Digital Electronics

(a) With the aid of appropriate sketches, describe how an n-channel MOSFET operates as a switch. [6 marks]

(b) The left-hand figure below shows a circuit that uses an n-channel MOSFET having the properties given in the right-hand figure. The supply voltage $V_{DD} = 10V$ and the resistor $R = 200\Omega$. The circuit input and output voltages are $V_1$ and $V_2$ respectively.

(i) Find the corresponding values of $V_2$ when $V_1 = 0V$, 2V, 2.5V, 3V, 3.5V, 4V, 4.5V, and sketch $V_2$ as a function of $V_1$. What logical function does this circuit implement? [8 marks]

(ii) When $V_1 = 4.5V$, calculate the power dissipated by the entire circuit and by resistor $R$. [2 marks]

(c) With the aid of a circuit diagram, describe how a p-channel MOSFET can be used in a modified version of the left-hand figure above to significantly reduce total power dissipation. [4 marks]