1.3 Exchanging Data: Databases, Networks and Web Technologies: Test Pack

Total Marks

OCR H446 · Calculators not allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A digitised photograph and a scanned black-and-white text document both need to be compressed for storage on a school's shared drive.

(a) Define lossy compression and lossless compression. **(2)**

(b) A single row of pixels from a bitmap image has the following greyscale values, read left to right: **(3)**

3, 3, 3, 3, 3, 7, 7, 2, 2, 2, 2, 2, 2, 9

Apply run-length encoding (RLE) to this row of data. Give your answer as a list of (count, value) pairs.

(c) State one type of file for which lossy compression would be a suitable choice and justify your answer. **(2)**

(Total for Question 1 is 7 marks)

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2 A school in Bristol is extending its network to a new sports hall approximately 200 metres from the main building.

(a) Compare a star topology with a mesh topology, giving one advantage and one disadvantage of each. **(4)**

(b) State one factor, other than cost, that the school should consider when choosing a transmission medium for the 200 metre link to the sports hall, and justify why it is relevant in this scenario. **(2)**

(c) Explain one advantage of using fibre optic cable, rather than copper cable, for this 200 metre link. **(2)**

(Total for Question 2 is 8 marks)

3 A student's laptop uses the TCP/IP protocol stack to request a web page from a server.

(a) Name the four layers of the TCP/IP model, in order from the layer closest to the application to the layer closest to the physical transmission medium. **(4)**

(b) Explain the role of the Transport layer when the laptop requests the web page. **(3)**

(c) Explain what happens if one segment of the web page data is lost in transit, with reference to TCP. **(3)**

(Total for Question 3 is 10 marks)

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Mark scheme · 1.3 Exchanging Data: Databases, Networks and Web Technologies: Test Pack

Question 1

(a) Lossy compression permanently removes some data/detail from the original file so it cannot be fully restored (oe) **B1**

(a) Lossless compression reduces file size so that the original file can be reconstructed exactly/with no loss of data (oe) **B1**

(a) Answer: Lossy: removes data permanently, original cannot be recreated exactly. Lossless: file size reduced but the original can be reconstructed exactly.

(b) Correctly identifies the four runs of repeated values in order (5x3, 2x7, 6x2, 1x9) **M1**

(b) Correct count recorded for at least three of the four runs **A1**

(b) Fully correct encoded output cao: (5,3),(2,7),(6,2),(1,9), oe equivalent notation such as 5,3,2,7,6,2,1,9 **A1**

(b) Answer: (5,3),(2,7),(6,2),(1,9)

(c) Suitable file type identified, e.g. a photograph (JPEG) or a music/audio file (MP3) **B1**

(c) Valid justification, e.g. the human eye/ear cannot perceive the fine detail that is removed, so the large reduction in file size is worth the small, unnoticeable loss in quality (oe) **B1**

(c) Answer: A photograph (JPEG) is suitable because the human eye cannot detect the fine colour/detail removed, so file size can be reduced greatly with negligible perceived quality loss.

Question 2

(a) Star advantage, e.g. if one cable/device fails, only that device is affected and the rest of the network keeps working (oe) **B1**

(a) Star disadvantage, e.g. if the central switch/hub fails, the whole network goes down (oe) **B1**

(a) Mesh advantage, e.g. highly resilient, as multiple redundant paths exist between devices, so failure of one link does not isolate a device (oe) **B1**

(a) Mesh disadvantage, e.g. requires far more cabling/connections and is expensive and complex to install as the number of devices grows (oe) **B1**

(a) Answer: Star: single cable failure only affects one device (advantage) but central device failure brings down the whole network (disadvantage). Mesh: highly resilient with redundant paths (advantage) but needs much more cabling and is costly to install (disadvantage).

(b) Valid factor identified, e.g. distance/signal attenuation, bandwidth needed, or susceptibility to electromagnetic interference **B1**

(b) Justification applied to the 200 metre scenario, e.g. copper cable suffers significant signal attenuation over such a distance and may need repeaters/may not maintain a reliable signal (oe) **B1**

(b) Answer: Distance/attenuation: over 200 metres, a copper cable's signal weakens significantly, which could require repeaters or cause an unreliable connection.

(c) Correct advantage identified, e.g. much lower signal attenuation, higher bandwidth, or immunity to electromagnetic interference **B1**

(c) Explained in the context of the scenario, e.g. the signal will travel the 200 metres with little loss, so no repeater is needed between the buildings (oe) **B1**

(c) Answer: Fibre optic suffers far less attenuation than copper, so the signal can travel the full 200 metres reliably without needing a repeater partway along the link.

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Question 3

(a) Application layer named first, cao **B1**

(a) Transport layer named second, cao **B1**

(a) Internet layer named third, cao **B1**

(a) Link/Network Access layer named fourth, cao **B1**

(a) Answer: Application, Transport, Internet, Link (Network Access)

(b) States that TCP (at this layer) breaks the data into segments for transmission (oe) **M1**

(b) States that port numbers are added to identify the correct application/process on the source and destination devices (oe) **A1**

(b) Explains that the layer provides reliable delivery, using acknowledgements to confirm receipt and control the flow of data (oe) **A1**

(b) Answer: The Transport layer (using TCP) splits data into segments, adds port numbers to identify the correct application, and manages reliable delivery through acknowledgements and flow control.

(c) States that TCP numbers each segment (sequence numbers) so missing segments can be detected (oe) **M1**

(c) States that the receiver does not send an acknowledgement (ACK) for the missing segment **A1**

(c) Explains that after a timeout with no ACK received, the sender retransmits the lost segment, ensuring reliable delivery (oe) **A1**

(c) Answer: Each segment has a sequence number; the receiver does not acknowledge the missing one, so after a timeout the sender retransmits it, ensuring all data eventually arrives correctly.

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