

1. NPV base case:

\$-100 million plus the cash flows from the perpetuity.

$$= -100 + \frac{\$25}{.2} = -100 + 125 = \$25 \text{ million}$$

NPV with option:

NPV of expansion in good case:

$$-75 + \frac{20}{.2} = -75 + 100 = \$25 \text{ mil, so we would expand in this case.}$$

NPV in bad case: (of expansion)

$$-75 + \frac{-10}{.2} = -\$125 \text{ mil, so we would not expand.}$$

Total NPV, good case:

$$-100 + \frac{40}{.2} + \frac{25}{1.2} = ~~44.57~~ 120.8\bar{3}$$

Total NPV, bad case

$$-100 + \frac{10}{.2} + \frac{0}{1.2} = -50$$

$$\begin{aligned} \text{Expected NPV of project} &= \frac{1}{2}(-50) + \frac{1}{2}(\overset{120.8\bar{3}}{\cancel{245.8\bar{3}}}) = \cancel{92.91\bar{6}} \text{ million} \\ &= 35.41\bar{6} \text{ million} \end{aligned}$$

$$\text{Value of option to expand is } 35.41\bar{6} \text{ million} - 25 \text{ million} = \boxed{10.41\bar{6} \text{ million}}$$