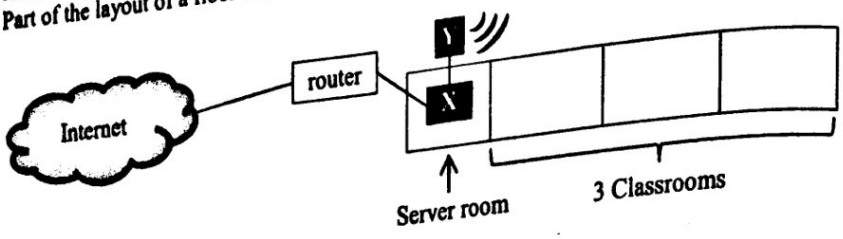
Answer all questions.

1. A school plans to build a computer network so that students can access learning materials on the campus. Part of the layout of a floor is shown below. X and Y are a switch and an access point (AP) respectively.



(a) (i) Briefly explain why X should be a switch instead of a hub.

(1 mark)

(ii) Y is used to connect the devices in classrooms to the network. Give **two** technical reasons why Y should be an AP instead of a switch.

(2 marks)

(b) The network bandwidth is 10 Gbps and the specifications of the AP are

Frequency:	2.4 GHz / 5 GHz
Number of connections:	100
Throughput:	1.2 Gbps

(i) Give one advantage of using each frequency.

2.4 GHz: _____

5 GHz: _____

(2 marks)

(ii) There are 32 mobile devices in each classroom and all mobile devices are connected to the AP. Estimate the average bandwidth of each connection. Show your calculation.

(2 marks)

(iii) Give **two** reasons why the school should install more APs on this floor to maintain the WiFi provision in (b)(ii).

(2 marks)

(c) The school plans to install the following devices. Give **two** services provided by each device.

(i) Domain controller

(2 marks)

(ii) DHCP server

(2 marks)

(d) Give an example to illustrate the process of data encapsulation across layers in a TCP/IP reference model.

(3 marks)

Answers written in the margins will not be marked.

2. Peter organises an e-sports competition on a school campus and each participant needs a computer during the competition. He plans to set up a single Class C network.

Suppose that the IP address of a computer in the network is 192.168.0.5 .

(a) (i) What is the default subnet mask? _____

(1 mark)

(ii) How many computers can the network support, under normal circumstances? _____

(1 mark)

Peter plans to set up two subnets using 255.255.255.192 as the subnet mask.

(b) (i) Other than network security, give a reason to support the use of subnets. Use an example to illustrate your answer.

_____

_____

_____

_____

(2 marks)

(ii) Write down the range of IP addresses for the computers in the first subnet.

192.168.0._____ ~ 192.168.0._____

(2 marks)

The e-sports competition is very popular and Peter needs to increase the number of computers to 500.

(c) Peter considers using some routers and 48-port switches to set up a network with four subnets. Each subnet has 125 computers.

(i) Each Class C network is divided into two subnets. How many Class C networks are required?

_____

(1 mark)

(ii) What is the minimum number of switches needed?

_____

(1 mark)

Answers written in the margins will not be marked.

(iii) Draft the network diagram of **one** of the subnets below. Indicate the numbers of computers and the names of network connecting devices to be connected in the diagram.

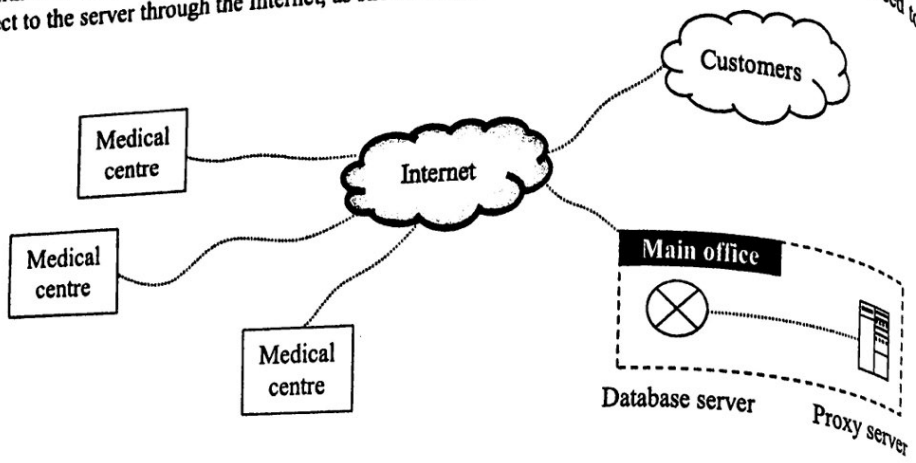
(4 marks)

(iv) Someone suggests Peter to increase the number of subnets to 8 but Peter disagrees with this suggestion. Give **two** reasons to support Peter.

(2 marks)

ers written in the margins will not be marked.

3. A health care company has a database server in its main office and staff in other medical centres need to connect to the server through the Internet, as shown below:



(a) On the network, a Virtual Private Network (VPN) is set up.

(i) State **two** features of a VPN that are related to information security.

(2 marks)

(ii) State a security measure or protocol used by a VPN.

(1 mark)

Originally customers accessed the company's web site through 'https://103.6.136.236'. Later on, the company changed a server setting and customers needed to enter 'https://103.6.136.236:9090' to access the web site.

(b) (i) What does the number '9090' represent?

(1 mark)

(ii) Why did the company change the URL?

(1 mark)

(c) The company does not provide a VPN for customers to connect to the server. Give **two** reasons for not providing this service.

(2 marks)

(d) A firewall is installed to enhance the network security in the main office. Give **two** ways in which a firewall can protect the network from hacking.

(2 marks)

(e) (i) Suggest and describe an appropriate hardware solution to prevent data loss from hard disk failure in the database server.

(2 marks)

(ii) The company decides to install an UPS to support the servers. Give **two** reasons to support the decision.

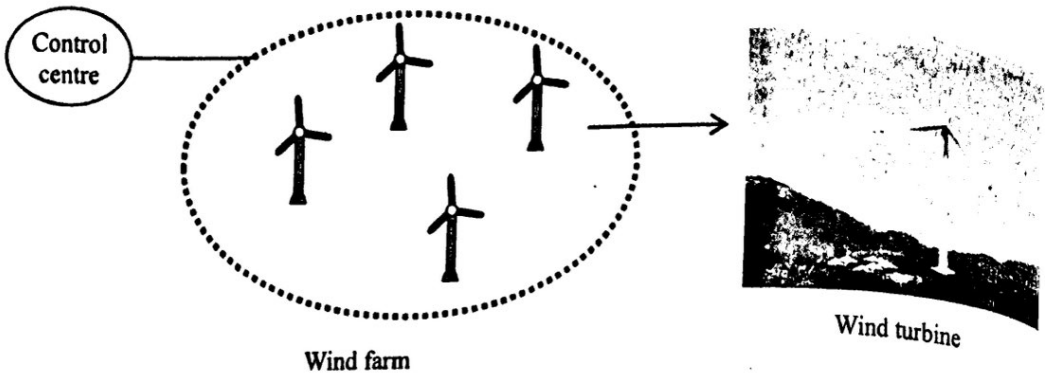
(2 marks)

(iii) If the company can only install the UPS on either the database server or the proxy server, which one should be chosen? Explain your choice briefly.

(2 marks)

Answers written in the margins will not be marked.

4. Mary works in a wind farm for generating electricity which has one hundred wind turbines. On average the distance between wind turbines is around 80 m. She needs to set up a network so that data (such as wind speed and temperature) can be transferred from each wind turbine to the control centre, as shown below:



Wind farm

Wind turbine

(a) (i) Mary can use copper wires or fibre optics to build the network. Give one advantage of each type of transmission medium.

Copper wires: _____

Fibre optics: _____

(2 marks)

(ii) Should Mary choose Bluetooth as the transmission medium? Explain your answer briefly.

_____

_____

(1 mark)

(b) In the network, what communication mode should Mary use for data transmission? Give an example to illustrate your answer.

_____

_____

_____

_____

(2 marks)

(c) The wind farm periodically collects data from each wind turbine to calculate the amount of electricity generated. Give one advantage and one disadvantage of using asynchronous transmission over synchronous transmission for receiving the data.

_____

_____

_____

_____

(2 marks)

Answers written in the margins will not be marked.

(d) In the wind farm, TCP/IP is used during data transmission in the network.

(i) State a function of TCP.

(1 mark)

(ii) State a function of IP.

(1 mark)

(iii) Someone suggests that User Datagram Protocol (UDP) should be used instead of TCP. Do you agree? Justify your opinion.

(2 marks)

Answers written in the margins will not be marked

(e) During the data transmission, each data packet consists of four 4-bit data (D_1, D_2, D_3, D_4) and a 4-bit checksum (D_5), as shown in the following example:

D_1	D_2	D_3	D_4	D_5
1111	0000	1111	0000	1110
Data				Checksum

The checksum is the 4 rightmost bits of the sum of the data. That is,

D_5 = the 4 rightmost bits of $(D_1 + D_2 + D_3 + D_4)$

(i) What is the checksum of the data 1110 0000 1110 0000 ? Show your calculation.

(2 marks)

(ii) Mary prefers using checksum to parity check. Why?

(2 marks)

END OF PAPER

Sources of materials used in this paper will be acknowledged in the *HKDSE Question Papers* booklet published by the Hong Kong Examinations and Assessment Authority at a later stage.

Answers written in the margins will not be marked.