Q-1.)

$$C = S \cdot N(d_1) - K e^{-rT} N(d_2)$$

$$d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$S = \$38$

$K = \$35$

$C = \$4.20$

$T = 4 \text{ months} = 1/3 \text{ yr}$

$r = 6\%$

a.)

Test-1 : $\sigma = 0.2$

$$d_1 = \frac{\ln(38/35) + (0.06 + 0.04/2)\,1/3}{0.2\sqrt{1/3}} = \frac{(0.0822 + 0.08 \times \frac{1}{3})}{0.2\sqrt{1/3}}$$

$$= 0.9431$$

$$d_2 = 0.9431 - 0.2\sqrt{1/3} = 0.8276$$

$N(d_1) = 0.8272$

$N(d_2) = 0.7961$

$$C = 38 \times 0.8272 - 35\, e^{-0.04/3} \times 0.7961 = 31.4336 - 28.4264$$

$C = \$3.0072$

Test-2 : $\sigma = 0.3$

$$d_1 = \frac{\ln(38/35) + (0.06 + 0.09/2)\,1/3}{0.3\sqrt{1/3}} = \frac{(0.0822 + 0.105 \times \frac{1}{3})}{0.3 \times 0.577}$$

$$= 0.6771$$

$$d_2 = 0.6771 - 0.3 \times 0.577 = 0.504$$

$N(d_1) = 0.7508$, $N(d_2) = 0.6929$

$$C = 38 \times 0.7508 - 35\, e^{-0.02} \cdot 0.6929 = 28.5304 - 24.7414$$

$C = \$3.7890$

Test-3: $\sigma = 0.4$

$$d_1 = \frac{\ln(38/35) + (0.06 + 0.08)\,1/3}{0.4\sqrt{1/3}} = \frac{0.0822 + 0.14 \times \frac{1}{3}}{0.4 \times 0.577} = 0.5583$$

$$d_2 = 0.5583 - 0.4 \times 0.577 = 0.3275$$

$N(d_1) = 0.7117$, $N(d_2) = 0.6284$

$$C = 38 \times 0.7117 - 35\, e^{-0.02} \cdot 0.6284 = 27.0446 - 21.5585$$

$C = \$5.4861$

By looking at the values, we can confidently say that $\sigma \in (0.3, 0.4)$ being more 0.3.

$\sigma \approx 0.34$ (just an estimation)

b.) $\sigma = 0.28$

$$P = K e^{-rT} N(-d_2) - S N(-d_1)$$

$$d_1 = \frac{\ln(S/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$$d_1 = \frac{\ln(38/35) + (0.06 + 0.0392)1/3}{0.28\sqrt{1/3}} = \frac{0.0822 + 0.3307}{0.28\sqrt{1/3}}$$

$$= 0.7130$$

$$d_2 = 0.7130 - 0.28\sqrt{1/3} = 0.5513$$

$N(-d_1) = 0.2379$

$N(-d_2) = 0.2907$

$$P = 35 \times e^{-0.02} \; 0.2907 - 38 \times 0.2379$$

$$P = \$0.9328$$

c.) Resemblence with call:

$S = 38$ million

$K = 35$ million

$T = 4$ months

$r = 6\%$

$\sigma = 0.28$

So, value of call = 4.20 million

Immediate lauche gives $S - K = 3$ million net gain

Holding the option add another 1.2 million.

So,

Company should wait.