| Question Number | Scheme | Marks |
|---|---|---|
| **5. (a)** | $\mathrm{E}(X) = -2p - p + 0 + \frac{1}{2} + 3p \;\; ; \;\; = \frac{1}{2}$ | M1 ; A1 (2) |
| **(b)** | $\mathrm{E}(X^2) = 4p + p + 0 + 1 + 9p = [14p + 1]$ | M1A1 |
| | [Var($X$) =] $\mathrm{E}(X^2) - [\mathrm{E}(X)]^2 = 14p + 1 - ("\frac{1}{2}")^2$ | dM1 |
| | So $14p + 0.75 = 2.5$ | M1 |
| | $p = \frac{1}{8}$ | A1 (5) |
| **(c)** | Sum of probabilities = 1 implies $q = \frac{3}{8}$ | B1ft (1) |
| **(d)** | P(Amar wins) = e.g. $\mathrm{P}(X_1 > 0) + \mathrm{P}(X_1 < 0) \times \mathrm{P}([X_1 + X_2] > 0 \{\mid X_1 < 0\})$ or $\mathrm{P}(X_1 = 2 \text{ or } 3) + \mathrm{P}(X_1 = -2) \times \mathrm{P}(X_2 = 3) + \mathrm{P}(X_1 = -1) \times \mathrm{P}(X_2 = 2 \text{ or } 3)$ | M1 |
| | **Cases** $X_1 = -2$ and $X_2 = 3$ so probability $= p^2$ | M1 |
| | $X_1 = -1$ and $X_2 \geqslant 2$ so probability $= p\left(p + \frac{1}{4}\right)$ | |
| | Total probability $= p + 0.25 + p^2 + p(p + 0.25) = \frac{1}{8} + \frac{1}{4} + \frac{1}{64} + \frac{1}{64} + \frac{1}{32}$ | A1ft |
| | $= \frac{7}{16}$ | A1 (4) |
| **(e)** | [Although E($X$) > 0 since] P(win) < 0.5 | M1 |
| | Amar should not play the game or "disagree" | A1 (2) |
| | | **[14]** |

| | Notes |
|---|---|
| **(a)** | M1 for a correct expr'n for E($X$) in $p$ (at least 3 non-zero terms seen). May be implied by A1<br>A1 for $\frac{1}{2}$ (or exact equivalent e.g. $\frac{2}{4}$ or 0.5) |
| **(b)** | 1st M1 for a correct expression for E($X^2$) (at least 3 non-zero terms). May be implied by A1<br>1st A1 for $14p + 1$ or any fully correct expression in terms of $p$<br>2nd dM1 dep on 1st M1 for use of [Var($X$) =] $\mathrm{E}(X^2) - [\mathrm{E}(X)]^2$<br>3rd M1 for forming a linear equation in $p$ using the 2.5<br>2nd A1 for $p = \frac{1}{8}$ or exact equivalent e.g. 0.125 |
| **(c)** | B1ft for $q = \frac{3}{8}$ or exact equivalent e.g. 0.375 or $\frac{3}{4} - 3p$ $0<p<1$ |
| **(d)** | 1st M1 for identifying only the correct cases (any correct list, adding not needed)<br>2nd M1 for identifying all the cases where a 2nd spin is required and probabilities (no extras)<br>1st A1ft for correct expression for total probability (allow their $0 < p < 1$ or letter $p$)<br>2nd A1 for $\frac{7}{16}$ (or exact equivalent e.g. 0.4375) [$\frac{7}{16}$ with no incorrect working seen gets 4/4] |
| **ALT** | Allow P(loses) = $q + p(1 - p) + p(0.75 - p)$ only if 1 – P(loses) is seen |
| **(e)** | M1 for identifying that the important feature is that P(win ) < 0.5 (o.e.) [ft their $\frac{7}{16} < 0.5$]<br>A1cao for concluding that he shouldn't play the game (dep on M1 seen & 0.375 < (d) < 0.5) |

If they think E($X^2$) = Var($X$) get $p = \frac{3}{28}, q = \frac{3}{7}$ and up to (b) M1A1M0M1A0 (c) B1ft and if they get $\frac{319}{784}$ in (d) it implies M1M1A1A0 there and access to (e)