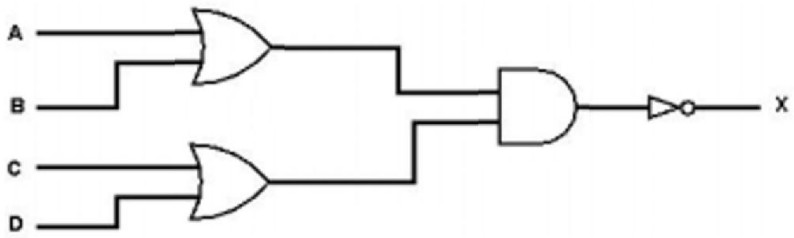
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1</td><td>1 mark for characteristic
1 mark for description of application to e-commerce company software

<table>
<tr><th>Thin-Client Characteristic</th><th>Description of use in this situation</th></tr>
<tr><td>Data is not stored on the client computer</td><td>Customer data / order information is stored on the server and not on the employees' computers // Customer data / order information are not permanently stored on the employees' computers</td></tr>
<tr><td>Client computer is reliant on access to server</td><td>Employees cannot process orders or service customers if their device cannot access the server / the server 'goes down'</td></tr>
<tr><td>Client computer heavily reliant on network/internet connection</td><td>Employees cannot access the order management software without network/internet access</td></tr>
<tr><td>Client computer requires few local resources/memory</td><td>Employees can use devices with low resources and the order management software will still function</td></tr>
<tr><td>Client computer performs minimal functions/processes</td><td>The order management software transmits requests, the server responds and sends the response to the user</td></tr>
</table></td><td>4</td></tr>
<tr><td>2(a)</td><td>1 mark each to max 3:
• Receives packets from internet
• Analyses the destination IP address of each packet
• Forwards the packet towards its destination
• … using the routing table
• Maintains/updates the routing table
• Finds the most efficient route to the destination</td><td>3</td></tr>
</table>

2(b)	**1 mark** each to **max 2:** • The PSTN consists of many different types of communication lines • … therefore the digital data may need to be converted into a different form/analogue signal • Data is transmitted in both directions at the same time // duplex data transmission • Using a PSTN the communication passes through different switching centres/ISPs	**2**
3(a)	**1 mark** for: 1.5 mebibytes	**1**
3(b)	**1 mark** each: • Converting 50 to binary 0011 0010 and 100 to binary 0110 0100 • Subtraction method – converting 50 to -50 and adding // direct subtraction … • … correct answer ** NOTE the ellipses…candidate cannot receive marks for answer without appropriate working Method 1: Coverting to -50 and adding: Binary for +50 is 0011 0010 Binary for -50 is 1100 1110 Binary for 100 is 0110 0100 100 + (-50): 0110 0100 +1100 1110 (1)0011 0010 Carries: 1 1 0 0 1 1 0 0 Method 2: Direct Subtraction Borrows: 0011 0010 0110 0100 -0011 0010 0011 0010	**3**

3(c)	**1 mark** for working: 0010 1010 0011 // 512 + 128 + 32 + 2 + 1 // (2 * 16^2)+ (10 * 16) + 3 // (2 * 16 * 16) + (10 * 16) + 3 // 512 + 160 + 3 **1 mark** for correct answer: 675	**2**
3(d)	1000 0101 1001 **1 mark** for working: 1000 0101 1001 8 5 9 **1 mark** for correct answer: 859	**2**
4(a)	**1 mark** for working: • (1200 * 400 * 4) / (1000 * 1000) = 1.92MB **1 mark** for correct answer: 1.92 MB	**2**
4(b)	**1 mark** each to **max 3:** • The file takes less storage space on the chat server than if lossless compression was used • The file is faster to upload/download to/from the server than if lossless compression was used • The file uses less bandwidth to transmit than if lossless compression was used • The file consumes less data allowance than if lossless compression was used	**3**
5(a)	**1 mark** for each correct answer: *AND* • The output is 1 when both inputs are 1, otherwise the output is 0 *OR* • The output is 0 when both inputs are 0, otherwise the output is 1 *NAND* • The output is 0 when both inputs are 1, otherwise the output is 1 *NOR* • The output is 1 when both inputs are 0, otherwise the output is 0	**4**

5(b)	**1 mark** for both OR gates with correct inputs **1 mark** for correct AND and NOT gates with correct inputs and no superfluous gates:  	**2**
6	**1 mark** for each bullet point (**max 4**) • Identify **and** explain how to deal with **repeating** groups of attributes • … Projects **and** ProjectCodes • Ensure all fields are atomic • … EmployeeName should be split, e.g. FirstName and LastName • Identify EmployeeID as the primary key for the table **and** if new tables are created a suitable primary key must be identified for each new table	**4**

7(a)	**1 mark** for:
	• Creating table ORDER_ITEM with opening and closing brackets
	• Setting all five attributes with appropriate data types using correct syntax and commas at the end of lines
	• Setting OrderItemID as Primary Key and ProductID as Foreign Key referencing PRODUCT table using correct syntax
	
	Example:
	`CREATE TABLE ORDER_ITEM(`
	`OrderItemID CHARACTER NOT NULL,`
	`OrderID CHARACTER,`
	`ProductID CHARACTER,`
	`Quantity INTEGER,`
	`TotalPrice REAL,`
	`PRIMARY KEY(OrderItemID),`
	`FOREIGN KEY(ProductID) REFERENCES PRODUCT(ProductID)`
	`);`
	
	NOTES:
	VARCHAR may be used in place of CHARACTER
	Addition of Primary and Foreign Key can be done in separate commands using ALTER TABLE but must come after the semi-colon (;) at the end of the CREATE TABLE command
		3

7(b)	**1 mark** for:
	
	• Selecting SUM of Quantity from ORDER_ITEM
	• WHERE with appropriate condition
	
	Example:
	`SELECT SUM(Quantity)`
	`FROM ORDER_ITEM`
	`WHERE ProductID = "P001"`
	
	NOTE:
	Given that only one table is accessed, using Table.Attribute is optional though not incorrect, e.g. SELECT SUM(ORDER_ITEM.Quantity)
		2

7(c)	**1 mark** each for **max 5:** e.g. • Suitable primary key identified for CUSTOMER table • … and other suitable fields, e.g. CustomerID, name, email, etc • Suitable primary key identified for ORDER table • … and other suitable fields, e.g. OrderID, CustomerID InvoiceAmount, etc • … that stores the primary key of the CUSTOMER table as a foreign key to join to the CUSTOMER table • The ORDER_ITEM table stores the primary key of ORDER table as a foreign key to join the ORDER table	**5**
7(d)	**1 mark** for: • One-to-Many PRODUCT to ORDER_ITEM • One-to-Many CUSTOMER to ORDER • One-to-Many ORDER to ORDER_ITEM NOTE: Marks removed for additional labels/symbols above the number required here.	**3**

8(a)	**1 mark** for each correctly completed statement: • accelerometer • microprocessor • acoustic/sound • monitoring The **accelerometer** is a sensor inside the device used to detect motion to track step count. All versions of the device will also contain sensors to measure heart rate, blood-oxygen, and location. Data is sent to a **microprocessor** for analysis. Some upgraded versions of the device also include **acoustic** sensors which allows the user to give voice commands to the device. This device uses sensors to read real-time data and uses that data to vibrate, send audio alerts and text notifications to the user and other third-party systems. This is an example of a **monitoring** system.	**4**
8(b)	**1 mark** each to **max 3:** • The buffer is used as a **temporary** store for data going to the smartphone • Data is **transferred** into the buffer by the fitness tracker • Data is **retrieved** from the buffer by the smartphone • When the buffer is empty/full an interrupt is sent to the fitness tracker requesting more data/stopping further data being sent • When the smartphone has enough data/needs more data, an interrupt is sent by the smartphone to the fitness tracker to stop sending data from the buffer	**3**
8(c)	**1 mark** each to **max 2:** • More reliable (no moving parts to go wrong) • Considerably lighter than other storage technologies (which makes it suitable for wearable technologies • does not have to ‘spin up’ or ‘get up to speed’ before working properly • much lower power consumption • operates much cooler (lower temperatures) • much smaller • much faster read/write speeds	**2**
8(d)	**1 mark** for correct answer: EEPROM/Electronic Erasable Programmable Read-Only Memory	**1**

8(e)	**1 mark** each for **advantages:** • SRAM is much faster than DRAM for reading/writing data from the sensors • During times when sensors are idle, SRAM will use less power because it does not need to constantly be refreshed **1 mark** each for disadvantages: • SRAM is more expensive than DRAM • During times when sensors are in frequent use, SRAM will use more power because it needs to power more components per bit of data • SRAM has a lower memory density so the fitness tracker will have less memory for a given area	**3**
8(f)(i)	**1 mark** for correct answer: Capacitive	**1**
8(f)(ii)	**1 mark** each to **max 2:** • The digital data is first passed through a digital to analogue converter/DAC where it is converted to an electric current • This current is then passed through an amplifier to create a current large enough to drive a speaker • This (larger) current is then passed to the speaker where it is converted into sound	**2**
8(f)(iii)	**1 mark** each to **max 2:** • Sound files used should be relatively small • … so they need no further reduction • … because they will be relatively low quality for alerts and chimes • Sound files are only used locally • … device uses high-speed memory/SRAM and Flash storage • … so no transmission speed considerations are required	**2**

9 — **4**

1 mark each to **max 4:**

- The robot uses the camera to visually detect obstacles
- The robot uses the distance sensors to calculate the distance to nearby objects
- The microprocessor reads data from these sensors and compares the data with programmed thresholds
- If thresholds are exceeded, the microprocessor reads data from the accelerometer to help calculate if a collision is imminent
- If the system determines there will be a collision, the microprocessor will send control signals to the motors to stop/change direction to avoid the collision

10(a) — **4**

1 mark for each correct answer:

Program number	Code	ACC Content
1	LDD 21 ADD #4	**14**
2	LDI 22 SUB 23	**2**
3	LDR #2 LDX 22 SUB &22	**6**
4	LDR #4 LDX 20 ADD B10010110	**190**

10(b) — **4**

1 mark for each correct answer:

Program number	Code	ACC Content
1	AND 25	**1000 0000**
2	OR 26	**1101 1111**
3	XOR 27	**0001 1000**
4	LSR #3	**0001 1010**