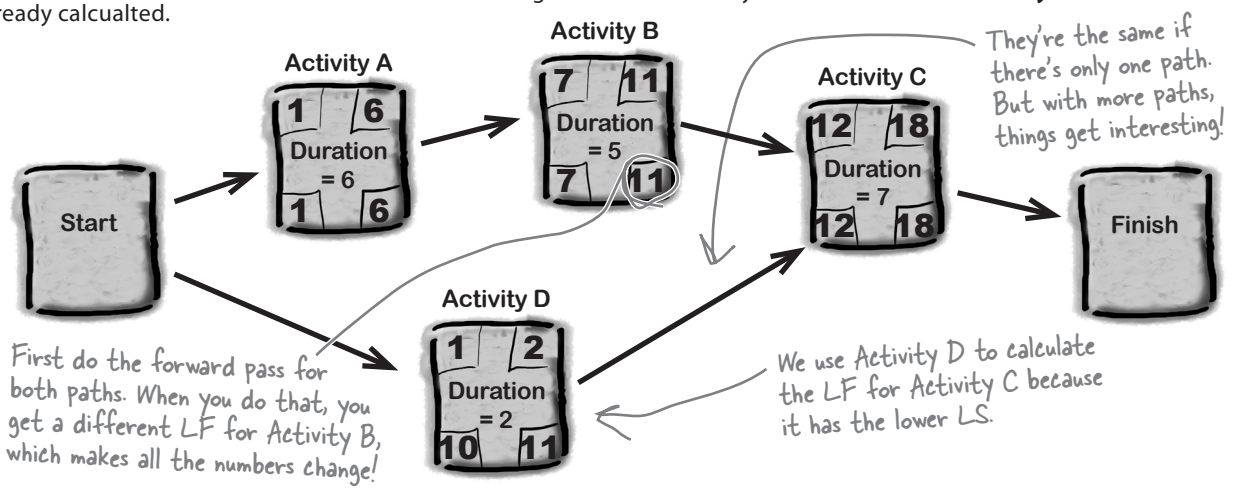
The backward pass is just as easy as the forward pass. Start at the end of the path you just took a pass through and work your way backward to figure out the late start and finish.



Start with the critical path.

You're calculating the latest any activity can start and finish, so it makes sense that you need to start at the end of the project and work backwards – and the last activity on the critical path is always the last one in the project. Then do these three steps, working backwards to the next-longest path, then the next-longest, etc., until you've filled in the LS and LF for all of the activities. Fill in the LF and LS for the activities on each path, but **don't replace** any LF or LS you've already calcualted.

1. Start at the end of the path, with Activity C. The LF (late finish) of the last activity is the same as the EF. Calculate its LS (late start) by subtracting its duration from the LF and adding one. LS = 18 - 7 + 1 = 12
2. Now move backwards to the previous activity in the path—in this case, Activity B. Its LF is the LS of Activity C minus one, so LF = 12 - 1 = 11. Calculate its LS in the same way as step 1: LS = 11 - 5 + 1 = 7.
3. Now do the same for Activity A. LF is the LS for Activity B minus one, so LF = 7 - 1 = 6. And LS is LF minus duration plus one, so LF = 6 - 6 + 1 = 1.
4. Now you can move onto the next-longest path, Start-D-C-Finish. If there were more paths, you'd then move on to the next-longest one, etc., filling in LF and LS for any nodes that **haven't already been filled in**.



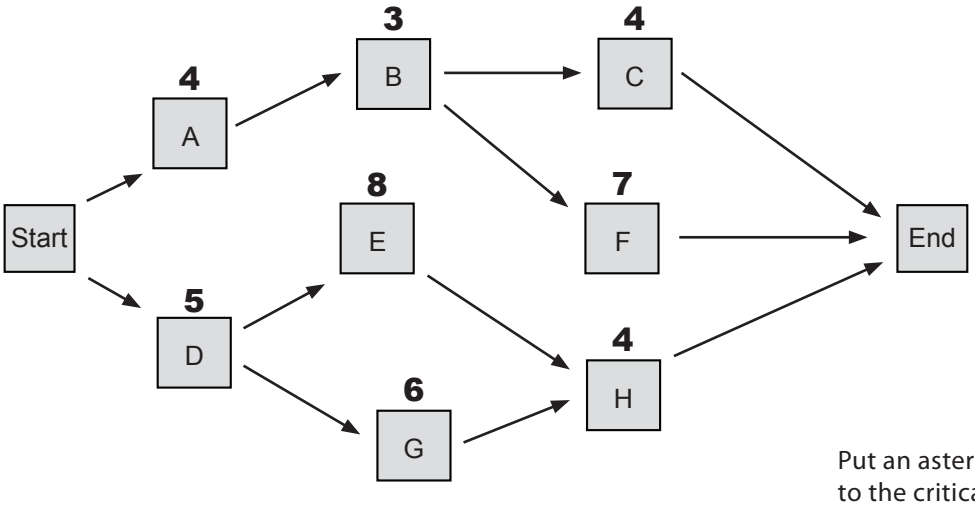
Let's take some time out to walk through this!

All of this critical path stuff seems pretty serious, right? It's one of the toughest concepts on the exam. But don't sweat it, because it's actually not hard! It just takes a little practice. Once you do it yourself, you'll see that there's really nothing to worry about.

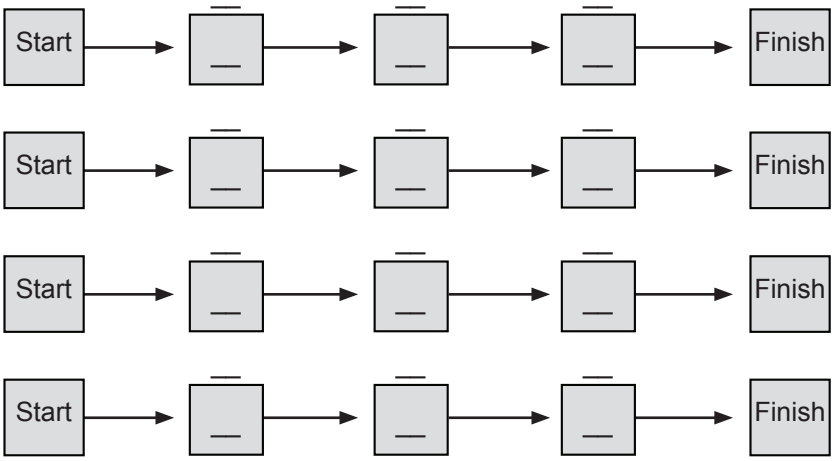
Calculating the ES, EF, LS, and LF may seem complicated, but it only takes a little practice to get the hang of it. Once you walk through it step by step, you'll see that it's actually pretty easy!

Sharpen your pencil

There are four paths in this network diagram. Fill in each of the activity names and durations for each of the paths.



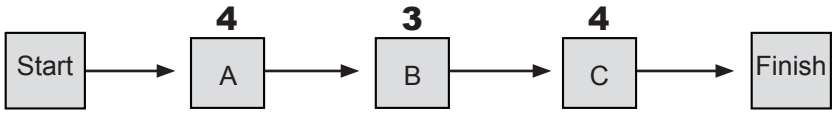
Put an asterisk (*) next to the critical path.



We're not done yet! There's more on the next page...

Sharpen your pencil

Take a forward pass through each of the four paths in the diagram and fill in the early starts and early finishes for each activity. Start with the first one.



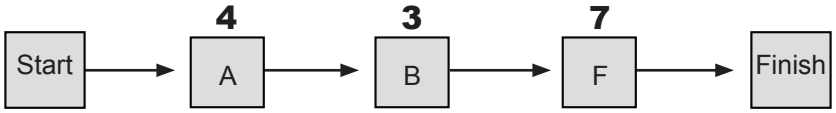
Remember, the early start of the first activity in a path is one.

ES=__ EF=__ | ES=__ EF=__ | ES=__ EF=__

The early finish of an activity is its ES plus its duration minus one.

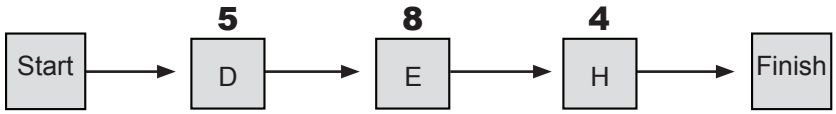
The early start of an activity is the early finish of the previous activity plus one.

Let's move on to the second path.



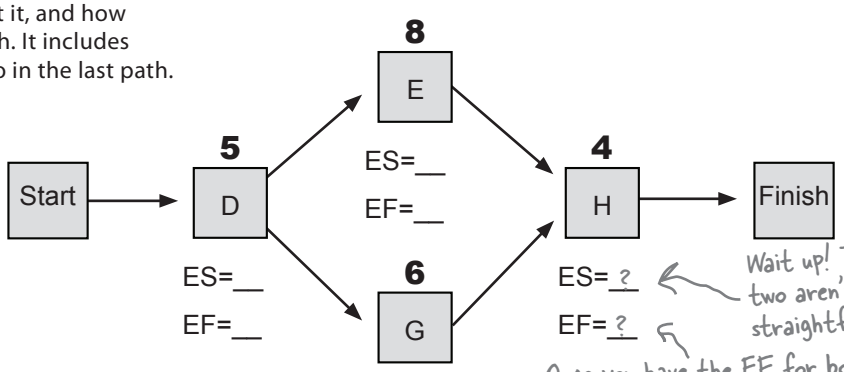
ES=__ EF=__ | ES=__ EF=__ | ES=__ EF=__

The next path isn't as straightforward as it looks. Start by filling in its values.



ES=__ EF=__ | ES=__ EF=__ | ES=__ EF=__

Now take another look at it, and how it mixes with the last path. It includes activity H, which was also in the last path. H will have a different ES depending on which path you use! So which predecessor do you use – E or G? The idea here is that you **use the predecessor with the larger EF value** when you calculate the ES for activity H (because you want the ***latest possible*** start date).



ES=__ EF=__

ES=__ EF=__

ES=__ EF=__

ES=__ EF=__

ES=__ EF=__

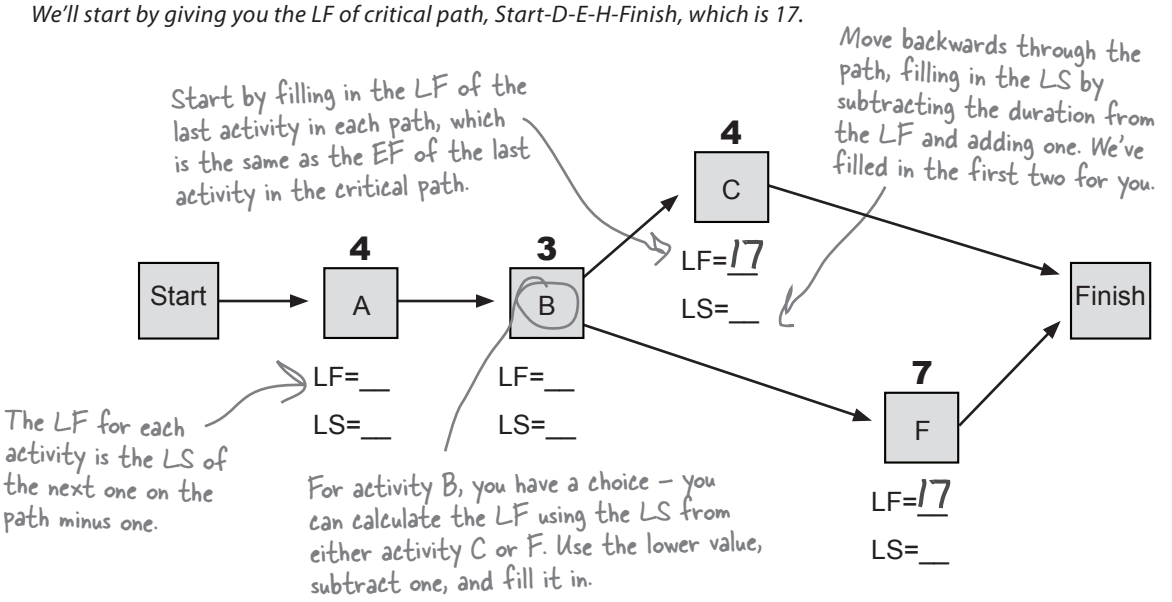
Wait up! These two aren't so straightforward.

Once you have the EF for both activities E and G, you can use the bigger one to come up with the ES for activity H.

You've calculated the ES for each activity. Use that information and take a backward pass through the paths, starting with the first two paths.

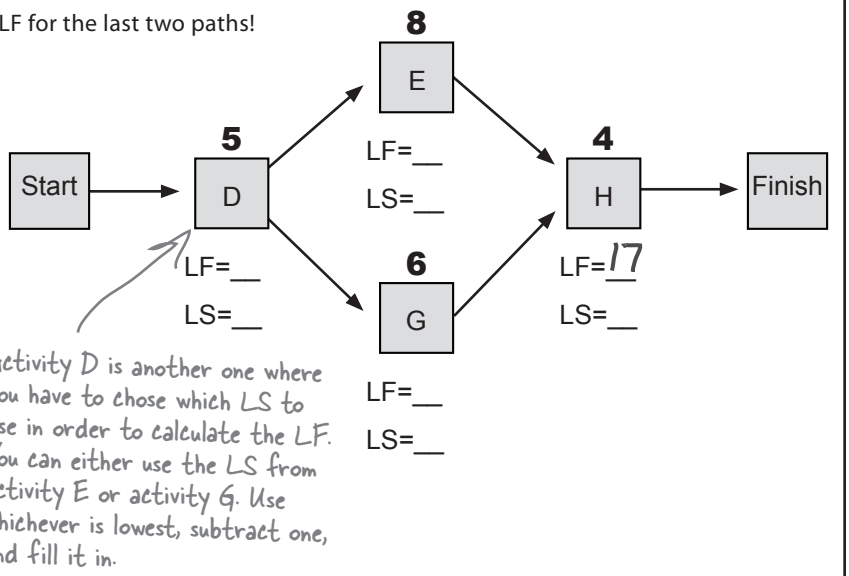
First start with the critical path. Take the EF of the last activity in the critical path and use it as the LF for the last activity in ***every*** path. If you take a minute to think about it, it makes sense to do that. The point of LF is to figure out the absolute latest that the activity can end without making the project late. And as long as every non-critical-path activity ends before the last activity in the critical path, then they won't be late.

We'll start by giving you the LF of critical path, Start-D-E-H-Finish, which is 17.



Finish up by calculating the LS and LF for the last two paths!

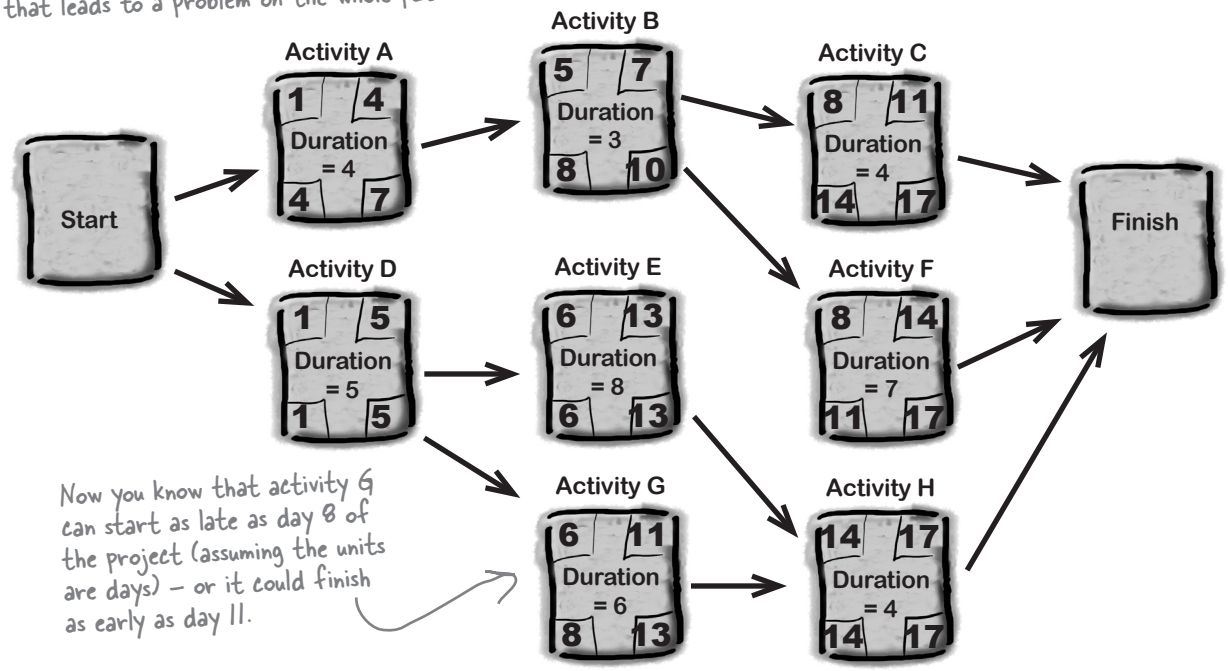
Activities B and D have two possible choices for which LS to use for the calculation. For activity B, do you use the LS of C or the LS of F? And for activity D, do you use the activity E or G? The answer is that you always **use the lowest value of LS to calculate the LF**. The reason is that you're trying to find the latest possible start date that *won't make the project late*. If you use an activity with a later LS, and the activity really is delayed by that much, then it'll cause a delay in both following activities. And that will make the one with the lower LS start too late.



Sharpen your pencil Solution

If you got a few of these wrong, don't worry. It's easy to miss one calculation, and that leads to a problem on the whole path.

For the exam, you'll only have to do one or two of these calculations, not a whole string of them like this. You'll definitely be able to handle the exam questions now!



Now you know that activity G can start as late as day 8 of the project (assuming the units are days) – or it could finish as early as day 11.

Wait a minute... I've never had to do this for my projects at work! I've got projects with dozens of activities, and this would take all day!

You won't have to do this kind of thing on the job... that's what computers are for!

Project management software like Microsoft Project will do these calculations for you. But you need to know how to do it yourself, because when the computer is doing critical path analysis, this is exactly how it figures it out!

there are no Dumb Questions

Q: Would I really use this critical path stuff in real life, or is it just something I need to memorize for the PMP exam?

A: Yes, critical path analysis really is important in real life! Sure, for a small project with a dozen or so activities, it's pretty easy to figure out which activities are critical and which can slip by a little bit. But what happens if you've got a project with dozens of team members and hundreds of activities? That's where critical path analysis can come in very handy. For a project like that, you'd probably be using project management software rather than calculating the critical path yourself, and the software will be able to highlight that path for you. Pay special attention to all of the activities that are on the critical path—those are the ones that could potentially delay the project.

Q: What about the other numbers? How do I use float?

A: Float is a very powerful planning tool that you can use to figure out how well your project is going, and to predict where your trouble spots might be. Any activity with a low or zero float absolutely must come in on time, while the people performing an activity with a larger float have more freedom to slip without delaying the project. So you might want to assign your "superstar" resources to the low-float activities, and those people who need a little more mentoring to the ones with higher float.

Q: Okay, but what about late start, early finish, and those other numbers? Do those do me any good?

A: Early and late start and finish numbers are also very useful. How many times have you been in a situation where you've been asked, "If we absolutely had to have this in two months, can we do it?" Or, "How late can this project realistically be?" Now you can use these numbers to give you real answers, with actual evidence to back them up.

Here's an example. Let's say you've got an activity in the middle of your project, and one of your team members wants to plan a vacation right at the time that the activity will start. Do you need to find someone to fill in for him? If he'll be back before the late start date, then your project won't be late! But that comes at a cost – you'll have used up the extra slack in the schedule.

Q: I can see how the critical path is useful on its own, but what does it have to do with the rest of time management?

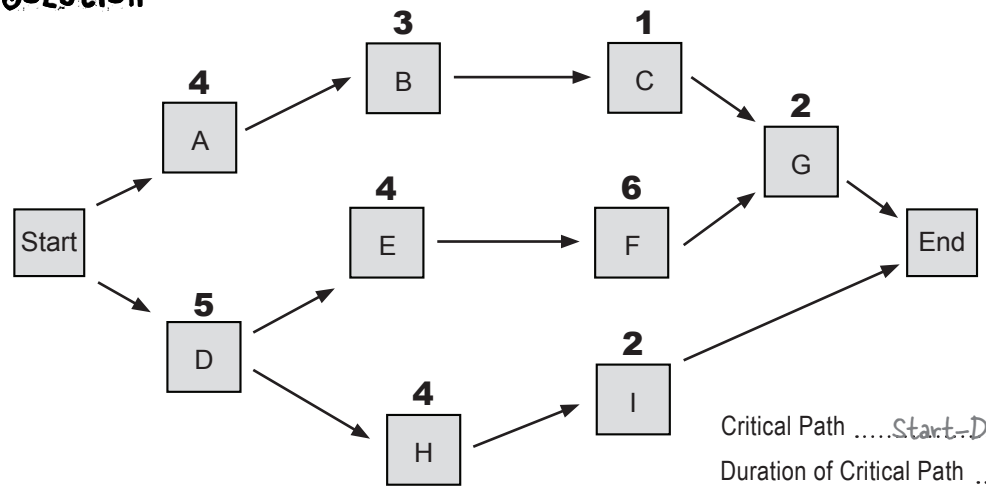
A: If you start putting together your schedule but the activities are in the wrong order, that's really going to cause serious problems... and sometimes doing critical path analysis is the only way you'll really figure out that you've made that particular mistake. That's why you need to pay a lot of attention to the Activity Sequencing tools and techniques. If you've come up with an inefficient or inaccurate sequence, with too many or incorrect predecessors and dependencies, then your entire critical path analysis will be useless.

BULLET POINTS: AIMING FOR THE EXAM

- The **critical path** is the path that has the longest duration.
- You should be able to figure out the number of paths in a **network diagram**, and the duration of each path.
- The **float** for an activity is the amount that its duration can slip without causing the project to be delayed. The float for any activity on the critical path is zero.
- You'll need to know how to calculate the **early start**, **late start**, **early finish**, and **late finish** for an activity in a network diagram using the forward pass and backward pass. This is the core of critical path analysis.
- You may see a **PDM** (or **activity-on-node**) diagram with special nodes that have extra boxes in the corners for the ES, EF, LF and LS. You may see an ADM (or activity-on-arrow) diagram too, but that's much less common.
- Don't forget that when two paths intersect, you have to decide which ES or LF value to take for the calculation in the next node. For the **forward pass**, use the larger value; for the **backward pass**, use the smaller one.

Exercise Solution

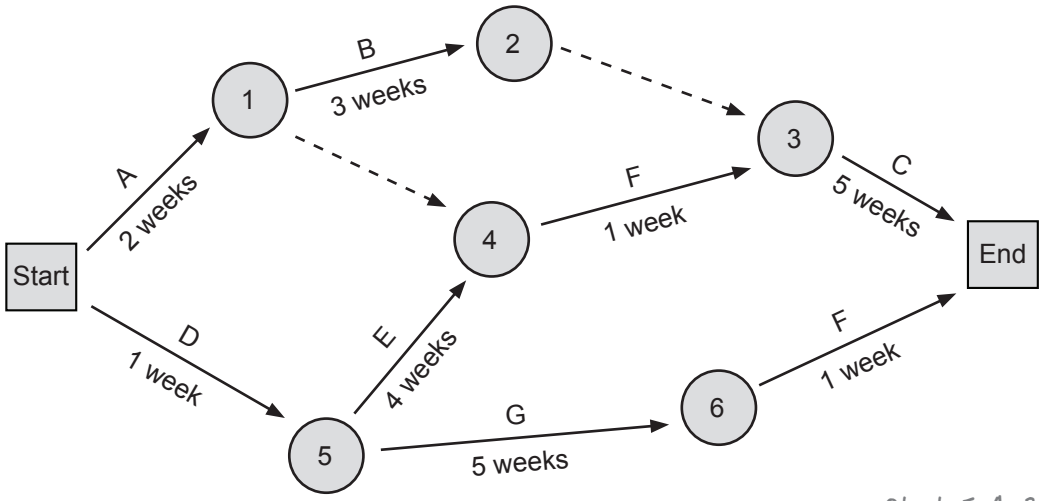
You may get questions on the exam asking you to identify the critical path in a network diagram. You had to practice that by finding the critical path and duration for this PDM and ADM.



Critical Path ..... Start-D-E-F-G-End

Duration of Critical Path 17

Total Number of Paths 3



Critical Path Start-5-4-3-End

Duration of Critical Path 11

Total Number of Paths 4

Exercise instructions should be repeated here.

1. What is the float for each activity on the critical path? 0

2. What is the total duration for path A – B – C – G? 10

3. What is the total duration for path A – B – F – G? 15

4. What is the total duration for path D – E – F – G? 17

5. What is the total duration for path D – H – I? 11

6. Which path is the critical path? D – E – F – G

7. Write down the float for each activity:

A 2 B 2 C 7 D 0 E 0

F 0 G 0 H 6 I 6