



Do not award half marks.

In all cases give credit for appropriate alternative answers.

Question 1 (Compulsory)

(a) What are the *two* primary services provided by Internet Protocol? [2]

**Addressing, routing, forwarding of packets and (1)
Dividing TCP messages up into packets (fragmentation) and re-
assembling packets into TCP messages. (1)**

(b) What is *CSMA/CD*? How does it work? [3]

- **Carrier Sense and Multiple Access with Collision Detection (1)**
- **All devices communicate on a single medium, but only one can transmit at a time. (1)**
- **If 2 devices try to transmit at the same instant, and a collision is detected, both devices will have to back off and wait a random amount of time before trying again. (1)**

(c) How are the ARP *request* and *response* packets similar? How do they differ? Use an example to explain your answer. [3]

- **Both are small packets containing four fields (1). The sender's Ethernet address, target IP address, and target Ethernet address (1). The target Ethernet address is blank when the packet is a request packet (1).**

(d) Provide the run-length encoding results for the following bit strings (using 4 bits). Show how you arrive at the solution. [6]

(i) 000001000000001000000110001 [2]
0101 1000 0110 0000 0011 (1 mark)

(ii) 0000000000000111000000000010000000001 [2]
1101 0000 0000 0000 1010 1001 (1 mark)

(iii) 0000000000000001000010000000000000001 [2]
1111 0100 1111 (1 mark)

Workings should be provided to get the full 2 marks.

(e) Explain how the routers make use of routing tables to relay packets towards their destination. [4]

- **A Routing table entry tells a router which of its neighboring routers provides the best path to a given destination network (1)**
- **The router parses the destination address of outgoing/incoming IP packets and uses the routing table to forward them to neighbors (1)**
- **Before a router can send a packet it must find its IP address (1)**
- **DNS provides a host names to address translation. (1)**

(f) With the aid of a diagram, explain the advantages and functions of a LAN hub in the Interface Layer. [6]

- **A LAN hub increases the bandwidth of the LANs beyond a simple Ethernet cabs. (1)**
- **With a LAN hub, each device linked to the network is directly connected to a central hub. (1)**
- **Within the LAN hub, there is a high-speed bus on which contention protocol operates to facilitate communications between the devices. (2)**

Award 2 marks for diagram. Page 9-3 figure 9-5

(g) Consider a secondary school identification card scheme were the first two integers describe the age of students from 12 to 15 inclusive.

(i) How can we compress the two integers transmitted? [1]

We can replace the two integers in each ID card number by a 2-bit integer. [1]

(ii) Show the possible values derived from the above solution. [2]

We can change the year of the birth of 12 years old students to 00 subsequently the year between 13 to 15 to 01 11 and 10 [2]

(h) Explain how an APPLET is initiated and what happens when your browser is not Java enabled? [3]

When a browser loads a web page containing an APPLET tag, it loads the class specified in the tag: this is how applets get started. The APPLET tag contains an attribute of the form code="<filename>" telling it the name of the file containing the bytecode for the class [2 marks].

If a browser is not Java-enabled, then it will not recognize the applet tag, and will not attempt to load the Java applet provided. Instead, it interprets the HTML commands between the applet tags [1 mark].

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Question 2

- (a) Explain briefly the role of the Transport layer in the ARPANET four-layer architecture. [2]

The Transport layer bridges the gap between the application layer and the network layer (1). Its tasks involve opening a connection between two hosts, managing the connection, as well as terminating an open connection (1).

- (b) List any *three* standards for data sharing on the Internet. [3]

ASCII, EBCDIC, MIME, JPEG, etc. (3)

Any three to get 3 marks

- (c) Write a file scheme for a local directory that includes a browser and a telnet scheme. You can use 'Informatics' as an example. [2]

File: C:\IEXPLORE\informatics.htm or C:\Netscape\informatics.htm (1)

Telnet: telnet://informatics.com.sg (1)

- (c) The key idea behind Java is to use HTTP to move a program from the server to the browser and then execute the program in the browser. What are the security concerns with this method? [2]

The browser has no idea what damage the program might do (1), for example, it could wipe out the hard disk or access and send out sensitive data. (1)

(d) What are the *three* main limitations of the TCP? [6]

1. **TCP data and control messages have the same message header structure (1). This makes the percentage overhead very high for interactive applications with small amounts of data in each message (1).**
2. **The TCP checksum mechanism is very weak (1). As the interface layer already has a checksum facility, errors that filter up to the transport layer could be subtle enough to escape detection with this simple scheme (1).**
3. **It is hard to obtain Quality of Service control over a TCP connection, as setting the URG bit in the TCP header does not affect normal flow control (1) . For applications where real-time transmission is vital, this is a serious problem (1).**

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Question 3

- (a) What are the two mail protocol standards currently in use? How do you overcome the compatibility problems between them? [3]

SMTP (1) and MOTIS (1).

Use mail gateways to translate between these different protocols. (1)

- (b) Discuss the potential *security* problems you may come across within SMTP and MIME. [4]

SMTP: There is no reliable way for the local machine to verify the return address (1), hence you can never be sure who sent the mail when using SMTP (1).

MIME: Ability to transfer executable programs (1) and to mail postscript files that themselves can contain dangerous actions and may cause damage to the system (1).

- (c) Direct Multicast support at the transport level can greatly enhance applications such as Web television. Explain how this is currently implemented in the Internet and why this approach is inefficient. Also suggest the most efficient way of providing such a service. [4]

Currently, the multicast is implemented as a series of point-to-point transfers (1). This method is inefficient because the message is sent out separately per viewer (1).

The most efficient way of providing such a services is broadcasting (1). This is very efficient as the message is sent only once (1).

- (d) What are the methods that a browser and server use to improve the HTTP efficiency? [4]

- **Caching - A Browser often caches Web pages and if they are requested again, they will be immediately available (1).**
- **Pipelining- A Browser can also improve performance by overlapping requests and allowing parallel retrieval (1).**
- **Multi-threading- A Server that executes on a multi-threaded architecture can respond to several client requests simultaneously (1).**
- **Streaming – A Server supporting streaming of media like audio and video, particularly for applications such as Web TV, Internet Telephony and Web Radio.**

Do not award half marks.

In all cases give credit for appropriate alternative answers.

Question 4

- (a) Explain briefly the use of the *isarithmic* method for handling network congestion control. [3]

It keeps the total number of packets constant by circulating permits in the network. (1)

A node captures a permit before it can release a packet into the network. (1)

When the packet reaches its destination, the permit is regenerated and circulated again. (1)

- (b) Explain *two* advantages and *two* disadvantages of organising network protocols into layers. [4]

Advantages:

- **handles complexity of network problems (1)**
- **provides independent implementation of layers (1)**

Disadvantage:

- **performance penalty (1)**
- **lack of flexibility(1)**

- (c) Explain how the ARP and IP modules on an individual host interact. [4]

When the IP packet has been constructed, the ARP table is used to look up the Ethernet address which is to be inserted into the packet (1), If the address is not present, an ARP request packet is broadcast on the Ethernet (1), and the IP packet is queued. When a suitable address is received, it is stored in the ARP table for future reference (1). The IP packet may now be broadcast (1)

(d) State *two* differences between *static* and *dynamic* routing strategies. [4]

Static routing:

- all routes between pairs of nodes in the network are computed before the network is up and running (1)
- cannot react to the changing traffic patterns as there is no updating of the routing table(s) (1)

Dynamic routing:

- routes are recomputed and configured during the operation of the network (1)
- can react to the changing traffic patterns by updating routing table(s) to redirect packets (1)

Marks are to be awarded for a pair of descriptions showing a different characteristic between the two.

Question 5

- (a) Explain how flooding routing technique works. What does selective flooding mean? In general under what circumstances is this technique useful? [5]

**The router forwards packets to all ports except the incoming port (1) by generating a large number of duplicate packets (1).
Selective flooding only forwards packets in the 'right direction' rather than to all neighbours (1).
It is useful in military applications, where a large number of nodes can get destroyed at any time (1). It is also useful in any application where robustness is important (1).**

- (b) Besides selective flooding, what other variant of flooding exists? How does it work? [2]

The other variant is known as 'Random Walk' (1). Random walk picks a neighbour at random in the "right direction", and forwards the packet there (1).

- (c) Is flooding practical? When should it be used? [2]

Flooding is not practical in general. [1]

It is useful when large numbers of nodes can be destroyed at any minute, or when robustness is important, e.g. military applications. [1]

- (d) What are the *two* identifiers in the ATM middle layer that provides addressing information? And what are they used for? [3]

- **Virtual Path identifiers (1) and Virtual Channels identifiers (1)**
- **The identifiers guide a cell along a connection that is set up at the start of the data transfer (1).**

- (e) Give *three* examples of a Method operation in a general request message format. [3]

**GET (1), PUT (1), DELETE (1), SEARCH (1).
Choose any three.**

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