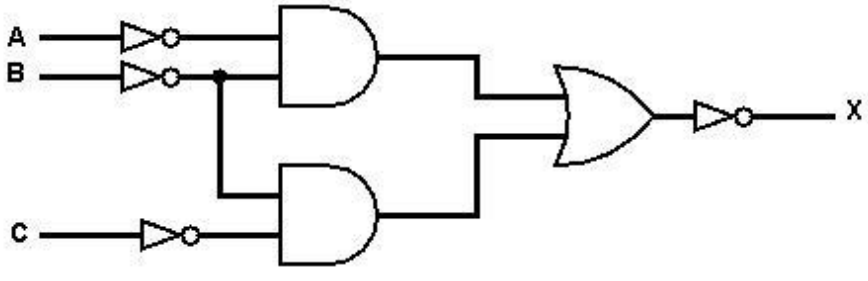
Question	Answer	Marks
1(a)(i)	39	**1**
1(a)(ii)	27	**1**
1(a)(iii)	−25	**1**

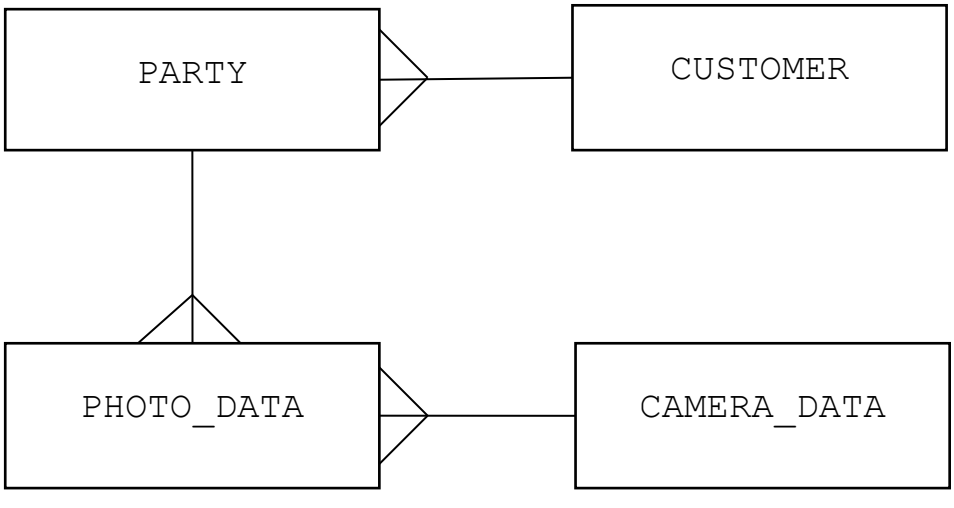
1(b)	**1 mark** for working, **1 mark** for answer (0011 1110)
	
	Working using borrowing:
	`  1  10  10  1`
	`0 ~~10~~ 0 0 ~~10~~ 10`
	`~~1~~ 0 ~~1~~ ~~1~~ 0 0 1 1`
	`0 1 1 1 0 1 0 1 −`
	`0 0 1 1 1 1 1 0`
	
	Working using two's complement:
	`1 0 1 1 0 0 1 1`
	Two's complement `1 0 0 0 1 0 1 1 +`
	`(1) 0 0 1 1 1 1 1 0`
	`1 1`
		2

1(c)	**1 mark** for similarity, **2 marks** for differences Similarity (**max 1**): • both **can** use 8 bits • both represent each character using a **unique** code • Unicode will contain all the characters that ASCII contains // ASCII is a subset of Unicode Differences (**max 2**): • Unicode can go up to 32 bits per character whereas ASCII is 7 or 8 bits Unicode can represent a wider range of **characters** than ASCII • different **languages** are represented using Unicode, ASCII is only for one language	**3**
1(d)(i)	the number of samples taken **per unit time** / per second	**1**
1(d)(ii)	**1 mark** for each bullet point (**max 2**): • increases the number of bits per sample // larger range of values • which means that the file size increases • makes the sound file more accurate //digital waveform closer to original (analogue) waveform • smaller quantisation errors	**2**

Question	Answer	Marks
2	**1 mark** for each correct line. **Security feature** / **Description** firewall → accepts or rejects incoming and outgoing packets based on criteria pharming → redirects a user to a false website anti-virus software → scans files on the hard drive for malicious software encryption → converts data to an alternative form verifies the authenticity of data	**4**

Question	Answer	Marks
3(a)	**1 mark** for each bullet point: • NOT A AND NOT B **and** NOT B AND NOT C // A NOR B **and** B NOR C • final OR and NOT gates (with correct inputs) // NOR gate (with correct inputs)  	**2**

Question	Answer	Marks
3(b)	**1 mark** for each set of rows as highlighted: **A** | **B** | **C** | **X** 0 | 0 | 0 | 0 0 | 0 | 1 | 0 0 | 1 | 0 | 1 0 | 1 | 1 | 1 1 | 0 | 0 | 0 1 | 0 | 1 | 1 1 | 1 | 0 | 1 1 | 1 | 1 | 1	**2**

Question	Answer	Marks
4(a)	**1 mark** for each correct relationship: • 1:M between CUSTOMER and PARTY • 1:M between PARTY and PHOTO_DATA • 1:M between CAMERA_DATA and PHOTO_DATA  	**3**
4(b)	**1 mark** for each bullet point (**max 3**): • no repeating groups of attributes // data is atomic • no partial key dependencies • no non-key dependencies // no transitive dependencies	**3**

Question	Answer	Marks
4(c)(i)	**1 mark** for the definition, **1 mark** for the example: • definition: a single row in a table • example: from the `PHOTO_DATA` table	**2**

4(c)(ii)	**1 mark** for each correctly completed empty space:
	
	• COUNT
	• PhotoID
	• PHOTO_DATA
	• 'CAN*' // 'CAN%'
	
	`SELECT COUNT(PhotoID)`
	`FROM PHOTO_DATA`
	`WHERE CameraID LIKE 'CAN*'; // WHERE CameraID LIKE 'CAN%';`
		4

4(d)	**1 mark** for each bullet point:
	
	• ALTER TABLE CAMERA_DATA
	• ADD NumberStored INTEGER
	• , LastUsed DATE;
	
	`ALTER TABLE CAMERA_DATA`
	`ADD NumberStored INTEGER, LastUsed DATE;`
		3

Question	Answer	Marks
5(a)	Instructions and data are stored in **the same** memory space / in main memory.	**1**
5(b)(i)	**1 mark** for each special purpose register: Program Counter (PC): • to **store** the address / location / memory location of the next instruction to be fetched Index Register (IX): • to **store** a value that is added to an address to give another address Status Register (SR): • to **store flags** which are set by events // from the results of arithmetic and logic operations and interrupt flags	**3**
5(b)(ii)	**1 mark** for both rows: **CPU component** / **Data bus** / **Address bus** / **Control bus** System clock / / / ✓ Memory Address Register (MAR) / / ✓ /	**1**

Question	Answer	Marks
5(b)(iii)	**1 mark** for each bullet point (**max 2**): • to coordinate / synchronise the actions of other components in the CPU • to send / receive control signals along the control bus • to manage the execution of instructions (in sequence) • to control the communication between the components of the CPU	**2**
5(c)	**1 mark** for each bullet point: • to **send a signal** from a device or process • ... seeking the attention of the processor	**2**
5(d)	**1 mark** for each bullet point (**max 2**). For example: • division by zero // runtime error in a program • attempt to access an invalid memory location • array index out of bounds • stack overflow	**2**

Question	Answer	Marks
6(a)(i)	**1 mark** for each set of highlighted rows.	**4**

Instruction address	ACC	IX	Memory address					Output
			100	101	110	111	112	
			0	0	66	65	35	
77		0						
78	66							
79								
80								
81								
82				66				
83	1							
84								
85			1					
86		1						
87	65							
88								
89								
81	66							
82								
83	1							
84	2							
85			2					
86		2						
87	35							
88								
89								
90	2							
91	50							
92								2
93								

6(a)(ii)	swaps the contents of memory address <u>100</u> and <u>101</u>	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(b)(i)</td><td><code>1000 1100</code></td><td>1</td></tr>
<tr><td>6(b)(ii)</td><td><code>1001 0000</code></td><td>1</td></tr>
<tr><td>6(b)(iii)</td><td><code>1101 1111</code></td><td>1</td></tr>
<tr><td>6(b)(iv)</td><td><code>0010 0100</code></td><td>1</td></tr>
<tr><td>6(c)</td><td>1 mark for each pair of highlighted rows

<table>
<tr><th>Task</th><th>First pass</th><th>Second pass</th></tr>
<tr><td>Remove comments.</td><td>✓</td><td></td></tr>
<tr><td>Read the assembly language program one line at a time.</td><td>✓</td><td>✓</td></tr>
<tr><td>Generate the object code.</td><td></td><td>✓</td></tr>
<tr><td>Check the opcode is in the instruction set.</td><td>✓</td><td></td></tr>
</table>
</td><td>2</td></tr>
</table>

Question	Answer	Marks
7(a)	**1 mark** for each benefit (**max 2**): • (main) memory requirements for program are reduced as dynamic link library is loaded only once / when required • the executable file size is smaller because the executable does not contain all the library routines • maintenance not needed to be done by the programmer because the DLL is separate from program • no need to recompile the main program when changes are made to DLL because changes / improvements/ error correction to the DLL file code are done independently of the main program	**2**
7(b)	**1 mark** for each bullet point (**max 2**): • RAM is assigned into blocks • dynamic allocation of RAM to programs / processes • reclaims unused blocks of RAM • prevents two programs / processes occupying the same area of RAM at the same time • moves data from secondary storage when needed // manages paging, segmentation and virtual memory	**2**

Question	Answer	Marks
7(c)	**1 mark** for each bullet point (**max 3**): • lossless compression • Run Length Encoding • repeated **sequences** of characters are replaced by • ... a single copy of the character • ... and a counter of the number of characters	**3**
7(d)	**1 mark** for each bullet point (**max 2**): • cache is fast access memory (close to the CPU) • cache stores frequently used instructions / data • ... more cache means more instructions / data can be transferred faster • ... less swapping between RAM and cache • prevents the CPU idling while waiting for data	**2**
7(e)	**1 mark** for each device. • **3D printer**: USB port / COM port • **Monitor**: HDMI / VGA / USB / DisplayPort	**2**

Question	Answer	Marks
8	**1 mark** for bullet point (**max 4**): • CSMA/CD is a protocol used to detect and prevent collisions in a bus topology • before transmitting, a **device** checks if the channel is busy • If the channel is busy the device waits // if the channel is free the data is sent • because there is more than one computer connected to the same transmission medium • ... two workstations can start to transmit at the same time, causing a collision • If a collision is detected by the device, transmission is aborted / a jamming signal is transmitted • both devices wait a (different) **random** time and then try again	**4**

Question	Answer	Marks
9(a)	**1 mark** for each bullet point (**max 2**): • the embedded system is **built into** / integrated into the TV • combination of hardware and software designed for a **specific function** • The system is **not easily changed**/updated by the TV owner	**2**

Question	Answer	Marks
9(b)	**1 mark** for each benefit and **1 mark** for corresponding expansion (**max 2**). For example: • no additional equipment is needed to change • ... enables firmware updates by non-technical users • can be erased and reprogrammed several times • ... so firmware can be updated • ... can erase a particular byte or the whole EEPROM • possible to reprogram / update • ... without removing it from the device	**2**