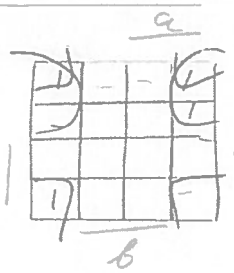
CAO exam

Q1]



$\bar{b} \cdot \bar{d} + \bar{b} \cdot \bar{c}$

Q2] $(a+b)(\bar{a}+b+c) = a\bar{a} + ab + ac + \bar{a}b + b + bc$

$a\bar{a} = 0$

$= ac + b$

Q3] $P \cdot Q + Q \cdot \bar{R} + P \cdot \bar{R}$

$P \cdot Q \cdot R + P \cdot Q \cdot \bar{R} + P \cdot \bar{Q} \cdot \bar{R} + \bar{P} \cdot Q \cdot \bar{R} + PQ\bar{R} + P \cdot \bar{Q} \cdot \bar{R}$

7 6 6 2 6 4

$\Sigma m(2,4,6,7)$

Q4] $A \cdot B + C \Rightarrow \overline{\overline{A \cdot B + C}} \Rightarrow \overline{\overline{A \cdot B} \cdot \bar{C}}$ 3 NAND gates

Q5] octal 3657 → binary 011 110 101 111

7 A F

Q6] sign bit 1
exp. 7 bits excess 64
fraction 8 bits, hidden 1. <8bits>

$8\frac{5}{8} = \frac{69}{8}$

69	1
34	0
17	1
8	0
4	0
2	0
1	

1000,101
↑ point because divide by 8

now convert to FP format.
Point must be right from first bit
shift over 3 positions to left and
multiply with 2^3_3
$\Rightarrow 1.000101 * 2^3$

exponent 3+64=67 Binary 1000011

FP format 0 1000011 00010100

4 3 1 4

Q7 | max. exponent $(2^7 - 1) - 64 = 63$

max fraction $1.\underbrace{11111111}_{8} = 2 - 2^{-8}$ decimal

max value $2^{63}(2 - 2^{-8})$

Q8 |

Q_0	Q_1	
0	0	↓
1	1	
0	1	
1	0	
0	0	

Q9 |

Q_1	Q_0	X	Q_1^+	Q_0^+	Y
0	0	0	0	0	0
0	0	1	1	0	0
0	1	0	0	0	0
0	1	1	0	0	1
1	0	0	0	1	0
1	0	1	1	0	0
1	1	0	-	-	-
1	1	1	-	-	-

D_1

Q_1 \ Q_0	0	1	0	0
0	1	-	-	
X				

$D_1 = \overline{Q_0} \cdot X$

Q10 |

Q_1 \ Q_0	0	0	1	0
0	0	-	-	
X				

$Y = Q_0 \cdot X$ with don't care valu.
not listed as answer.
$Y = \overline{Q_1} \cdot Q_0 \cdot X$ is also OK

Q11 | D_1

Q_1 \ Q_0	0	1
0	0	1
1	1	1

$D_1 = Q_1 + Q_0$

D_0

Q_1 \ Q_0	1	0
1	1	

$D_0 = Q_1 + \overline{Q_0}$

Q12 2 * N ms

(3)

Q13 answer a)

Q14 answer a) check with ARC tools

Q15 answer a) check with ARC tools

Q16 answer c) check with ARC tools

Q17

1792: %temp0 ← R[RS1] (shift 2 in multiple with a)

1793 %temp1 ← 4 * R[RS1]

1794 R[Rd] ← R[%temp0] + R[%temp1] =

R[rd ← 5 * R[RS1]

(d)

Q18

1792 / 2 = 0
896 / 2 = 0
448 / 2 = 0
224 / 2 = 0
112 / 2 = 0
56 / 2 = 0
28 / 2 = 0
14 / 2 = 0
7 / 2 = 1
3 / 2 = 1
1

→ 1 11 000000000

op op3

(a)

Q19 answer a)

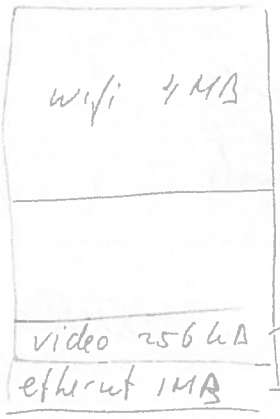
Q20 error in question; all solutions are marked correct

Q21 answer d)

Q22 service time of D is 50 ms. The max. latency of A is 15 ms.

answer b)

Q23 $8\,MB \Rightarrow 2^{23} \Rightarrow$ 22 21 ... 0 (4)



address bits

$\rightarrow 2^{18} \rightarrow$ 17 ... 0

$\rightarrow 2^{20} \rightarrow$ 19 ... 0 $\Rightarrow \overline{A_{22}} \cdot \overline{A_{21}} \cdot \overline{A_{20}}$

$SelEth = \overline{A_{22}} \cdot \overline{A_{21}} \cdot \overline{A_{20}} \cdot \overline{M}$ (6)

Q24 $SelVideo = \overline{A_{22}} \cdot \overline{A_{21}} \cdot A_{20} \cdot \overline{A_{19}} \cdot A_{18} \cdot \overline{M}$

Q25 16 bits processor $\Rightarrow$ 1 word $\Rightarrow$ 2 bytes address bits

4 MB $\Rightarrow 2^{22} \Rightarrow$ address bits

cache 16kB / 4 $\Rightarrow$ 4 kB $\Rightarrow 2^{12}$

4 way associative

Solution 512 B $= 2^{9}$ $\rightarrow$

21 20 ... 0

11 ... 0

8 ... 0

set in cache $= A_{11} \cdot A_{10} \cdot A_9$

Q26 word in slot $= A_8 \cdot A_7 \cdot A_6 \cdot A_5 \cdot A_4 \cdot A_3 \cdot A_2 \cdot A_1$

Q27 64M x 2 $\Rightarrow$ 32 bits therefore 16 modules

for each row $\frac{64M \times 32}{8}$ bytes $= 256$ Mbytes

total rows $\frac{1024 \text{ Mbytes}}{256 \text{ Mbytes}} = 4$