Ralph's rationing and taxes[1]

This is a follow-up to problem 18-15 (and a variation on problem 13-14) in Demski's *Managerial Uses of Accounting Information*. Ralph manages a decentralized firm in which division managers have significant authority to make production-investment decisions. However, all capital expenditures are approved by Ralph. Ralph and division know the cost of a project is $c \in \{18, 40, 50, 90\}$ with probabilities $p \in \{0.25, .0.05, 0.1, 0.6\}$ and payoff $x = 100$. Division learns the cost before submitting a capital request to Ralph and Ralph will never learn the cost.

Suggested:

1. Suppose all parties face a flat tax rate of 10% on earnings. Determine expected after-tax profits to Ralph under all possible rationing schemes. For Ralph's preferred rationing scheme determine the division manager's expected after-tax rent, and expected taxes to tax authorities.

2. Suppose taxes are progressive such that income up to 50 is taxed at 7.5% and above 50 are taxed at 50%. Determine expected after-tax profits to Ralph under all possible rationing schemes. For Ralph's preferred rationing scheme determine the division manager's expected after-tax rent, and expected taxes to tax authorities.

3. Which tax scheme (flat or progressive) does Ralph prefer?
— the division manager prefer?
— the tax authority prefer?

[1] This example is drawn from Arya, Glover, and Mittendorf, 2006. "Taxes and the efficiency-rent extraction trade-off," *Journal of Public Economic Theory* 8 (5), 741-760.