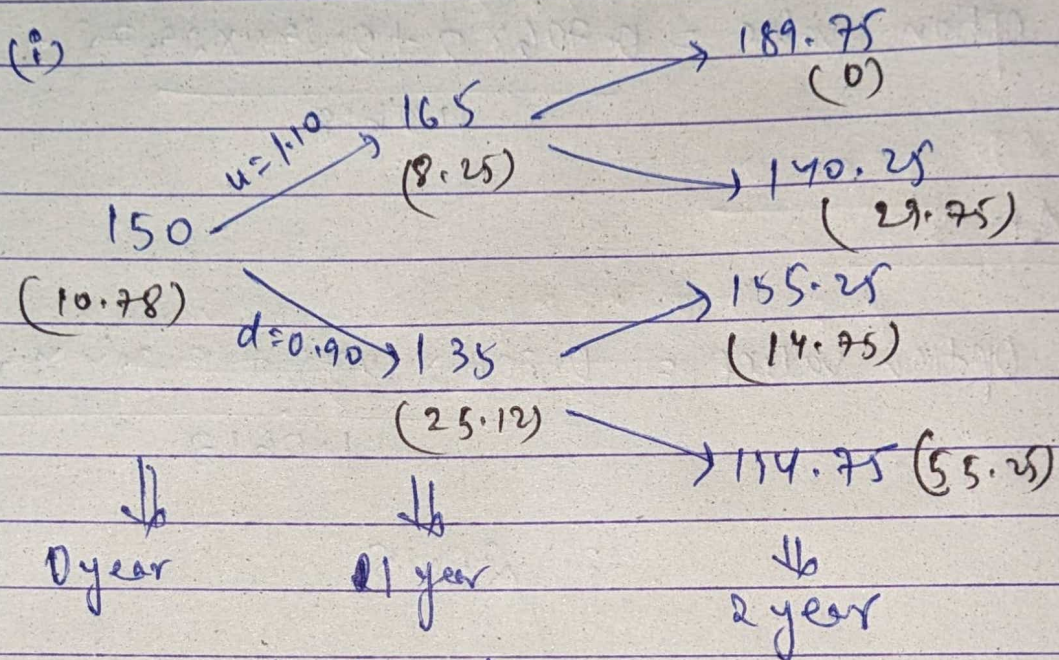(3) we know, $q = \dfrac{e^{-rt} - d}{u - d}$

$$c = e^{-rt}\left(q \times P_{up} + (1-q) P_{down}\right)$$

(i)

$$q_1 = \dfrac{e^{-rt} - d}{u - d} \quad (u = 1.10, \ d = 0.90)$$

$$q_1 = 0.809 \qquad 1 - q_1 = 0.191$$

$$\therefore q_2 = \dfrac{e^{-rt} - d}{u - d} = 0.706 \quad , \quad 1 - q_2 = 0.294$$

$$(u = 1.15, \ d = 0.85)$$

Option Payoffs ⟹ $\max(K - S_0, 0)$ $K = 170$

At $189.75 = 0$

At $140.25 = 29.75$

At $155.25 = 14.75$

At 114.75 = 55.25

At 165,

option value = $\dfrac{0.706 \times 0 + 0.294 \times 29.75}{1.0618} = 8.25$
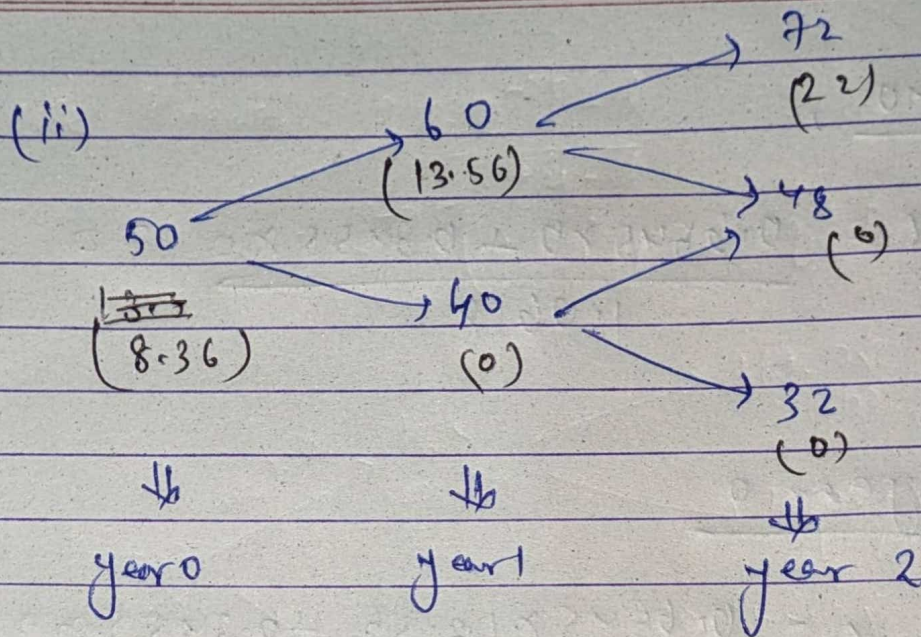
At 135

Option value = $\dfrac{0.706 \times 14.75 + 0.294 \times 55.25}{1.0618}$

= 25.15

$\left(\begin{array}{c}\text{Option value} \\ \text{year=0}\end{array}\right) = \dfrac{0.809 \times 8.25 + 0.191 \times 25.12}{1.0618}$

= 10.78

(ii)

$$\to 72$$
$$(22)$$

$$60$$
$$(13.56)$$

$$50$$

$$\to 48$$
$$(0)$$

$$\boxed{\cancel{50}}$$
$$(8.36)$$

$$\to 40$$
$$(0)$$

$$\to 32$$
$$(0)$$

$$\Downarrow \qquad\qquad \Downarrow \qquad\qquad \Downarrow$$

year 0   year 1   year 2

$$q = \frac{e^{-rt} - d}{u - d} \quad (u = 1.20, \ d = 0.80)$$

$$q = 0.6545 \qquad\qquad , \ 1-q = 0.3455$$

Option Payoffs $\max (S - K, 0)$

At 72, $\max(72 - 50, 0) = 22$

(from 60) At 48 $\max(48 - 50, 0) = 0$

(from 40) At 48 $\max(48 - 50, 0) = 0$

At 32 $\max(32 - 50, 0) = 0$

At 60

$$C = \frac{0.6545 \times 22 + 0.3455 \times 0}{1.0618} = 13.56$$

At 40,

$$C = \frac{0.6545 \times 0 + 0.3455 \times 0}{1.0618} = 0$$

year 0

$$C = \frac{0.6545 \times 13.56 + 0.3455 \times 0}{1.0618} = 8.36$$