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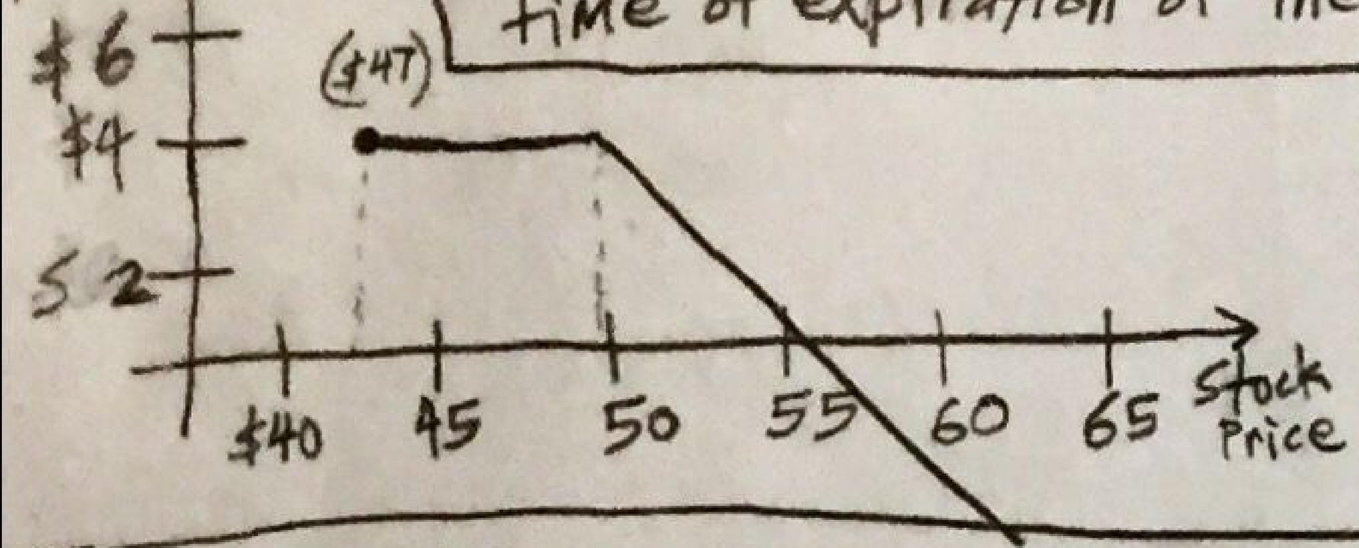
Stats C183
HW 4
6-1-20

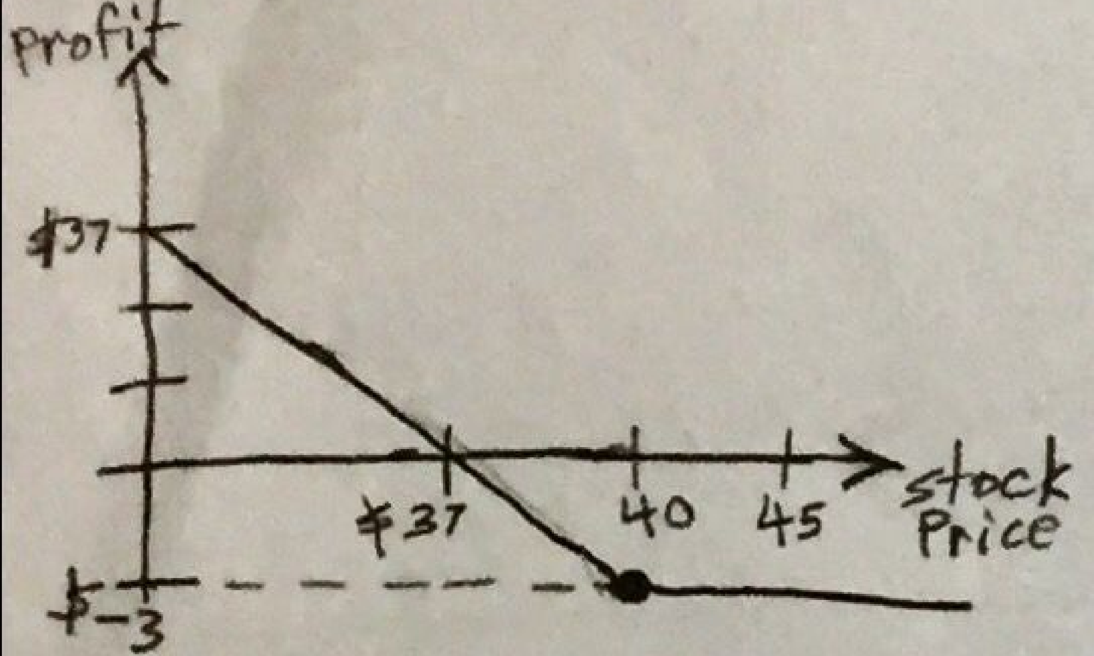
① EU Call/share = \$4
stock price = \$47
exercise prise = \$50 } 47 − 50 = −\$3 → NOT exercised → take stock price at expiration time w/ priced at \$54 →

if stock below \$50 → NOT exercised → investor profits \$4 → Diagram... →

the investor will profit is stock price below \$54 at time of expiration of the option → if b/w \$50−54 stock price, then option exercised

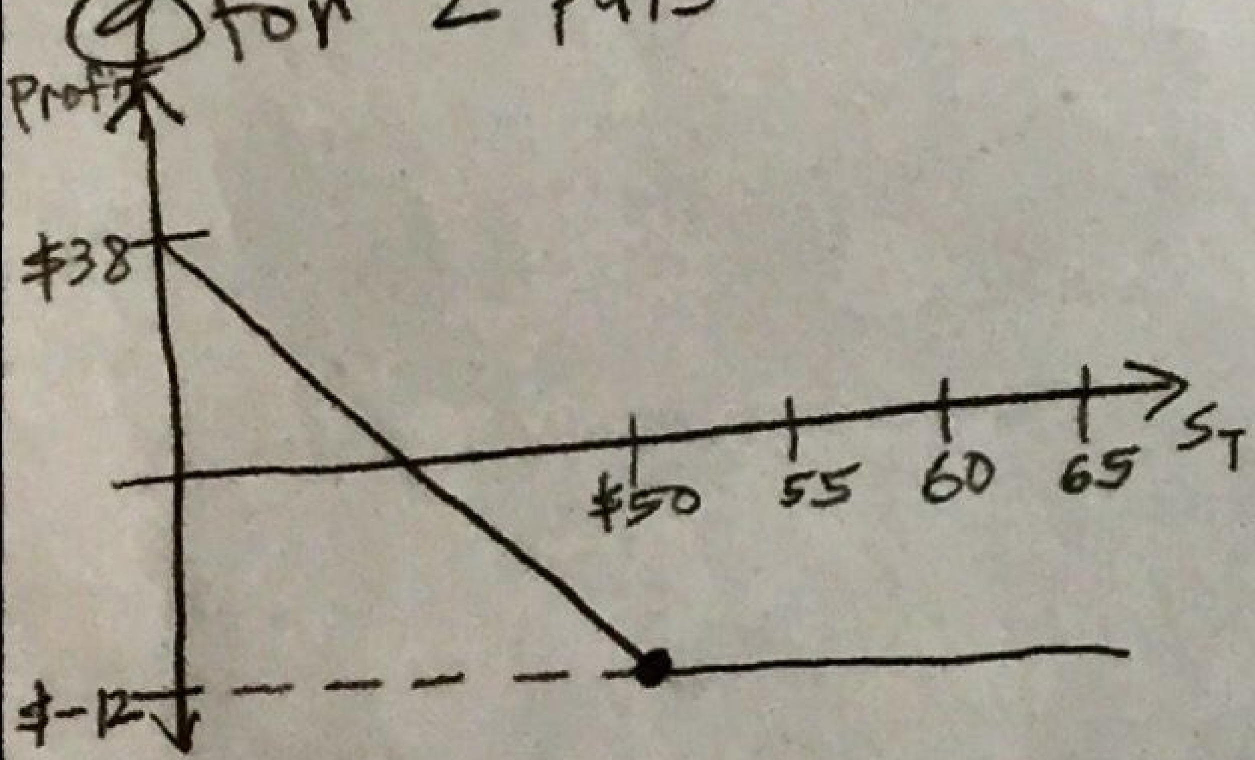


② EU Put = \$3
stock price = \$42
exercise price = \$40 } 40 − 3 = \$37 → the investor makes profit when stock below \$37 → exercised option if stock less than \$37 → diagram... →

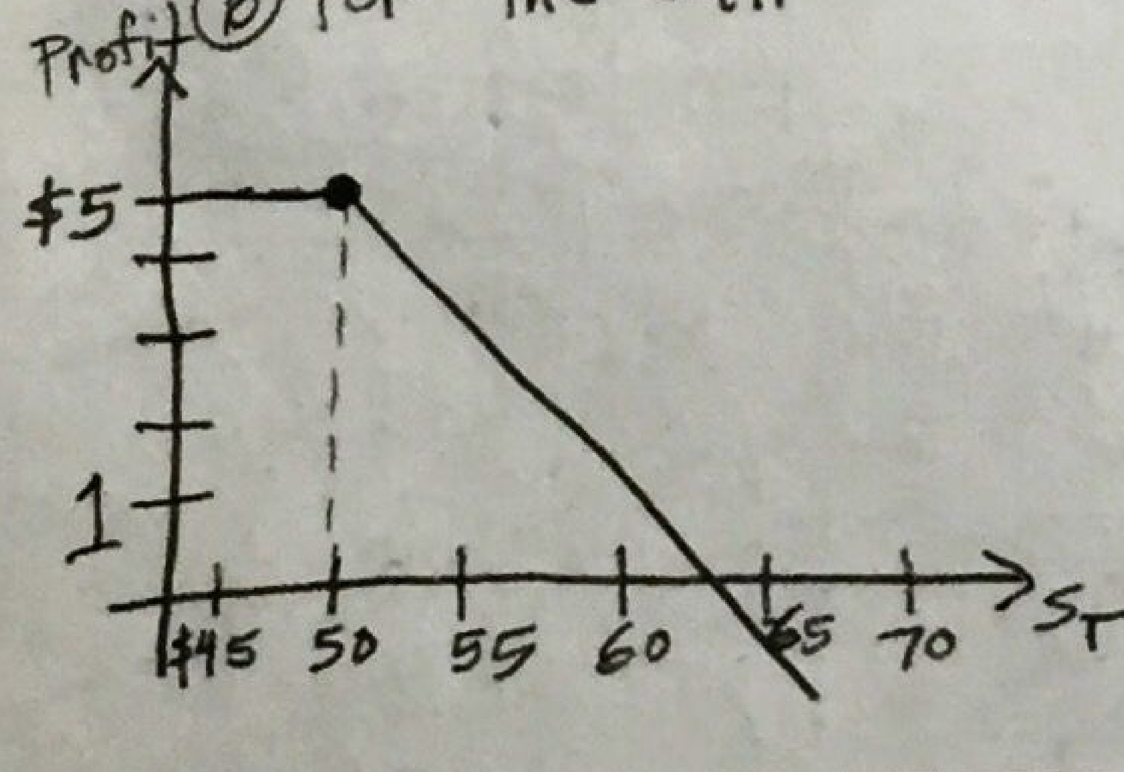


2 puts → \$6/put → P = \$12
1 call → \$5/call → C = \$5
E = \$50 } ⓐ expiration time priced at \$38
ⓑ expiration time priced at \$55
ⓒ expiration time priced at \$43 } diagram for ⓐ, ⓑ, ⓒ... →

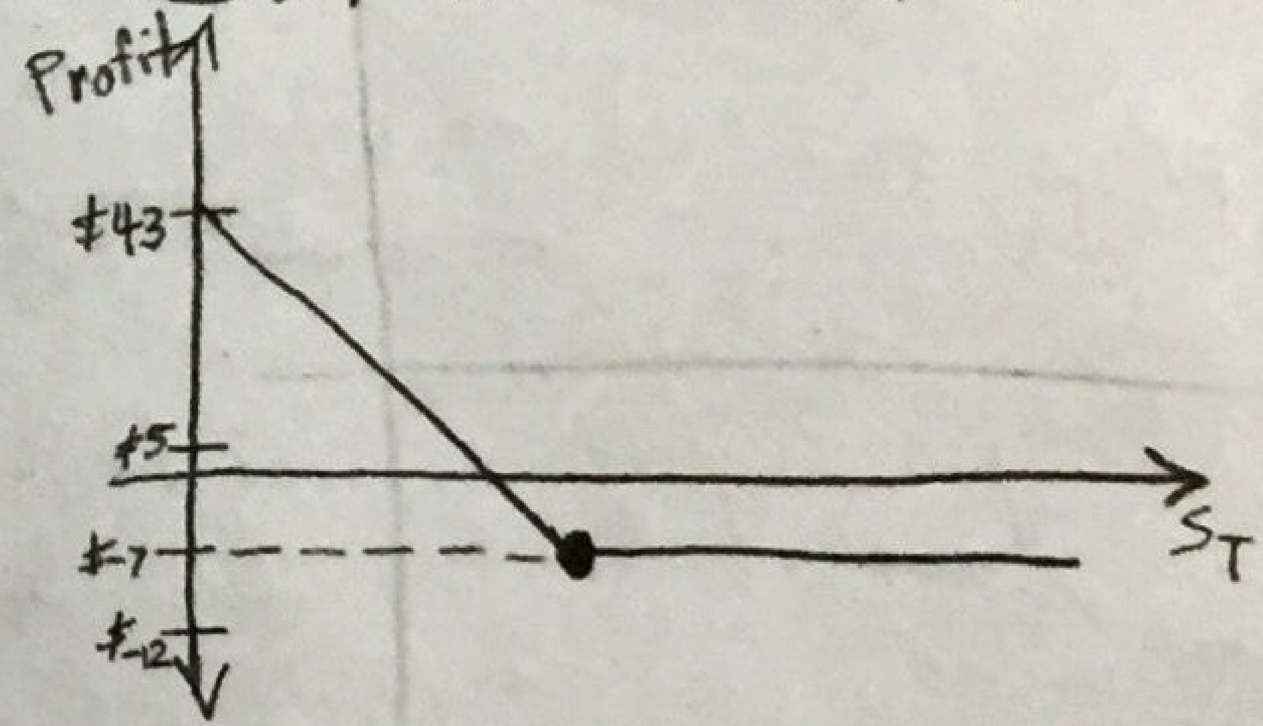
ⓐ for 2 puts



ⓑ for the call



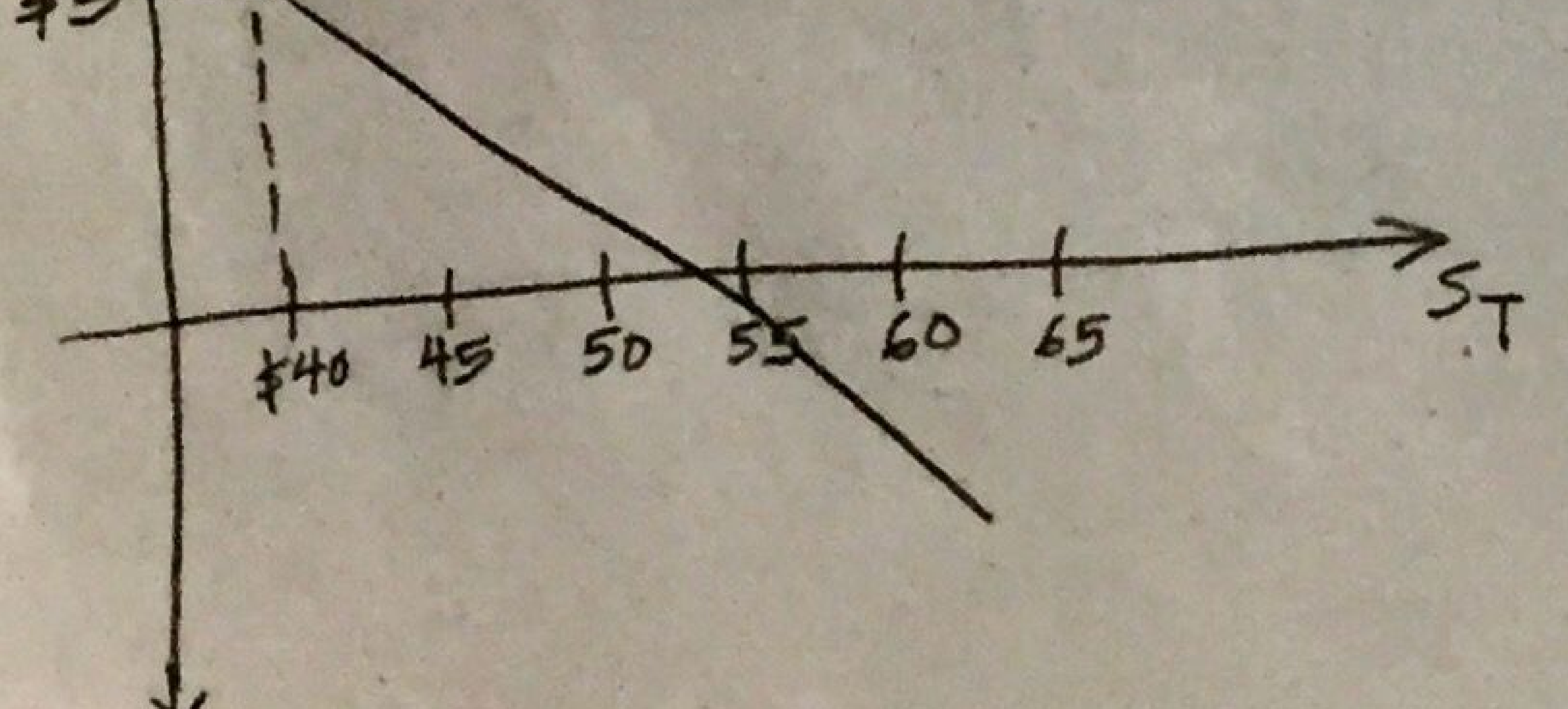
ⓒ for the combination



④ Write:
2 calls → \$5/call → \$10 calls
E = \$45
at \$55 exp. date

Holder:
1 call → \$8/call → \$8 call
E = \$40
at \$32 exp. date

→ diagram... →



⑤ **Bull Call Spread:** buy call w/ $E_1 = \$50$ & sell call w/ $E_2 = \$60$
Bear Put Spread: buy put w/ $E_2 = \$60$ & sell put w/ $E_1 = \$50$

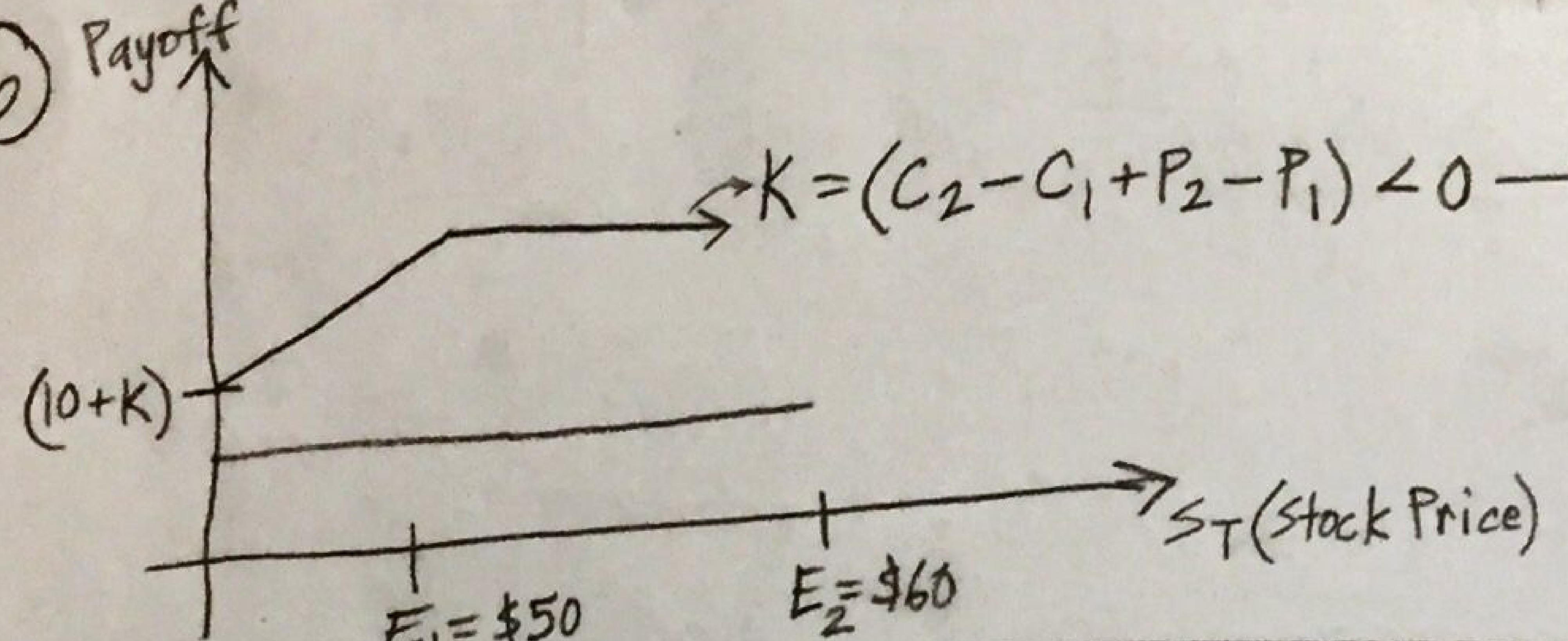
$\left.\begin{matrix} C_1 > C_2 \\ P_1 > P_2 \end{matrix}\right\}$ (Assume) Cash flow (Initial) $= C_2 - C_1 + P_2 - P_1 = K$

ⓐ

Price	Short Call	Long Call	Short Put	Long Put	Net Cash Flow
$S_T < 50$	0	0	$-(S_T - 50)$	$(60 - S_T)$	$(10 + K)$
$50 < S_T < 60$	0	$(S_T - 50)$	0	$(60 - S_T)$	$(10 + K)$
$S_T > 60$	$-(S_T - 60)$	$(S_T - 50)$	0	0	$(10 + K)$

→ Payoff Diagram (Spread) →

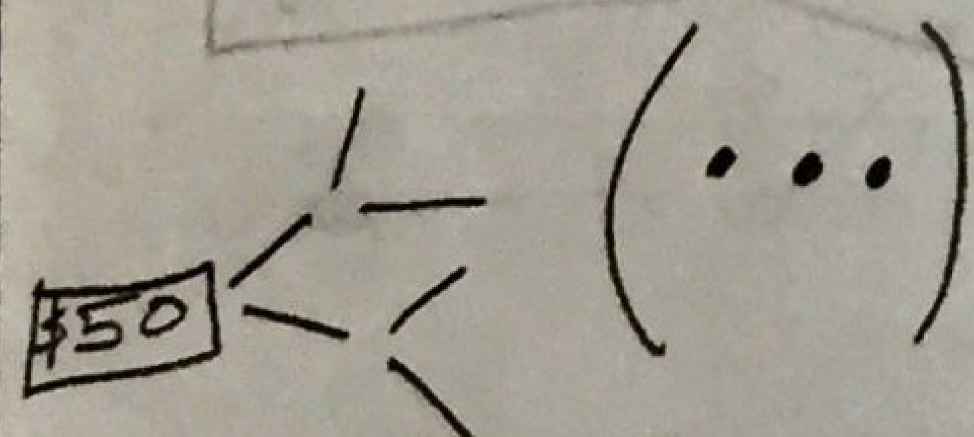
ⓑ



⑥ $\left.\begin{matrix} S_0 = \$50 & u = 1.2 \\ E = \$60 & d = \frac{1}{u} \\ r = 0.10/\text{period} & n = 10 \end{matrix}\right\}$ (Binomial) $\rightarrow d = \frac{1}{1.2} = 0.8\overline{33}$

ⓐ $k = \dfrac{\log\left(\frac{E}{d^n \cdot S_0}\right)}{\log\left(\frac{u}{d}\right)} \doteqdot 5.50493 \rightarrow \boxed{k = 6}$

ⓑ price of stock at node $= u^j \cdot d^{10-j} \cdot S_0$ for $j = 0, \ldots, 10$



$u^{10} \cdot S_0 \cdot d^0 =$	309.5868
$u^9 \cdot S_0 \cdot d^1 =$	214.9908
$u^8 \cdot S_0 \cdot d^2 =$	149.2992
$u^7 \cdot S_0 \cdot d^3 =$	103.5556
$u^6 \cdot S_0 \cdot d^4 =$	71.8849
$u^5 \cdot S_0 \cdot d^5 =$	49.9001
$u^4 \cdot S_0 \cdot d^6 =$	34.6390
$u^3 \cdot S_0 \cdot d^7 =$	24.0452
$u^2 \cdot S_0 \cdot d^8 =$	16.6914
$u^1 \cdot S_0 \cdot d^9 =$	11.5866
$u^0 \cdot S_0 \cdot d^{10} =$	8.0430

ⓒ $\max\{S_T - E, 0\}$

$C_{u^{10}d^0} = 249.5868$	$C_{u^5d^5} = 0$
$C_{u^9d^1} = 154.9908$	$C_{u^4d^6} = 0$
$C_{u^8d^2} = 89.2992$	$C_{u^3d^7} = 0$
$C_{u^7d^3} = 43.68$	$C_{u^2d^8} = 0$
	$C_{u^1d^9} = 0$
$C_{u^6d^4} = 12$	$C_{u^0d^{10}} = 0$

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6 (d) (i) $C = S_0 \cdot \sum_{j=k}^{n} \binom{n}{j} p'^{(j)} (1-p')^{(n-j)} - \frac{E}{(1+r)^n} \sum_{j=k}^{n} \binom{n}{j} p^{(j)} (1-p)^{(n-j)} \longrightarrow$

$C = S_0 \cdot P(X \geq k) - \frac{E}{(1+r)^n} \cdot P(Y \geq k)$ for $X \sim b(n, p')$ & $Y \sim b(n, p)$ $\longrightarrow$ calculate $\rightarrow$

$u = 1.2$

$d = 0.833$

$r_p = (1.10)^{(1/10)} - 1 = 0.02$

$p = 0.7273$

$p' = 0.7934$

$k = \frac{\log\left(\frac{E}{d^n \cdot S_0}\right)}{\log\left(\frac{u}{d}\right)} = 5.50493 \rightarrow k = 6$

$C = (50) \cdot P(X \geq 6) - \left(\frac{60}{(1+0.10)^{10}}\right) \cdot P(Y \geq 6) \rightarrow$

$\boxed{C = 27.4864}$

(ii) $C = \frac{\sum_{j=0}^{10} \binom{10}{j} (0.7273)^j (1-0.7273)^{10-j} \cdot C u^j d^{10-j}}{(1+0.10)^2}$

$\boxed{C = 27.4864}$

Note: Both are the same!

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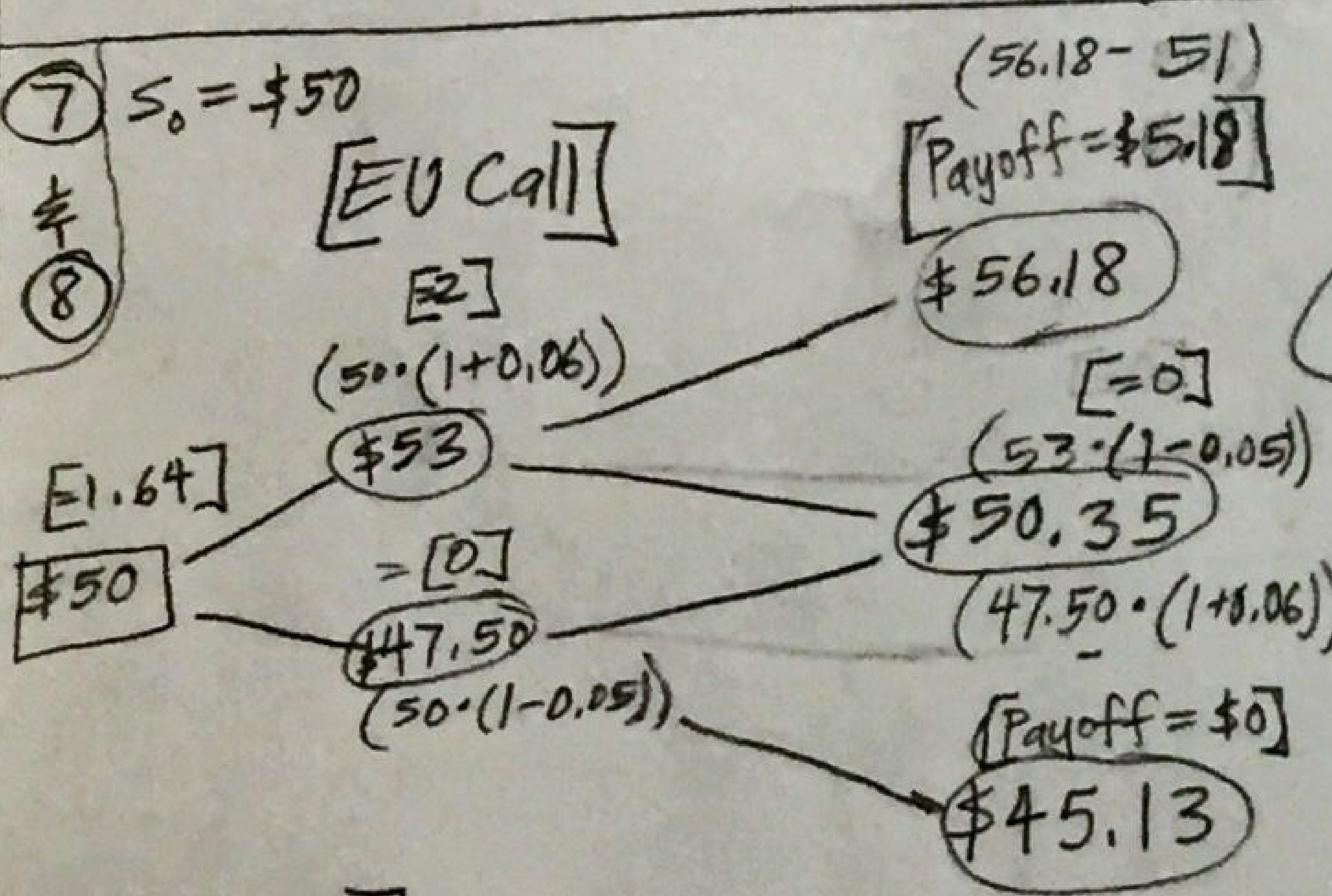
7 $S_0 = \$50$

& 8

[EU Call]



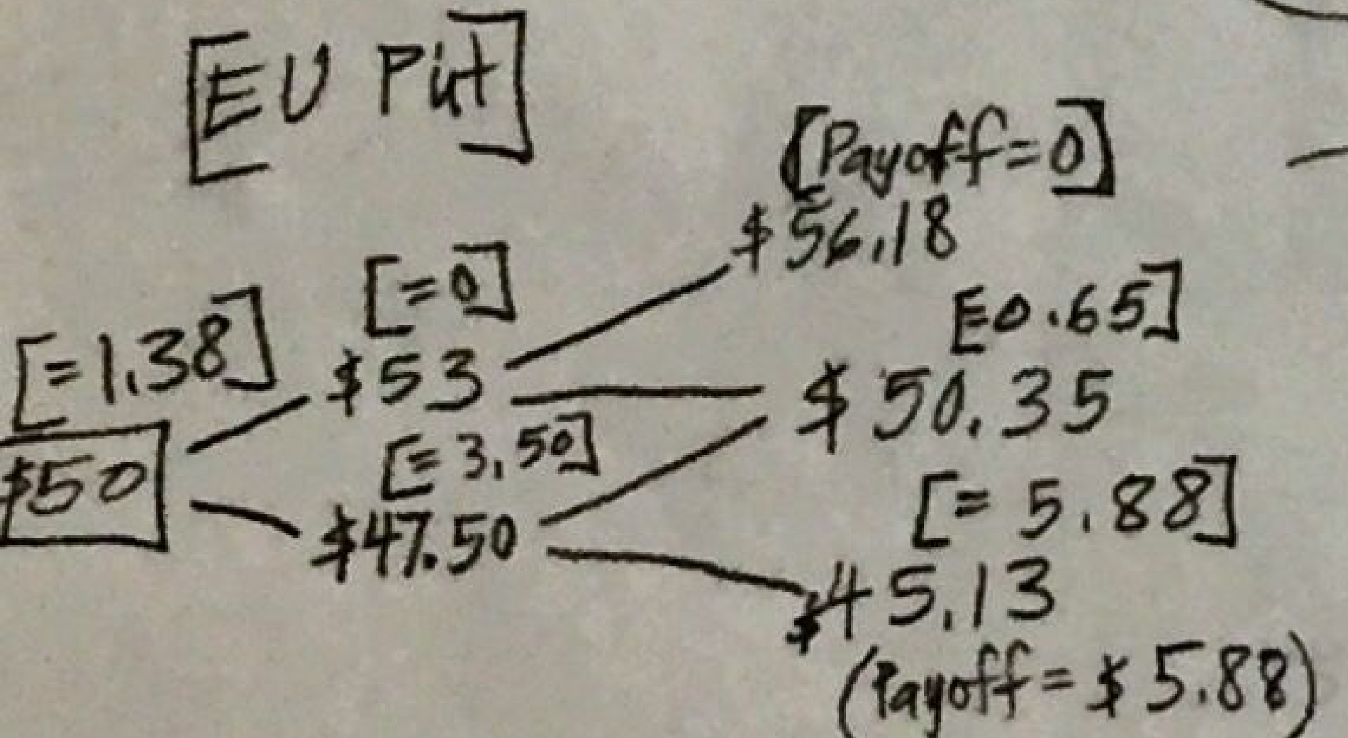
$p = \frac{e^{rt} - d}{u - d} = \frac{e^{(0.05)(\frac{3}{12})} - (1 - 5\%)}{(1+6\%) - (1-5\%)} \Rightarrow p = 0.568895$

$(1-p) = 0.431105 \rightarrow P = e^{-rt} \cdot \left[(p^2 \cdot f_u) + (2 + p(1-p) \cdot f_d) + ((1-p)^2 \cdot f_d) \right]$

$\longrightarrow = e^{-(6\%)(\frac{6}{12})} \left[(0.568895^2 \cdot 5.18) + (2 \cdot 0.568895 \cdot 0.431105 \cdot 0.65) + (0.431105^2 \cdot 0) \right]$

$P = 1.6350711 \longrightarrow \boxed{P_c = 1.6351}$

[EU Put]



$P = e^{-(6\%)(\frac{6}{12})} \left[(0) + (2 \cdot 0.568895 \cdot 0.431105 \cdot 0.65) + (0.431105^2 \cdot 5.88) \right] = 1.3758767$

$\longrightarrow \boxed{P_p = 1.3759}$

Conclusion: Option should be exercised at \$47.50 w/ profit of \$3.50 (51-47.50). Not exercised at \$53 or/and \$50

$C + \frac{E}{1+r} = P + S_0 \longrightarrow P = 1.376$ ✓

$C = 1.635$ ✓