[redacted]

Question **1**

Correct

Mark 13.00 out of 13.00

Match the term with the best description.

Huffman codes	Variable-length prefix coding used in data compression ✔
MP3	Audio file format that employs lossy compression to reduce the file size ✔
Vector graphics	Computer graphics that are defined using mathematical equations rather than individual pixels ✔
Spatial compression	Data compression technique that aims to reduce redundancy within a single frame or image ✔
Temporal compression	Data compression technique used to reduce redundancy in video sequences ✔
Sequential circuit	Type of digital circuit that has memory elements ✔
Control unit	Responsible for coordinating and controlling the various operations performed by the CPU ✔
Program counter	Register in a computer processor that holds the memory address of the next instruction to be fetched and executed ✔
Fetch-execute cycle	Basic operational cycle of a computer processor ✔
Magnetic disks	Type of data storage device that use magnetic storage to store and retrieve digital data ✔

Your answer is correct.

The correct answer is: Huffman codes → Variable-length prefix coding used in data compression,
MP3 → Audio file format that employs lossy compression to reduce the file size,

Vector graphics → Computer graphics that are defined using mathematical equations rather than individual pixels,

Spatial compression → Data compression technique that aims to reduce redundancy within a single frame or image,

Temporal compression → Data compression technique used to reduce redundancy in video sequences,

Sequential circuit → Type of digital circuit that has memory elements,

Control unit → Responsible for coordinating and controlling the various operations performed by the CPU,

Program counter → Register in a computer processor that holds the memory address of the next instruction to be fetched and executed,

Fetch-execute cycle → Basic operational cycle of a computer processor,

Magnetic disks → Type of data storage device that use magnetic storage to store and retrieve digital data

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:18	Saved: Huffman codes -> Variable-length prefix coding used in data compression; MP3 -> Audio file format that employs lossy compression to reduce the file size; Vector graphics -> Computer graphics that are defined using mathematical equations rather than individual pixels; Spatial compression -> Data compression technique used to reduce redundancy in video sequences; Temporal compression -> Data compression technique that aims to reduce redundancy within a single frame or image; Sequential circuit -> Type of digital circuit that has memory elements; Control unit -> Responsible for coordinating and controlling the various operations performed by the CPU; Program counter -> Register in a computer processor that holds the memory address of the next instruction to be fetched and executed; Fetch-execute cycle -> Basic operational cycle of a computer processor; Magnetic disks -> Type of data storage device that use magnetic storage to store and retrieve digital data	Answer saved	

Step	Time	Action	State	Marks
3	1/06/23, 15:39	Saved: Huffman codes -> Variable-length prefix coding used in data compression; MP3 -> Audio file format that employs lossy compression to reduce the file size; Vector graphics -> Computer graphics that are defined using mathematical equations rather than individual pixels; Spatial compression -> Data compression technique that aims to reduce redundancy within a single frame or image; Temporal compression -> Data compression technique used to reduce redundancy in video sequences; Sequential circuit -> Type of digital circuit that has memory elements; Control unit -> Responsible for coordinating and controlling the various operations performed by the CPU; Program counter -> Register in a computer processor that holds the memory address of the next instruction to be fetched and executed; Fetch-execute cycle -> Basic operational cycle of a computer processor; Magnetic disks -> Type of data storage device that use magnetic storage to store and retrieve digital data	Answer saved	
4	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**13.00**

Question **2**

Correct

Mark 2.00 out of 2.00

In the context of computer architecture, what does bit-level parallel processing refer to?

- A technique used to manipulate bigger words in each process ✔
- A method to perform arithmetic operations on individual bits
- A way to encode binary data using parallel lines
- A type of error detection used in computer networks

Your answer is correct.

The correct answer is:
A technique used to manipulate bigger words in each process

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:18	Saved: A technique used to manipulate bigger words in each process	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **3**

Correct

Mark 2.00 out of 2.00

In the HSI color model, which component represents the dominant color?

- Hue ✔
- Saturation
- Intensity
- RGB

Your answer is correct.

The correct answer is:
Hue

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:33	Saved: Hue	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **4**

Correct

Mark 2.00 out of 2.00

What would be the resulting color from the following RGB color code?

(255,0,255)

Select one:

- a. Black
- b. White
- c. Blue
- d. Green
- e. Red
- f. Yellow
- g. Cyan
- h. Magenta ✔
- i. Grey

The correct answer is: Magenta

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:19	Saved: Magenta	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **5**

Correct

Mark 2.00 out of 2.00

What would be the resulting color from the following RGB color code?

(127,127,127)

Select one:

- a. Black
- b. White
- c. Blue
- d. Green
- e. Red
- f. Yellow
- g. Cyan
- h. Magenta
- i. Grey ✔

The correct answer is: Grey

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:19	Saved: Grey	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **6**

Correct

Mark 2.00 out of 2.00

Using the Huffman code table below, find the code for the word 'BEETHOVEN'.

Huffman Code	Character
00	E
01	O
100	T
110	B
111	H
1010	N
1011	V

Answer: 11000001001110110110010 10

The correct answer is: 11000001001110110110010 10

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:22	Saved: 11000001001110110110010 10	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **7**

Correct

Mark 2.00 out of 2.00

Consider the following Huffman table:

Huffman Code	Character
00	E
01	I
100	S
110	M
111	Y
1010	H
1011	W

Use the table above to decode the word 1011101001110100111

Answer: WHIMSY ✔

The correct answer is: WHIMSY

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:24	Saved: WHIMSY	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **8**

Correct

Mark 12.00 out of 12.00

Suppose that you are given the following corpus of text:

"Betty Botter bought butter butter bitter batter bitter batter butter batter batter Botter bitter butter Betty Botter bitter batter bitter batter"

Use the above corpus to answer the following questions.

(a) Ignoring spaces in the above corpus, what is the probability of each of the words used? Round off two decimal places.

Betty =

0.10

✔

Botter =

0.14

✔

bought =

0.05

✔

butter =

0.19

✔

bitter =

0.24

✔

batter =

0.29

✔

(b) Using the Huffman encoding technique we did in class, encode the above text corpus.

Betty =

11110

✔

Botter =

1110

✔

bought =

11111

✔

butter =

110

✔

bitter =

10

✔

batter =

0

✔

NB. Check that your code has the prefix property.

(c) Calculate the average number of bits required to encode all the characters in your Huffman coding system above. (Round off your final answer to two decimal places)

2.62 ✔

(d) Calculate the compression ratio for your coding system. (Round off your final answer to two decimal places)

0.86 ✔

(d) Is the compression ratio above or below the accepted theoretical limit of 1.21? Below theoretical limit ✔

(d) Is this the best binary variable-length compression that is achievable? Yes ✔

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:45	Saved: part 1: 0.10; part 2: 0.14; part 3: 0.05; part 4: 0.19; part 5: 0.24; part 6: 0.29; part 7: 11110; part 8: 1110; part 9: 11111; part 10: 110; part 11: 10; part 12: 0; part 13: 2.62; part 14: 0.86; part 15: Below theoretical limit; part 16: Yes	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**12.00**

Question **9**

Correct

Mark 3.00 out of 3.00

Complete the truth table below to prove the absorption property: A.B + A = A.

A	B	A.B	A.B + A
0	0	0 ✔	0 ✔
0	1	0 ✔	0 ✔
1	0	0 ✔	1 ✔
1	1	1 ✔	1 ✔

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:27	Saved: part 1: 0; part 2: 0; part 3: 0; part 4: 0; part 5: 0; part 6: 1; part 7: 1; part 8: 1	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**3.00**

Question **10**

Correct

Mark 6.00 out of 6.00

Use the rules of Boolean algebra to reduce the following expression to its simplest form.

(A.B.C.D)'.C'

- A.C + B'.C + C + D'.C
- A.C + B'.C
- C' ✔
- A.C
- B
- A
- A'
- B'
- A.B' +D
- B'.B
- A + C

Your answer is correct.

The correct answer is:
C'

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:47	Saved: C'	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**6.00**

Question **11**

Correct

Mark 6.00 out of 6.00

Use the rules of Boolean algebra to reduce the following expression to its simplest form.

(A + B) (A' + B') (A' + B')

- $A \oplus B$ ✔
- $A' \oplus B'$
- A'B + A'B'
- A
- B
- AA' + AC + B'
- A (A + B)

Your answer is correct.

The correct answer is:
$A \oplus B$

Response history

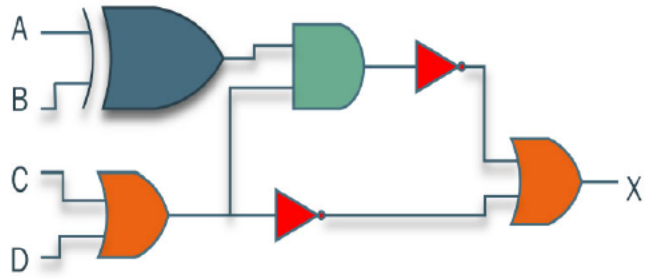
Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:51	Saved: [A \oplus B]	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**6.00**

Question **12**

Correct

Mark 4.00 out of 4.00

Which of the following is a Boolean expression for the output X of the circuit below?



- $((A \oplus B).(C + D))' + (C + D)'$ ✔
- $((A \oplus B).(C + D)) + (C + D)'$
- $((A \oplus B).(C + D)) + (C.D)'$
- $((A \oplus B).(C + D)) + (C' + D')$
- $((A \oplus B).(C.D)) + (C' + D')$

Your answer is correct.

The correct answer is:
$((A \oplus B).(C + D))' + (C + D)'$

Response history

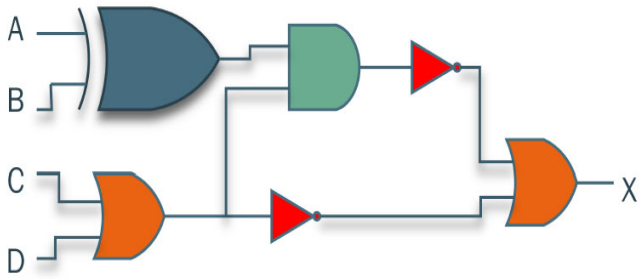
Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:53	Saved: [((A \oplus B).(C + D)) + (C + D)]	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**4.00**

Question **13**

Correct

Mark 2.00 out of 2.00

What would be the output, X, of the below circuit if we set A = 0, B = 1, C = 0 and D = 1?



Answer: 0

The correct answer is: 0

Response history

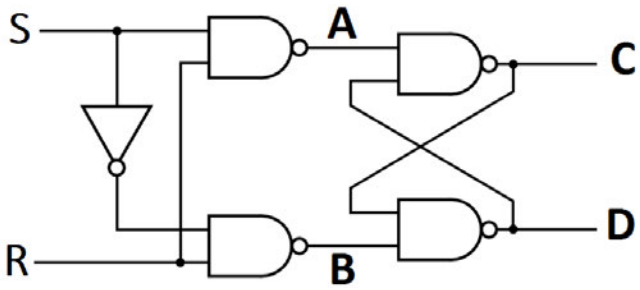
Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:54	Saved: 0	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**2.00**

Question **14**

Correct

Mark 6.00 out of 6.00

Consider the sequential circuit shown below and suppose that S= 0 and R = 1.



a) What will be the final values A, B, C, and D?

A= 1 ✔

B = 0 ✔

C = 0 ✔

D = 1 ✔

b) Following the state of the sequential circuit from (a) above, suppose we switched R to be 0. What will be the final values of A, B, C and D?

A= 1 ✔

B = 1 ✔

C = 0 ✔

D = 1 ✔

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 15:01	Saved: part 1: 1; part 2: 0; part 3: 0; part 4: 1; part 5: 1; part 6: 1; part 7: 0; part 8: 1	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**6.00**

Question **15**

Incorrect

Mark 0.00 out of 4.00

Suppose you are given a hard drive with four platters. Each platter has 2000 tracks, each track has 200 sectors, and each sector has 12KB of space per block to store data. What is the total capacity of this hard drive? Give your answer in Kilobytes (KB).

Answer: 19200000 ✖

Capacity = (Number of platters × 2) × Tracks per platter × Sectors per track × Block size x 2 (since you can print on either side)

= 4 x 2000 x 200 x 12kb x 2

= 38400000KB

The correct answer is: 38400000

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:30	Saved: 19200000	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Incorrect**	**0.00**

Question **16**

Correct

Mark 1.50 out of 1.50

In a computer system, what component is responsible for storing the instruction that is currently being executed?

a. Program counter
b. Instruction register ✔
c. Bus
d. Main memory

Your answer is correct.

The correct answer is:
Instruction register

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:31	Saved: Instruction register	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**1.50**

Question **17**

Incorrect

Mark 0.00 out of 4.00

An image is 1024 by 1024 pixels. How many bytes will we need to store a color image using RGB if we use 1 byte to store each color value associated with each pixel? (Give you answer in bytes)

Answer: 1048576 ✖

Number of pixels = 1024x1024 = 1048576

Number of bytes = 1048576 x 3 = 3145728 bytes

The correct answer is: 3145728

Response history

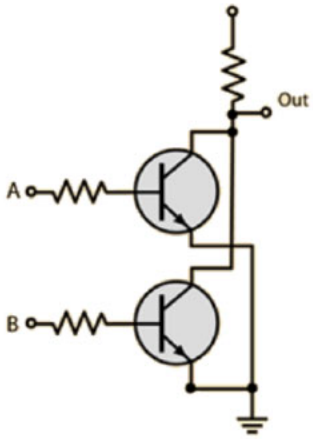
Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 14:32	Saved: 1048576	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Incorrect**	**0.00**

Question **18**

Incorrect

Mark 0.00 out of 2.00

Consider the given transistor diagram. Which of the following Boolean expressions does the transistor diagram correspond to?



- A + B
- A.B
- $A \oplus B$
- A'
- (A.B)' ✖

Your answer is incorrect.

Transistors are connected in parallel.

The correct answer is:
A + B

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 15:04	Saved: (A.B)'	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Incorrect**	**0.00**

Question **19**

Correct

Mark 4.00 out of 4.00

Suppose that the NOT gate can be implemented using one transistor; the NAND gate can be implemented using two transistors; and the NOR gate can be implemented using two transistors. All other gates must be derived from these architectural constraints.

How many transistors would be needed to implement the following Boolean expression exactly as it stands (without simplifying):

(A + D)' + (B' + C)'

Answer: 12 ✔

The correct answer is: 12

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 15:06	Saved: 12	Answer saved	
3	**1/06/23, 15:46**	**Attempt finished**	**Correct**	**4.00**

Question **20**

Partially correct

Mark 40.91 out of 45.00

Suppose that you have an A-register (accumulator) of 16 bits; an instruction register of 8 bits; an operand specifier of 16 bits; and a program counter of 16 bits. Assume that memory has been reset. Consider the set of machine language (Pep/8) instructions below, where zz ends the program.

49 00 20 31 00 30 31 00 25 C1 00 30 80 00 05 70 00 03 71 00 25 E1 00 30 51 00 20 39 00 30 zz

(a) Convert each instruction into 24-bit binary string. Do not include any spaces in your answers. Remember to use the correct number of bits in your answer, otherwise it will be marked as incorrect.

490020

010010010000000000100000

✔

310030

001100010000000000110000

✔

310025

001100010000000000100101

✔

C10030

110000010000000000110000

✔

800005

100000000000000000000101

✔

700003

011100000000000000000011

✔

710025

011100010000000000100101

✔

E10030

111000010000000000110000

✔

510020

010100010000000000100000

✔

390030

001110010000000000110000

✔

zz

(b) What type of addressing is used in each instruction?

490020 Direct-mode addressing ✔

310030 Direct-mode addressing ✔

310025 Direct-mode addressing ✔

C10030 Direct-mode addressing ✔

800005 Immediate-mode addressing ✔

700003 Immediate-mode addressing ✔

710025 Direct-mode addressing ✔

E10030 Direct-mode addressing ✔

510020 Direct-mode addressing ✔

390030 Direct-mode addressing ✔

Read in the following input:

R 9 5

Pretend to be a (Pep/8) compiler and run through the program. Include the program counter, instruction register, and other important components of the computer in your layout to help you answer the following questions. Please use the description of machine language instructions and ASCII table provided below.

(c) What is stored in Hex memory locations 30 and 31 at the end of the program? Give your answer in decimal.

12

✔ .

(d) What is stored in Hex memory locations 25 and 26 at the end of the program? Give your answer in decimal.

5

✔ .

(e) What is stored in the Instruction Register immediately after the third instruction has completed being executed? (Give your answer in binary with the correct bit count)

11000001

✔

(d) What is stored in the program counter while the fourth instruction is being executed? (Give your answer in hexadecimal with the correct bit count)

0080 Correct answer is = 0012

✖ .

(e) What is stored in the accumulator before the instruction "700003" is executed? (Give your answer in binary with the correct number of bits)

0000000000000100

✔ .

(f) What is stored in the Status bit N after the instruction "710025" is executed? 0 ✔

(g) What is stored in the Status bit Z before the instruction "E10030" is executed? 0 ✔

(h) What will be the output after the program has completed?

R12

✔

Instruction	Instruction definition
1100 0000	Load into accumulator (AC) from immediate
1100 0001	Load into AC from memory address
1110 0001	Store from AC into memory
0111 0000	Add AC + immediate (into AC)
0111 0001	Add AC + memory (into AC)
1000 0000	Subtract AC - immediate (into AC)
1000 0001	Subtract AC - memory (into AC)
0100 1001	Character input to memory
0101 0000	Character output from immediate
0101 0001	Character output from memory
0011 0001	Read a decimal number into memory.
0011 1000	Write a decimal number from immediate.
0011 1001	Write a decimal number from memory.

ASCII TABLE

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	0	[NULL]	32	20	[SPACE]	64	40	@	96	60	`
1	1	[START OF HEADING]	33	21	!	65	41	A	97	61	a
2	2	[START OF TEXT]	34	22	"	66	42	B	98	62	b
3	3	[END OF TEXT]	35	23	#	67	43	C	99	63	c
4	4	[END OF TRANSMISSION]	36	24	$	68	44	D	100	64	d
5	5	[ENQUIRY]	37	25	%	69	45	E	101	65	e
6	6	[ACKNOWLEDGE]	38	26	&	70	46	F	102	66	f
7	7	[BELL]	39	27	'	71	47	G	103	67	g
8	8	[BACKSPACE]	40	28	(	72	48	H	104	68	h
9	9	[HORIZONTAL TAB]	41	29	)	73	49	I	105	69	i
10	A	[LINE FEED]	42	2A	*	74	4A	J	106	6A	j
11	B	[VERTICAL TAB]	43	2B	+	75	4B	K	107	6B	k
12	C	[FORM FEED]	44	2C	,	76	4C	L	108	6C	l
13	D	[CARRIAGE RETURN]	45	2D	-	77	4D	M	109	6D	m
14	E	[SHIFT OUT]	46	2E	.	78	4E	N	110	6E	n
15	F	[SHIFT IN]	47	2F	/	79	4F	O	111	6F	o
16	10	[DATA LINK ESCAPE]	48	30	0	80	50	P	112	70	p
17	11	[DEVICE CONTROL 1]	49	31	1	81	51	Q	113	71	q
18	12	[DEVICE CONTROL 2]	50	32	2	82	52	R	114	72	r
19	13	[DEVICE CONTROL 3]	51	33	3	83	53	S	115	73	s
20	14	[DEVICE CONTROL 4]	52	34	4	84	54	T	116	74	t
21	15	[NEGATIVE ACKNOWLEDGE]	53	35	5	85	55	U	117	75	u
22	16	[SYNCHRONOUS IDLE]	54	36	6	86	56	V	118	76	v
23	17	[ENG OF TRANS. BLOCK]	55	37	7	87	57	W	119	77	w
24	18	[CANCEL]	56	38	8	88	58	X	120	78	x
25	19	[END OF MEDIUM]	57	39	9	89	59	Y	121	79	y
26	1A	[SUBSTITUTE]	58	3A	:	90	5A	Z	122	7A	z
27	1B	[ESCAPE]	59	3B	;	91	5B	[	123	7B	{
28	1C	[FILE SEPARATOR]	60	3C	<	92	5C	\	124	7C	|
29	1D	[GROUP SEPARATOR]	61	3D	=	93	5D	]	125	7D	}
30	1E	[RECORD SEPARATOR]	62	3E	>	94	5E	^	126	7E	~
31	1F	[UNIT SEPARATOR]	63	3F	?	95	5F	_	127	7F	[DEL]

Response history

Step	Time	Action	State	Marks
1	1/06/23, 14:15	Started	Not yet answered	
2	1/06/23, 15:37	Saved: part 1: 0100100100000000000100000; part 2: 0011000100000000000110000; part 3: 0011000100000000000100101; part 4: 1100000100000000000110000; part 5: 1000000000000000000000101; part 6: 0111000000000000000000011; part 7: 0111000100000000000100101; part 8: 1110000100000000000110000; part 9: 0101000100000000000100000; part 10: 0011100100000000000110000; part 11: Direct-mode addressing; part 12: Direct-mode addressing; part 13: Direct-mode addressing; part 14: Direct-mode addressing; part 15: Immediate-mode addressing; part 16: Immediate-mode addressing; part 17: Direct-mode addressing; part 18: Direct-mode addressing; part 19: Direct-mode addressing; part 20: Direct-mode addressing; part 21: 12; part 22: 5; part 23: 11000001; part 24: 0005; part 25: 0000000000000100; part 26: 0; part 27: 0; part 28: R12	Answer saved	
3	1/06/23, 15:45	Saved: part 1: 0100100100000000000100000; part 2: 0011000100000000000110000; part 3: 0011000100000000000100101; part 4: 1100000100000000000110000; part 5: 1000000000000000000000101; part 6: 0111000000000000000000011; part 7: 0111000100000000000100101; part 8: 1110000100000000000110000; part 9: 0101000100000000000100000; part 10: 0011100100000000000110000; part 11: Direct-mode addressing; part 12: Direct-mode addressing; part 13: Direct-mode addressing; part 14: Direct-mode addressing; part 15: Immediate-mode addressing; part 16: Immediate-mode addressing; part 17: Direct-mode addressing; part 18: Direct-mode addressing; part 19: Direct-mode addressing; part 20: Direct-mode addressing; part 21: 12; part 22: 5; part 23: 11000001; part 24: 0080; part 25: 0000000000000100; part 26: 0; part 27: 0; part 28: R12	Answer saved	
4	**1/06/23, 15:46**	**Attempt finished**	**Partially correct**	**40.91**

◄ Part-time Test

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Final Exam 2023 (hidden) ►