A1.

This question is about the frames used by the Local Area Network (LAN) technology known as Ethernet /IEEE 802.3.

a) Produce a sketch diagram to show the fields of a frame as used by Ethernet / IEEE 802.3. **(6 marks)**

b) Explain the role of the preamble and start of frame delimiter fields in an Ethernet / IEEE 802.3 frame. **(6 marks)**

c) How was the original definition of an Ethernet / IEEE 802.3 frame updated by IEEE 802.1Q to permit the use of Virtual Local Area Networks (VLANs)?

(4 marks)

d) What range of sizes is permitted for the data/payload field of an Ethernet / IEEE802.3 frame? **(3 marks)**

e) Why was it necessary to specify both a minimum length and a maximum length for the data/payload field of an IEEE802.3 frame? **(6 marks)**

Part (a)

Preamble	Start of frame delimiter	MAC destination	MAC source	802.1Q tag (optional)	Ethertype (Ethernet II) or length (IEEE 802.3)	Payload	Frame check sequence (32–bit CRC)
7 octets	1 octet	6 octets	6 octets	(4 octets)	2 octets	46(42)[b]–1500 octets	4 octets
		← 64–1518(1522) octets →					

(Marking scheme: 6 marks for the correct frame)

Part (b)

The preamble is an alternating sequence of 1s and 0s and is largely present to enable receivers' clocks to be tuned to the precise bit rate being used as the transmit bit rate. The start of frame delimiter, which is 8 bits, is 11010101, that is, it ends with two 1s and its purpose is to enable the receiver to synchronize to the octet boundaries and know that the real packet information follows next.

(Marking scheme: 3 marks per correct explanation)

Part (c)

The type/length field and the 802.1Q tag field were added to hold VLAN ID and priority information.

(Marking scheme: 2 marks per field)

Part (d)

The data/payload field has a "traditional" minimum size of 46 octets and a maximum size of 1500 octets. The presence of an 802.1Q tag field changes the minimum size to 42 octets.

(Marking scheme: 1 mark for indicating original minimum size; 1 mark for maximum size and 1 mark for minimum size when 802.1Q tag was included)

Part (e)

The origin of the sizes are related to the use of the CSMA/CD algorithm, in shared co-axial cable Ethernets and the maximum permitted network path length. The essence of the minimum size is that the time to transmit even the smallest permitted packet should be at least the round trip time of a 10mbps co-axial Ethernet at maximum permitted length of 2.5km including four repeaters. The maximum time is based on not allowing any one station to be greedy and taking too high a share of the available capacity

(Marking scheme: 2 marks for relating

A2.

This question is about the service provided by the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).
a) What is the difference in the service offered to applications by the TCP and UDP protocols? **(8 marks)**

b) For each of the following applications determine whether you would use TCP or UDP and explain the reasons for your choice.
i. File transfer **(3 marks)**

ii. Watching a real time streamed video **(3 marks)**

iii. Web browsing **(3 marks)**

iv. A Voice Over IP (VoIP) telephone conversation **(3 marks)**
c) Both TCP and UDP use port numbers. What are these port numbers used for?

(5 marks)

Part (a)

TCP operates above IP and provides a connection orientated service in which end to end data transfer is guaranteed with flow control and congestion avoidance capabilities. It is a reliable service.

UDP operates above IP and provides a connectionless, unacknowledged service to the upper layers. There is no error recovery and no flow control provided by UDP. It is a best effort service.

(Marking scheme: 4 marks for each correct definition)

Part (b)

i. TCP, losing date in text is not acceptable, therefore the error detection and correction mechanisms of TCP are needed.
ii. UDP, the reason is that when watching a movie, delay is critical and therefore there simply isn't any time to seek the retransmission of any errors. The simplicity of UDP is therefore required.
iii. TCP, The reason is that web pages need to be delivered without error so that all content is properly formatted and presented. Therefore the error detection and correction properties of TCP are needed.
iv. UDP, The reason is that a telephone conversation has strict timing requirements for the transfer of data and seeking the retransmission of any errors would introduce too much delay. Therefore the simplicity of UDP is needed.

(Marking scheme: 3 marks for each correct answer)

Part (c)

Both TCP and UDP provide services to higher layer protocols however multiple higher layer protocols can be multiplexed onto a single UDP or TCP layer. Each of these higher layer protocols are then differentiated by means of UDP/TCP port numbers. Port numbers are 16 bits in length. Therefore the port number identifies the particular higher layer protocol to which a given data stream is destined.

(Marking scheme: 2 marks for explaining the multiplex nature of the protocols; 2 marks for indicating the purpose of the ports; 1 mark for specifying the length of the port)

A3

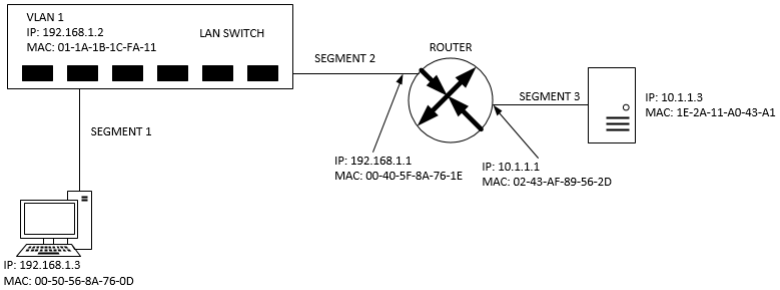
This question is about the ISO Reference Model and the TCP/IP protocol stack.

a) The ISO Reference Model defines seven protocol layers, each of which is responsible for a specific range of functions. By considering this model, mention two main functions performed by a protocol operating at the network layer.

(2 Marks)

b) Give the names of the seven layers of the ISO Reference Model and the names of the four corresponding layers in the TCP/IP protocol stack, showing the correspondence explicitly. **(11 marks)**

c) Figure 1 shows a small scale network comprising one switch and one router. A personal computer is connected to the switch and a server is connected to the router. All switch and router ports are IEEE 802.3 CSMA/CD.



For this network, consider data being sent from the personal computer to the server and indicate the values of the source and destination address fields of the frame and the IP header for each segment. **(12 marks)**

Part (a)

The network layer is responsible for packet forwarding, including routing, through intermediate routers. The functions include:

i. Connectionless communication
ii. Host addressing
iii. Message forwarding

(Marking scheme: 1 mark per function up to 2 marks for the question)

Part (b)

Layer 7	Application	Application
Layer 6	Presentation	
Layer 5	Session	
Layer 4	Transport	Transport
Layer 3	Network	Internet
Layer 2	Data link	Network Access
Layer 1	Physical	

Part (c)

ISO Reference model **TCP/IP**

	Segment 1	Segment 2	Segment 3
Source IP address	192.168.1.3	192.168.1.3	192.168.1.3
Destination IP address	10.1.1.3	10.1.1.3	10.1.1.3
Source MAC address	00-50-56-8A-76-0D	00-50-56-8A-76-0D	02-43-AF-89-56-2D
Destination MAC address	00-40-5F-8A-76-1E	00-40-5F-8A-76-1E	1E-2A-11-A0-43-A1