Q1. a

For fully-controlled rectifier

Average output voltage when there is line inductance is equal to :

$$V_d = 0.9 \times V_s \times cos(\alpha) - \frac{2wL_sI_d}{\pi}$$

$$V_d = R \times I_d$$

We want I_d to be 40 A, hence ;

$$V_d = 4 \times 40 = 160\ V$$

$$160 = 0.9 \times 230 \times cos(\alpha) - 4 \times 50 \times 0.5 \times 10^{-3} \times 40$$

$$\alpha = 37.6\ degrees$$

For half-controlled rectifier

Average output voltage when there is line inductance is equal to :

$$V_d = 0.45 \times V_s \times (1 + cos(\alpha)) - \frac{2wL_sI_d}{\pi}$$

$$V_d = R \times I_d$$

We want I_d to be 40 A, hence ;

$$V_d = 4 \times 40 = 160\ V$$

$$160 = 0.45 \times 230 \times (1 + cos(\alpha)) - 4 \times 50 \times 0.5 \times 10^{-3} \times 40$$

$$\alpha = 54.22\ degrees$$