Tutorial for Week 9 - Answers

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2. (a) $S = (P \wedge Q \wedge R) \vee (P \wedge \neg Q \wedge R) \vee (P \wedge \neg Q \wedge \neg R)$ where S is the output of the circuit. Therefore, $S = 0$.

   (b) As above the DNF is: $(P \wedge Q \wedge R) \vee (P \wedge \neg Q \wedge R) \vee (P \wedge \neg Q \wedge \neg R)$

   (c)

$$\begin{aligned}
S &= (P \wedge Q \wedge R) \vee (P \wedge \neg Q \wedge R) \vee (P \wedge \neg Q \wedge \neg R) \\
&= (P \wedge ((Q \wedge R) \vee (\neg Q \wedge R) \vee (\neg Q \wedge \neg R))) \\
&= (P \wedge ((Q \wedge R) \vee (\neg Q \wedge (R \vee \neg R)))) \\
&= (P \wedge ((Q \wedge R) \vee (\neg Q \wedge 1))) \\
&= (P \wedge ((Q \wedge R) \vee \neg Q)) \\
&= (P \wedge ((\neg Q \vee Q) \wedge (\neg Q \vee R))) \\
&= (P \wedge (1 \wedge (\neg Q \vee R))) \\
&= (P \wedge (\neg Q \vee R))
\end{aligned}$$