Question 1 **(25 marks)**

In a competition Mary has a probability of $\frac{1}{20}$ of winning, a probability of $\frac{1}{10}$ of finishing in second place, and a probability of $\frac{1}{4}$ of finishing in third place. If she wins the competition she gets €9000. If she comes second she gets €7000 and if she comes third she gets €3000. In all other cases she gets nothing. Each participant in the competition must pay €2000 to enter.

(a) Find the **expected value** of Mary's loss if she enters the competition.

(b) Each of the 3 prizes in the competition above is increased by the same amount (€x) but the entry fee is unchanged.
For example, if Mary wins the competition now, she would get €(9000 + x).
Mary now expects to break even.
Find the value of x.

Q1	Model Solution – 25 Marks	Marking Notes
(a)	$\frac{1}{20}(9000)+\frac{1}{10}(7000)+\frac{1}{4}(3000)$ $=1900$ $E(x)=2000-1900=100$ **Or** $E(x)=\frac{1}{20}(-7000)+\frac{1}{10}(-5000)$ $+\frac{1}{4}(-1000)+\frac{3}{5}(2000)$ $=-350-500-250+1200=100$ So expected gain for organisers of competition and therefore a loss for Mary of 100	**Scale 15C (0, 4, 11, 15)** *Low Partial Credit:* $E(x)$ partially formulated (1 or 2 terms) *High Partial Credit:* $E(x)$ fully formulated (sum of all three/all four terms)

(b)	$\frac{1}{20}(9000+x)+\frac{1}{10}(7000+x)$ $+\frac{1}{4}(3000+x)=2000$ $\left(1900+\frac{8}{20}x\right)=2000$ $\frac{8}{20}x=100$ $x=250$ **Or** From **(a)** to break even it will take €100. $\frac{x}{20}+\frac{x}{10}+\frac{x}{4}=100$ $\frac{x+2x+5x}{20}=100$ $\frac{8}{20}x=100$ $x=250$ **Or** $E(x)=\frac{1}{20}(-7000-x)$ $+\frac{1}{10}(-5000-x)$ $+\frac{1}{4}(-1000-x)+\frac{3}{5}(2000)=0$ $-7000-x-10\,000-2x-5000-5x$ $+24\,000=0$ $2000=8x\Rightarrow 250=x$	**Scale 10D (0, 3, 5, 8, 10)** *Low Partial Credit:* Any relevant use of x, excluding $(9000+x)$ *Mid Partial Credit:* $E(x)$ fully formulated (LHS). $\left(1900+\frac{8}{20}x\right)$ or equivalent and stops. $\frac{x}{20}+\frac{x}{10}+\frac{x}{4}$ *High Partial Credit* Relevant equation in x *Low Partial Credit:* Any relevant use of x e.g. $(-7000+x)$ *Mid Partial Credit:* $E(x)$ fully formulated (LHS). $\left(100-\frac{8}{20}x\right)$ or equivalent and stops. *High Partial Credit* Relevant equation in x