1. $E = \$250B$ $D = \$10B$

a. Based on M&M proposition I, the firm value is independent of capital structure, so the firm value does not change $= 250 + 10 = \$260B$

Debt after recapitalization: $\frac{D}{D+E} = 0.4 \rightarrow D = 0.4 \times 260 = 104$

New Debt issued: $104 - 10 = \$94B$

$r_D = r_f = r_f + \beta_D(\text{market premium}) \longrightarrow \beta \times \text{market premium} = 0$

$\longrightarrow \beta_D = 0$

Because M&M's proposition II, r_A, β_A remain constant

$\therefore \beta_A = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E = \frac{10}{260} \times 0 + \frac{250}{260} \times 1.13 = 1.0865 \approx 1.09$

$\because D/D+E = 0.4 \quad E/D+E = 0.6$

$\therefore \beta_A = 1.09 = 0.4 \times 0.3 + 0.6 \times \beta_E \qquad \therefore \beta_E = 1.61$

b. $\beta_A = 1.0865 \rightarrow r_A = r_f + \beta_A(r_m - r_f) = 0.03 + 1.0865 \times 0.06 = 0.09519$

Before: $D/D+E = 10/260 \rightarrow E/D+E = 250/260 \rightarrow \frac{1}{25} = D/E$

$r_D = r_f = 0.03$

$\therefore r_E = r_A + D/E(r_A - r_D) = 0.09519 + \frac{1}{25}(0.09519 - 0.03)$

$= 0.0978$

或 $r_E = r_f + \beta_E \times \text{premium}$
$= 0.03 + 1.13 \times 0.06$
$= 9.78\%$

After: $D/E = 2/3$, $\beta_D = 0.3 \rightarrow r_D = 0.03 + 0.06 \times 0.3 = 0.048$

$r_E = 0.09519 + \frac{2}{3}(0.09519 - 0.048) = 0.12665$ 或 $r_E = r_f + \beta_E(r_m - r_f)$
$= 0.03 + 1.61 \times 0.06$
$= 12.66\%$

2. a. Before: $48/(48+E) = 0.4 \quad \therefore 48/0.4 = 120 = 48 + E \Rightarrow E = 72$

$P = E / \text{Shares outstanding} = 72/3 = \$24$ (before & After Price)

After: $D/(D+E) = 0.05$ & M&M says $D+E$ does not change

$D_{new} = 0.05 \times 120 = 6 \longrightarrow E_{issued} = 48 - 6 = 42$

Because we're in M&M's world, Price is constant

$\therefore$ newShares $\times$ 24 = 42

$\therefore$ new shares $= 42/24 = 1.75$ M

b. After: $r_D = $ risk free $= 0.03 = 0.03 + \beta_D(0.05)$

(因为After之后rf了)

$\therefore \beta_D = 0$

c Before: $\beta_D = 0.45$, $r_E = 0.13$, $r_f = 0.03$, $r_m - r_f = 0.05$

$r_D = 0.03 + 0.45 \times 0.05 = 0.0525$

In M&M's proposition II, r_A remains constant

$r_A = 0.4 \times 0.0525 + 0.6 \times 0.13 = 0.099$

(before & After)

d. After issurance, $r_D = $ risk free $= 0.03$

$D_{new}/E_{new} = 6/114$

$r_E = r_A + D/E(r_A - r_D) = 0.099 + \frac{6}{114}(0.099 - 0.03)$

$= 0.1026$

$35 = \frac{3}{r_A - 0.01}$ $\therefore r_A = 9.57\%$

3. a. $V = \frac{C}{r_A} \longrightarrow 30 + 5 = \frac{3}{r_A - g} \longrightarrow r_A = 0.0857$

b. Before, D is risk free

$r_E = r_A + \frac{D}{E}(r_A - r_D) = \cancel{0.0857}\ 0.0957 + \frac{5}{30}(\cancel{0.0857}\ 0.0957 - 0.03)$

$= \cancel{0.09498}$ 0.1067

c. Because D is risk free $\rightarrow r_D = r_f = 0.03$

d. $EPS = \frac{EBIT - Interest}{\#\ s\ outstanding} = \frac{3 - 0.03 \times 5}{5} = 0.57$

e. Issue \$6 M Debt to buy Shares, $D_{new} = 5 + 6 = 11$

$P_{new} = 30 - 6 / (5 - s)$ & $P_{new} \times S = 6$

$\frac{24}{5 - s} = \frac{6}{s} \longrightarrow S = 1$

$EPS_{new} = \frac{3 - 0.035 \times 11}{5 - 1} = 0.65375$

f. $E = \frac{C}{r_E} \rightarrow \frac{3 - 0.035 \times 11}{30 - 6} = r_E = 0.108958$ ✗ $r_E = r_A + \frac{D}{E}(r_A - r_D)$

g. Before: $P/E = \frac{30/5}{0.57} = 10.5263$

After: $P_{new} = 6/5 = 6/1 = 6$

$P/E = 6/0.65375 = 9.1778$

$= 0.0957 + \frac{11}{24}(0.0957 - 0.035)$
$= 12.35\%$

h. (bonus) I need to find the year when the EPS before equals the EPS after $\Rightarrow \frac{CF - 0.03 \times 5}{5} = 0.65375 \Rightarrow CF = 3.41875$

$\therefore 3.41875 = 3 \times 1.01^n$

when $n = 13$, $1.01^{13} = 1.13809 < \frac{3.41875}{3}$ → take $n = 14$

$\therefore$ it needs 14 years ✗ (15)

Because 3M is generated next year, 15 years from now ☆

4. a. $V_{(E)} = \frac{C}{r_A - g} = \frac{C}{r_E - g} \rightarrow 86 = \frac{5.25}{r_E - 0.03}$

$\therefore r_E = 0.091$

b. $P_{before} = \frac{E}{\#S\ outstanding} = \frac{86}{6} = 14.33$

Because risk of tax shield and risk of debt are same,

$DTS = \tau_c \cdot D = 0.35 \times 30 = 10.5M$

$P_{new} = \frac{V_U + PV(DTS) - D}{6 - R}$ & $R\, P_{new} = 6$

$P_{new} = \frac{86 + 10.5 - 30}{6 - R} = P_{new} = \frac{30}{R}$

$66.5R = 180 - 30R \rightarrow R = 1.8653$

$\therefore P_{new} = 30/1.8653 = 16.08$

c. Because only τ_c & τ_e exist,

$\tau^* = 1 - \frac{(1-\tau_c)(1-\tau_e)}{(1-\tau_i)} = 1 - (1-\tau_c)(1-\tau_e)$

$= 1 - (1 - \tau_e - \tau_c + \tau_c \tau_e)$

$= \tau_e + \tau_c - \tau_c \tau_e$

$= \tau_c + \tau_e(1 - \tau_c) > \tau_c$

So, the debt tax shield will increase

d. Because only τ_c and τ_i

$$\tau^* = 1 - \frac{1-\tau_c}{1-\tau_i} = \frac{\tau_c - \tau_i}{1-\tau_i}$$, compared to τ_c

$$\tau^* \Rightarrow \tau_c - \tau_i \ \& \ \tau_c(1-\tau_i)$$

$$\tau_c - \tau_i < \tau_c - \tau_c\tau_i$$

$\therefore \tau^* < \tau_c$, so the debt tax shield will decrease

5. a. $1/0.35 = 2.857 = r_D \cdot D$

$$\therefore D = \frac{2.857}{0.075} = 38.095$$

$$DTS = \tau_c \cdot D = 0.35 \times 38.095 = 13.33$$

b. $$\tau^* = 1 - \frac{(1-\tau_c)(1-\tau_e)}{1-\tau_i}$$

$$= 1 - \frac{0.65 \times 0.85}{0.65} = 0.15$$

$$DTS^* = \tau^* D = 0.15 \times 38.095 = 5.71425$$

change in $DTS^* = 13.33 - 5.71425$

$$= 7.61575$$

c. $$\tau^* = 1 - \frac{0.65 \times 0.85}{1-\tau_i} = 0$$

$$1 - \tau_i = 0.5525$$

$$0.4475 = \tau_i$$

When personal tax rate on Interest income is 0.4475, the value of DTS is 0.

6. $r_E = r_f + \beta_E(r_m - r_f)$

$$= 0.02 + 1.1(0.06 - \cancel{0.02}) = \cancel{0.064} \quad 0.086$$

$$D/E = 0.9 \rightarrow D/(D+E) = 0.9E/(0.9E+E) = \frac{0.9}{1.9} = 0.4737$$

$$\therefore r_{WACC} = (1-0.4737) \times \underset{0.086}{\cancel{0.064}} + 0.4737 \times 0.7 \times 0.03$$

$$= \cancel{0.043631} \quad 0.0552$$

$$V_L = -90 + 10/(\cancel{0.043631} - 0.05)\left(1 - \left(\frac{1.05}{\cancel{1.043631}}\right)^7\right)$$

$$+\left[10(1.05)^{6}(1.01)^{7}/(\cancel{0.043631}^{\,0.0552}-0.01)\right]/(1+\cancel{0.043631}^{\,0.0552})^{7}$$

$$=\cancel{68.31407717+300.2831196-90}$$

$$=\cancel{278.5971968}$$

$$\approx \cancel{278.5972}$$

$=-90+65.3654$

$+205.5773$