

Question 1 – Short Answer Questions

1.1 Match the following to one or more layers of the OSI model:

- a. Route determination – **Network Layer (Layer 3)**
- b. Flow control – **Transport Layer (Layer 4)**
- c. Interface to transmission media – **Physical Layer (Layer 1)**
- d. Provides access for the end user – **Application Layer (Layer 7)**

[2 marks]

1.2 Match the following to one or more layers of the OSI model:

- a. Reliable process to process message delivery– **Transport Layer (Layer 4)**
- b. Route selection – **Network Layer (Layer 3)**
- c. Defines frames – **Data Link Layer (Layer 2)**
- d. Provides user services such as email and file transfer – **Application Layer (Layer 7)**
- e. Transmission of a bit stream across a physical medium – **Physical Layer (Layer 1)**

[2 marks]

1.3 What is meant by **CRC**? (Interpret the letters) – **Cyclic Redundancy Check**

How many times a CRC is calculated and **explain your answer**?

- a. Once before transmission
- b. Once after receipt
- c. **Twice: Once before transmission and again after receipt**
- d. Three times: Once before transmission, once on receipt and a third time during transmission.

[2 marks]

1.4 Which layer of the OSI model does Project 802 divide into two sub-layers?

- a. Physical layer
- b. **Data Link layer**
- c. Network layer
- d. Session layer

Name the two sub-layers. **LLC and MAC Layers. (LLC = Link Layer Control and MAC = Media Access Control Layer)**

[2 marks]

1.5 Which of the following problems can occur at the Physical layer? (Choose all that apply)

- a. **NIC driver problems**
- b. Incorrect IP address
- c. **Signal errors caused by noise**
- d. Incorrect segment size

[2 marks]

1.6 What is a **PDU**? (Interpret the letters) – **Protocol Data Unit**

[2 marks]

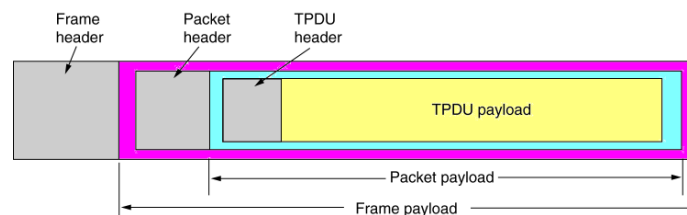
What is the name of the PDU at the Transport layer? – **PDU at Transport Layer is a Segment**

1.7 The addition of information to a PDU as it's passed from one layer to the next is called which of the following?

- a. Headlining
- b. Encapsulation**
- c. Decapsulation
- d. Converting

Draw a diagram showing this process as information passes from the Transport layer to the Physical layer.

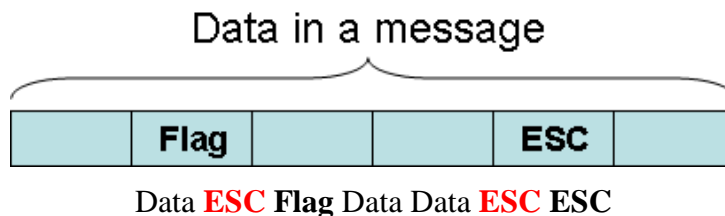
Diagrams similar to the following are acceptable:



[2 marks]

1.8 In Data Link Control briefly explain the procedure known as **byte stuffing**. **When a flag or ESC character is encountered in the byte stream, we must include another ESC character ahead of it to ensure that it is not misinterpreted.**

If data from an upper layer consists of the following data, explain how byte stuffing would be implemented to ensure that the data is not misinterpreted:



[2 marks]

1.9 Change the following IP addresses from dotted decimal notation to binary notation:

- a. 114.34.2.8 – **01110010 00100010 00000010 00001000**
- b. 208.34.54.12 – **11010000 00100010 00110110 00001100**

[2 marks]

1.10 Find the class of the following binary addresses and convert to dotted decimal format:

- a. 11110111 11110011 10000111 11011101 –
247.243.135.221(Class E)
- b. 10101111 11000000 11110000 00011101 – **175.192.240.29 (B Class)**

[2 marks]

1.11 a. What is the purpose of a subnet mask? – **To partition space into sub-networks more efficiently to have appropriate sized clusters of hosts.**

[2 marks]

- b. Is the subnet mask 255.255.0.255 valid for a Class A address? Explain. Not valid as a mask must consist of contiguous '1's and this mask does not have this property.
- 1.12** Briefly explain what is meant by NAT. How can NAT help in IP address depletion? Network Address Translation. A single IP address connects to the outside world from the router. The router handles translation of IP packets into local addresses using the private number range for IP. This preserves IP addresses from the global pool as the private addresses do not use up more than the single connecting IP address. [2 marks]
- 1.13** For the BGP4 routing protocol, explain the differences between the following three types of Autonomous Systems:
- a. Stub AS – A single source or destination group with no transiting capability.
 - b. Multi-homed AS – An AS that connects with several other AS groups but does not have a transit capability
 - c. Transit AS – An AS that allows traffic to transit as well as being able to provide source/sink for traffic streams. [2 marks]
- 1.14**
- a. What is ICMP (Interpret the letters)? – Internet Control Message Protocol
 - b. What is the primary function of the ICMP protocol? Give an example situation where it would be used in the Internet. The protocol is used to provide error and information messages that IP cannot provide. Example: If packet encounters boundary where packet would need to be segmented, but the segmentation flag has not been set (segmentation is not allowed) In this case an ICMP message is sent back to the source to say that the packet cannot be delivered. [2 marks]
- 1.15** List, in bullet point form, 4 key advantages of IPv6 over IPv4.
- Larger address space
 - Better and more compact header format
 - New options
 - Allowance for extension
 - Support for resource allocation (flow labelling and control options)
 - Support for more security (authentication and privacy) [2 marks]
- Total [30 marks]

Question 2 – More Detailed Answers are Required

- 2.1 This question is concerned with shortest path algorithms as used in the Internet. Consider the following segment of the Internet that consists of 7 nodes and 11 links and answer the questions below:

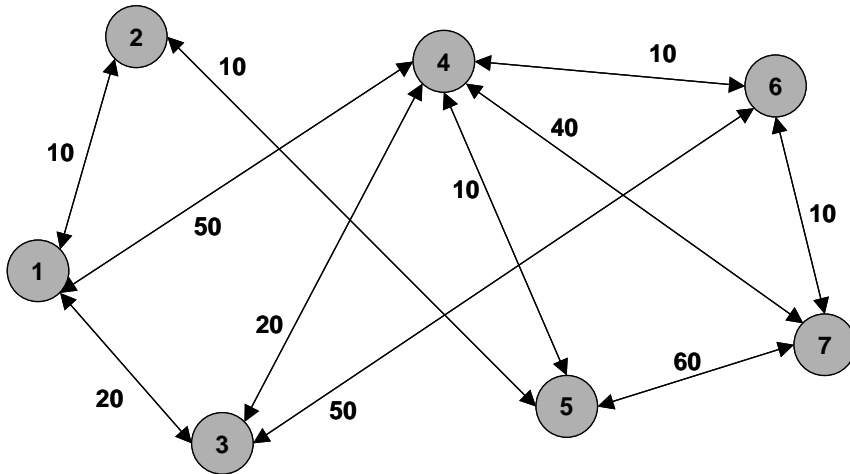


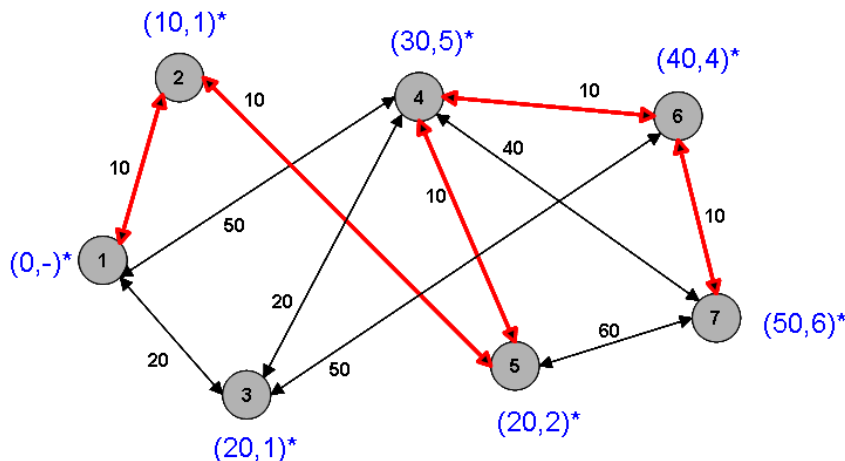
Figure 1: Sample Network from the Internet

The figures on the links represent the delay (in milliseconds) for traffic using that link.

- a. Determine the **shortest route tree** based on the home node "1", and connecting to all other nodes, using the Dijkstra algorithm. *Carefully draw one copy of this network into your answer book. Show your working by placing appropriate labels on the nodes of this network. (Do not draw multiple copies of the network for your answer – one will be sufficient.)*

[5 marks]

[3 marks]



[2 marks]

[4 marks]

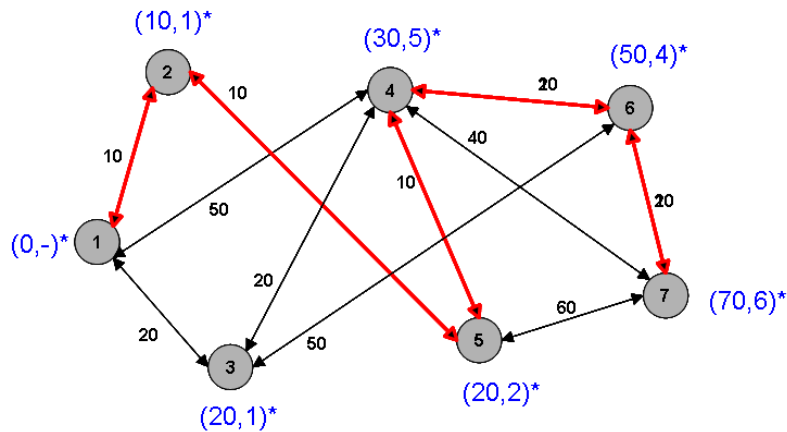
[2 marks]

- b. Draw another copy of the network into your answer book. How does the shortest route change between nodes 1 and 7 if the delays on links 4 – 6 and 6 – 7 are both increased from 10ms to 20ms?

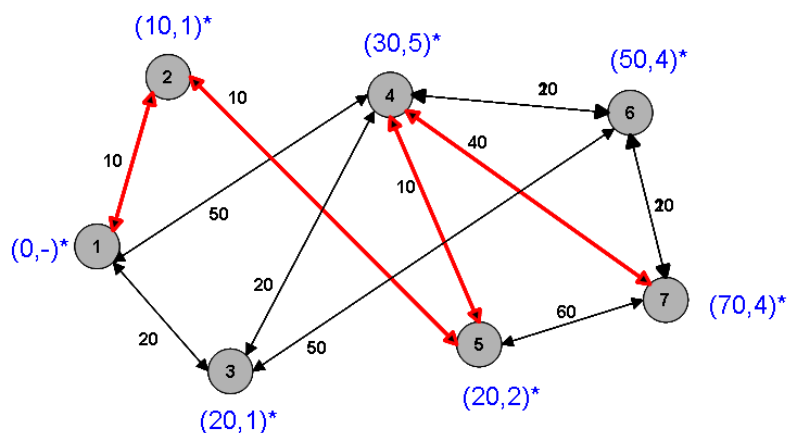
[1 mark]

Total delay becomes 70 but there are now two possible paths giving this shortest path result.

[1 mark]



OR



- c. If all the delays into and out of node 3 are misreported as zero, what effect will this misinformation have on traffic using the network? (**Do not compute the new shortest route on a new diagram – only a descriptive answer is required.**)

Node 3 begins to attract traffic from everywhere as it is seen to be giving excellent delay performance. Major congestion is the likely result of this misinformation.

- d. Suppose that we need to determine a **backup route** between node 1 and node 7 in the network, and that it has been suggested that this route could be the *second shortest route* between these two nodes.

- Suggest a way that could be used to find this second shortest route and use your method to locate this route for the network given in Figure 1 above.

One way is to successively set link costs to infinity if they appeared on the original shortest path and then find the shortest path from among these contenders. Another approach which answers the question below is to set all link costs to infinity if they appear on the shortest path. In that case we ensure that the new path is link disjoint from the first path.

- What is the delay on this second shortest route? **About 80 if we choose the path 1 – 3 – 4 – 7.**
- Are there any links that are common to the shortest and

second shortest route from node 1 to node 7? (If so, which links?) **Not in my answer, but other answers are possible.**

- How many links occur in **both** the shortest and second shortest routes? **0 in my answer.**

2.2 An organisation is granted the block 211.17.180.0/24. The administrator wants to create 32 subnets:

- Find the subnet mask required – **This is a Class C network. We require a mask that provides 32 subnets. /24 has no subnets, so we increase it until 32. Thus the mask is /29 = 255.255.255.248.**
- Find the number of addresses in each subnet: **There are 3 host bits remaining and $2^3 = 8$. Two addresses are not available hence a maximum of 6 hosts can be used.**
- Find the first and last allocatable addresses in subnet 1. **The first allocatable address in subnet 1 will be 211.17.180.1, the last allocatable address in subnet 1 will be 211.17.180.6**
- Find the first and last allocatable addresses in subnet 32: **The first allocatable address in subnet 1 will be 211.17.180.249, the last allocatable address in subnet 1 will be 211.17.180.254**

[6 marks]

2.3 a. Briefly describe the key differences between the Link State Protocol OSPF and the protocol known as BGP4.

- OSPF uses shortest path algorithm (Dijkstra) to compute the optimal path. BGP4 is rule based and does not rely on metrics.**

b. Identify the situations where each of these routing protocols would be applied and reasons for selecting them for those situations.

- BGP4 is used for inter-ISP or inter-region routing, whereas OSPF is more likely to be used for routing within an organisation's internal network. OSPF cannot extend its reach beyond the local network.**

[3 + 3 = 6 marks]

Total

[30 marks]