

# COMPUTER NETWORKS

Philip Irving

## Revision guide and sample questions

### Guide summary

This guide aims to help you achieve good marks in assignments and exams/TCTs. It contains a sample assignment and a sample time-constrained test, along with suggested worked solutions. These are based on real assignments and TCTs.

## Section 1: How to tackle assignment questions

### Introduction

Assessors are required to submit a marking scheme along with their assessment. To gain maximum marks from the assessment, you need to be able to discuss as many points on the marking scheme as possible. A common mistake in answering assessments is to avoid the more difficult parts – in doing so, you are giving up potential marks. Assignments often present scenarios which can appear complicated. Appearances can be deceptive: the assignment might be quite straightforward. The mark of a good consultant is being able to go into an organisation knowing the information he or she wants. He or she can often extract this information from the organisation even though the organisation itself cannot always supply it.

In an assignment situation you are the consultant and need to extract the information, not from an organisation, but from a case study. Often the case study will have been deliberately created to cover most of the syllabus. The following is an assignment similar to those used at the University of Sunderland. Although assignments will vary from one institution to another, it will serve as a guideline as to what the assessor is looking for in the answers you give.

## Sample assignment

### Introduction

Sir Philip Irving, a local businessman, has helped to raise money for a special pensioners' project in a deprived area of a city. Grangetown Computing (GC) will specialise in short computer courses for the elderly. Sir Philip has raised enough money to cover the building of an IT suite, which will involve the installation of a network infrastructure as well as 100 PCs. The other money is to be provided by a grant.

Work has already commenced on the building and the contractors estimate that they can begin installation of the network infrastructure within three months. The equipment must be purchased before this date with all invoices paid within one month, otherwise the grant will be lost. Unfortunately neither Sir Philip nor the contractors have any idea of what kind of networking infrastructure should be installed at GC. It has therefore been decided that bids will be obtained from local companies to design, supply and supervise the installation of the networking infrastructure. Being wary of small companies, Sir Philip has contracted a potential local GC user, Mr Warrender, who has had some networking experience. Mr Warrender will have the task of reviewing rival bids to ensure these are appropriate for the centre's requirements. He must also ensure that the successful bidders provide a reasonable level of 'future proofing', and that the contractors understand the requirements and meet them through knowledge and good design rather than luck. Accordingly, Mr Warrender has set out a scoring mechanism against which the network contractors will be judged. The company that scores the highest points should have demonstrated better knowledge and design details and therefore will be recommended to Sir Philip for detailed contract negotiations.

### Current equipment

GC plan to create three IT working areas – one for male pensioners, one for female pensioners and a larger common facility for mixed groups. Both the male and female IT areas will be equipped with 20 machines each. The larger common IT facility will be equipped with 100 machines.

Sir Philip has received 25 IBM Token Ring adaptor cards and 170 10Base2 network cards from a local benefactor and is keen these be used in the centre provided they do not add any cost to the overall project.

To make maximum use of the facilities, it has been determined that individual sessions will last for only one hour. GC is open Monday to Friday from 9.00 am to 4.00 pm with one hour off for lunch. It is a contractual condition that users will be able to use any program within three minutes of starting up.

Mr Warrender has made an initial survey and has produced the following as a basis for the design:

Area	Program estimate (MB)	Data estimate (MB)	Print load/hour (MB)
Male area	6	10	10
Female area	5	4	8
Common area	13	6	12

All estimates are on a per machine basis.

As the costs for carrying out the work are unclear, Mr Warrender has decided to ask for two separate prices. To keep the cost of software down per machine, it has been decided that both the male and female areas will have their own dedicated servers and operate on a client/server basis. The common area will be similar but can make use of two servers to cut down network traffic. In the first bid cost, it is assumed that each network will be standalone with no interconnection between systems. Software costs will come from a different budget but all hardware costs must be accounted for – including the costs of servers.

In Mr Warrender’s second scenario, he would like to see a fully integrated facility with email and Internet access to all computers. He has also specified that, for security reasons, all servers should be moved out of each area and placed in a common lockable area to be located on the ground floor. As part of a cost saving to help finance this enhanced facility, Mr Warrender has estimated that the number of servers could be reduced to three.

The server room (if used), as well as the common IT area, is to be located on the ground floor with both the male and female IT areas on the first floor. The first floor will also house another of Sir Philip’s enterprises, Phil’s Radio Taxis. Unfortunately, the radios that will be used in this venture grossly exceed the normal transmission limits for this type of equipment.

The GC will use a converted ‘listed’ building that has solid floors and suspended ceilings. Under the terms of the lease, only one drop for cabling between floors will be permitted, somewhere close to the lift shaft. The planning department has also insisted that cabling from the female IT area must pass through Phil’s Radio Taxis’ room before dropping to the ground floor where the server is to be located.

As well as forming three distinct networks, in the second of the two proposals it has been determined that these networks should be linked to provide for local file exchange as well as to allow a single shared connection to the Internet (it has been estimated that this will require an overall capacity of 1 Mbps connection speed at peak times). Sir Philip has made it a requirement that bidders provide some way of preventing unsuitable materials from being accessed at this facility.

The layout of the building will be as follows:

Ground floor

Server room	Common IT area	Office
Lift		Reception area and stairway
Canteen		

First floor

Male IT area	Phil’s Radio Taxis	Female IT area
Lift	Corridor	Stairs
Toilets	Storage	

## ***Requirements***

Your task is to analyse the requirements of GC and to produce the following for submission:

1. A report detailing whether the networking cards donated by the local benefactor could be used in the overall scheme. (20%)
2. A detailed design of the basic scheme with costs. (20%)
3. A detailed design of the enhanced scheme including central servers, email and Internet access with costs. (20%)
4. A report confirming compatibility, together with sketches illustrating how each design will be implemented. (10%)
5. A report explaining how unsuitable material can be kept out of such facilities. (10%)
6. Detailed instructions concerning the installation of Linux, including creating users and groups. (20%)

## Marking scheme

### Question 1

As you will have probably guessed, this assignment requires capacity planning. The first step is to trawl the assignment looking for facts and figures. It is not uncommon for an assessor to start off with a relatively simple capacity plan and then to 'pad this out' with lots of useless information and red herrings. This gets you to search for the required information. A sample capacity plan follows:

*Report on the possibility of using the existing networking cards*

Male area	Program + Data	= 16 Mb
Total load at start	2061668	= 2560 Mbps
Loading time for 10Base2	2560/7 seconds	= 6.09 minutes
Loading time for TR	2560/16 seconds	= 2.67 minutes
Loading time for 100BaseT	2560/100 seconds	= 0.43 minutes
Female area	Program + data	= 9 Mb
Total load at start	206968	= 1440 Mbps
Loading time for 10Base2	1440/7 seconds	= 3.43 minutes
Loading time for TR	1440/16 seconds	= 1.50 minutes
Loading time for 100BaseT	1440/100 seconds	= 0.24 minutes
Common area	Program + data	= 19 Mb
Assume two distinct networks, then total load at start	50 x 19 x 8	= 7600 Mbps
Loading time for 10Base2	7600/7 seconds	= 18.10 minutes
Loading time for TR	7600/16 seconds	= 7.92 minutes
Loading time for 100BaseT	7600/100 seconds	= 1.27 minutes

Note that none of the above times include any contingency allowance.

All 10Base2 cards can be ruled out on start-up performance.

Although Token Ring cards could be used in either the male or female areas, it should be noted that there are insufficient cards for both rooms. Therefore use in the female area could be considered but more than likely ruled out on the basis of standardisation and the costs to replace. (20%)

#### TIPS & ADVICE

It is very, very important to show your workings out. You will receive more marks for the process than you do for the correct result. You will, of course, receive maximum marks if you get both right! However, if you go off track the assessor will usually give you marks if the process is right.

### Question 2

In the initial scenario, there should be four distinct networks with four servers. Each network will be 100BaseT Ethernet (except possibly the female area) as described above.

Calculations and design to be given plus costs. (20%)

#### TIPS & ADVICE

Capacity planning again – the assessors asking you to demonstrate that your network will work. As you now know, there is far more to networking than simply plugging two machines together.

### Question 3

In the second scenario, we can combine the server for the male and female areas. Cables from the female area passing through Phil's Radio Taxis will be subject to interference from the high output radio and should be fibre – most likely 100BaseF using media converters (include the costs). (20%)

#### TIPS & ADVICE

Don't just give a list of equipment and prices. If you were spending many thousands of pounds you wouldn't just expect a shopping list: you would expect some sort of justification, and you must provide this justification for marks. Anyone can throw together a shopping list but, if you want good marks, justify each item, discuss alternatives and outline why you made the choice. For example, to those unfamiliar with networking, there would seem no point in using fibre in the taxi room.

### Question 4

In this part, the assessor is asking you to demonstrate that you have confidence your design and selected equipment will work. You can do this by supplying catalogue cuttings that show the equipment and their technical specifications. You should annotate these with details of which interfaces, etc., you are going to use and how these will connect. (20%)

#### TIPS & ADVICE

The assessor is asking you to prove that you didn't take a pin and stick it randomly in a catalogue to come up with the equipment. The assessor is asking you to demonstrate that the kit is compatible and that you have made sure it will link. You may have to justify your choices.

### Question 5

There are controls in Internet Explorer and also in products such as Netnanny that can help restrict access to the Internet. However, such restrictions should really be formalised and implemented through an organisational security policy. In particular, they should be implemented using proxies, firewalls and routers. (20%)

#### TIPS & ADVICE

The assessor is asking you to think as a network professional and expects you to go for an organisational-level solution to the problem. Choosing Netnanny is a PC-level solution.

### Question 6

Your report should detail how Linux is installed and also how to create users and groups. (20%)

#### TIPS & ADVICE

Assessors find it difficult to watch students build Linux machines. One solution is to ask you to produce a manual that will assist someone else to install Linux. This is what you are being asked for: a step-by-step guide for installing Linux, creating users and groups and allocating users to groups.

## Section 2: How to tackle exam questions

### Introduction

Assessors are required to submit a marking scheme along with their exam/TCT questions. To gain maximum marks from the exam/TCT you need to be able to discuss as many points on the marking scheme as possible. Simply writing something about the subject will gain you very few marks – ensure you know enough about the question to make it worth your while answering it.

Exams or time constrained tests have, as their name suggests, time restrictions, and will often ask specific questions rather than give you a scenario. The assessor is looking to test your knowledge. Contrary to popular belief, exams/TCTs are not there to fail you: they are for assessment integrity purposes. For this reason they are often treated as a true representation of your abilities – make sure you do yourself justice!

What follows are TCTs similar to those used at the University of Sunderland. Although TCTs/exams will vary from one institution to another, they will serve as a guideline to what the assessor is looking for in the answers you give.

### Sample TCT – rubric

#### TIPS & ADVICE

Read the rubric! The rubric is the rules of the TCT/exam. It is the part at the front that gives you information about which questions you should attempt, what marks they carry, how many you should attempt and whether calculators or books can be used.

It is a common mistake to arrive at an exam and 'jump straight in'. Imagine how you would feel if you did just that with a capacity planning question: you did not use a calculator but found afterwards your fellow students did!

This TCT consists of three sections. The questions in section A are multiple choice – the correct answer should be ticked. Section B and C questions are written answer questions.

Section A questions are worth 4 marks (correct) or –1 mark (incorrect) (10 questions). If no answer is given, you neither receive a mark nor lose a mark. There is only one correct answer to each question.

Section B questions are worth 30 marks each (one question to be attempted).

The Section C question is worth 30 marks (compulsory).

#### TIPS & ADVICE

This is a kind assessor – you are being given a pass (40%) just for the multiple-choice questions. If you have revised this should be easy!

## Sample TCT: multiple choice questions

### Section A

1. Which of the following does not adversely influence communication on a network?
  - a) attenuation
  - b) impulse noise
  - c) bandwidth increase
  - d) intermodulation
  - e) crosstalk
  
2. What is the function of a modem?
  - a) to boost the signal strength
  - b) to allow a computer to be connected to an RS232C line
  - c) to allow data to be sent over a telephone line
  - d) to allow connection to a Token Ring network
  - e) to allow an RS232C line to run over a much greater distance
  
3. Which of the following cables would be used to connect to a 10BaseT network system?
  - a) fibre optic cable
  - b) MICC cable
  - c) coaxial cable
  - d) printer cable
  - e) CAT 5/UTP cable
  
4. On what topology does FDDI operate?
  - a) star
  - b) ring
  - c) bus
  - d) tree
  - e) point-to-point
  
5. The following is a brief description of one of the layers in the ISO seven-layer model for open system interconnection: 'converts data into an abstract format . . . compresses data... associated with file types such as JPEG, GIF, etc.' Which of the following layers fits the description?
  - a) physical
  - b) presentation
  - c) network
  - d) transport
  - e) session

6. Which ISO seven-layers would be used by a bridge?
- a) physical only
  - b) physical + data link layer
  - c) physical + data link + network layer
  - d) physical + data link + network + transport layer
  - e) physical + data link + network + transport + session layer
7. Which command is important for file system security in UNIX?
- a) security
  - b) chmod
  - c) modify
  - d) delete
  - e) lock
8. Which command is useful for establishing inherited rights in UNIX?
- a) umask
  - b) mark
  - c) mask
  - d) rights
  - e) lefts
9. What is the following a definition of? 'This category of networks usually spans a university campus or, at its limits, a small geographical area – for example, a town, county or district.'
- a) LAN
  - b) WAN
  - c) MAN
  - d) district
  - e) region
10. Which of the following is not a layer in the TCP/IP model?
- a) network access
  - b) internetwork
  - c) application
  - d) transport
  - e) presentation

## Section B

Answer one question out of the following:

1. Networks commonly use the following components:
  - a) repeaters
  - b) bridges
  - c) routers
  - d) gateways

Describe the purpose of two only of these components, showing clearly how these can be used within a network. (15 marks each)

2. Local area networks are generally interconnected using either copper or fibre optic cables. With the aid of a diagram, describe the construction of the following cables clearly stating where each type would typically be used:
  - Coaxial cable (5 and 10 mm) (5 marks)
  - STP cable (5 marks)
  - UTP cable (5 marks)
  - Fibre optic cable (5 marks).

Show how data is carried in a fibre optic cable and explain the main advantages of using this type of medium. (10 marks)

3. Ethernet is a widely used technology for local area networks (LANs):
  - a) Describe in detail the operation of Ethernet and list the supported topologies. (15 marks)
  - b) Compare the advantages and disadvantages of Ethernet with those of another popular networking technology. (15 marks)

## Section C

Answer the following question:

1. There are essentially three types of backup:
  - Name the three types. (6 marks)
  - Discuss each type and compare its advantages/disadvantages compared to the others. (24 marks)

## Sample TCT: answers to multiple choice questions

### Section A answers

#### TIPS & ADVICE

Look for the red herrings! In general, multiple choice answers contain two answers that are 'possibles' and some that are red herrings. Look for the red herrings and eliminate them.

1. Answer c (bandwidth increase) – all the rest are legitimate sources of error!
2. Answer c (to allow data to be sent over a telephone line) – modems modulate digital-to-analogue signals and vice versa; they are needed to send data over a telephone line.
3. Answer e (CAT 5/UTP Cable) – 10BaseT uses twisted pair in a star configuration and the T stands for twisted pair!
4. Answer b (ring) – FDDI is similar to Token Ring and operates on a dual concentric fibre ring.
5. Answer b (presentation) – these functions are associated with the presentation layer.
6. Answer b (physical + data link layer) – a bridge operates in layer 2 and therefore uses the services of layer 1.
7. Answer b (chmod) – the chmod command modifies file attributes – the primary file security in UNIX.
8. Answer a (umask) – this specifies the default file creation mask – remember its rights taken away!
9. Answer c (MAN) – the town, regional or university campus should give this away.
10. Answer e (presentation) – remember A TIN!

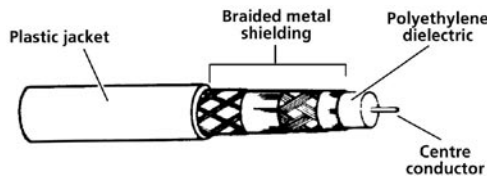
### Section B answers

#### Question 1

- Repeater: A device used to regenerate digital signals in both directions. It is used to extend the maximum size of a network (either in terms of numbers of nodes and/or operating distance). Operates on the OSI layer 1 (physical layer) and thus requires little intelligence.
- Bridge: A device used for three reasons – to:
  1. interconnect two smaller networks when the combined size exceeds the physical limitations of that technology. Communication can take place through the bridge;
  2. manage traffic and security between two separate networks only allowing internetwork traffic to pass through the bridge and thus ensuring that traffic local to one network does not cross to the other network;
  3. provide a conversion between technologies.
 Operates on OSI layer 2 (data link layer)
- Router: This is a device used to interconnect networks that are administratively separate or of a different network topology. These operate on OSI layer 3 (network layer) and are commonly used to connect a network to the Internet. They require no knowledge of the network to which they are connecting.
- Gateway: This is a device used to interconnect systems with different network protocols. This operates on OSI layer 7 (application layer). An example would be the exchange of email between two computers in different networks using a mail gateway.

Question 2

- 5 and 10 mm coaxial cable:



You should discuss the fact that 5 mm coaxial cable is employed in 10Base2 Ethernet systems, primarily used in small office and workplace environments where distance is not a major concern. Also that 5 mm coaxial is reasonably flexible and can be hidden easily. On the other hand, 10 mm coaxial cable is used in 10Base5 Ethernet systems where more distance is required. It is not particularly flexible and, hence, not easy to hide as it requires a significant turning radius, etc.

- STP cable:



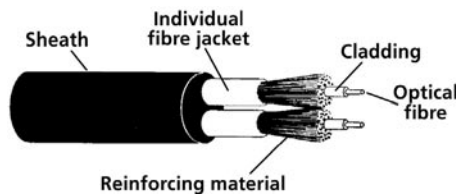
Screen twisted pair cable is used in 10BaseT and 100BaseT Ethernet environments. You should mention that the screened version of this cable gives better noise immunity but is more expensive and is more difficult to install due to the larger bending radius.

- UTP cable:



Unshielded twisted pair cable is used in 10BaseT and 100BaseT Ethernet environments. You should discuss the fact that it is essentially the same as telephone cables and is often used in home and small office environments where cables can be hidden very easily and where noise is not a significant issue.

- Fibre optic cable:



You should discuss the fact that fibre optic cable is more expensive than its copper counterparts and is used in high data rate transfer situations, such as FDDI and gigabit technologies. It is also used in areas susceptible to electrical noise due to its natural immunity. You should also note that fibre optic cable must tolerate large bending radii.

The following are the things you should discuss. Fibre optic cable consists of strands of optical fibres (traditionally, glass or some form of plastic equivalent) packaged within a protected environment similar to normal cable construction. Each fibre represents a communication channel. Light pulses pass longitudinally down the fibre to a receiving station where the original electrical signals can be regenerated. The fibre acts as a light tube reflecting the beam on its inner surface, which ensures there are very low losses of light over distance. Fibre optics, therefore, have a very high bandwidth compared to copper cables and, as they have very low losses, they can operate over very long distances. Being light pulses, the signals are completely immune to any form of electromagnetic radiation and, hence, immune to electrical noise.

*Question 3*

You should explain how data is sent across an Ethernet network, including waiting for a transmission pause; reading back the data being transmitted to ensure no collisions have taken place; and dealing with collisions. The topologies supported include bus, tree and star. Ideally your comparison should be made with Token Ring as this is also a LAN technology. Its advantages include cost and ease of implementation. Its disadvantages include its performance under high loads (collisions), its relatively short range and the need for some form of repeaters even if only a small number of devices are connected to the network.

**Section C answer**

Full, differential and incremental.

You need to discuss each type of backup and the advantages and disadvantages of each.

Full backup is the recommended method.

**TIPS & ADVICE**

You will earn marks simply for naming the different types of backup, so you may as well have them. In the second part, the assessor wants you to show you understand the different types and can discuss these professionally, identifying the advantages and disadvantages of each.