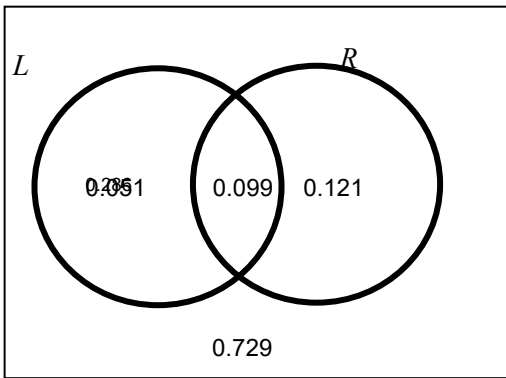
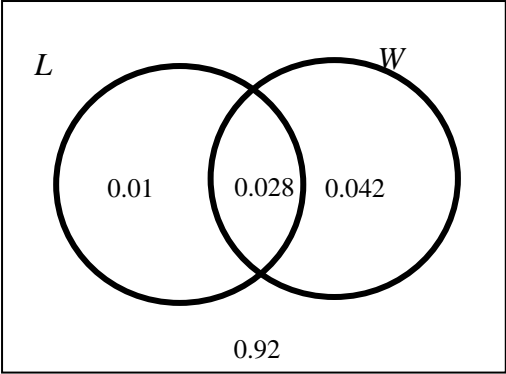


Question			Answer	Marks	Guidance	
1	(i)	(A)	$P(\text{Watched cyc but not fb}) = \frac{15}{250} = \frac{3}{50} = 0.06$	B1 [1]	CAO (aef)	
	(i)	(B)	$P(\text{Watched one or two}) = \frac{33+12+21+14+3+65}{250}$  $= \frac{148}{250} = \frac{74}{125} = 0.592$	M1  A1 [2]	OR: $\frac{250 - (64 + 38)}{250} =$  CAO (aef)	For M1 terms must be added with no extra terms (added or subtracted)
	(ii)		$P(\text{Not watched fb watched cyc}) = \frac{15}{67} = 0.224 \quad (0.223880597\dots)$	M1  A1 [2]	CAO (aef)	For denominator of either 67 or 67/250 or 0.268  Allow 0.22 with working

2	(i)	$P(\text{Neither is an ace}) = \left(1 - \frac{4}{52}\right)^2$ $= \frac{2304}{2704} = \frac{144}{169} = 0.852 \text{ (0.8572071...)}$	M1 A1 <b>[2]</b>	For 48/52 oe seen CAO	Allow 0.85 with working
	(ii)	Expected number = $10 \times 0.852 = 8.52$	B1 <b>[1]</b>	FT their (i) if seen	Do <u>not</u> allow whole number final answer even if 8.52 seen first. Allow fractional answer

Question		Answer	Marks	Guidance
3	(i)		<p>G1 G1</p> <p>G1</p> <p>[3]</p>	<p>Do a vertical scan and give:</p> <p>First column Second column</p> <p>Final column</p> <p>Do not award if first two branches missing Branches two and three should come out of 'retest'</p> <p>Allow labels such as A, R, F(Fail) etc All probabilities correct All probabilities correct</p> <p>All probabilities correct</p> <p>If any labels missing or incorrect allow max 2/3 Do not allow misreads here as all FT (eg 0.3 and 0.5 reversed)</p>
	(ii)	$P(\text{Accepted}) = 0.2 + (0.3 \times 0.2) + (0.3 \times 0.3 \times 0.4)$ $= 0.2 + 0.06 + 0.036 = 0.296$	<p>M1</p> <p>A1</p> <p>[2]</p>	<p>For second or third product</p> <p>CAO</p> <p>FT their tree provided correct numbers of terms and correct structure of 3, 3, 2 branches. Allow 37/125 oe</p>
	(iii)	$P(\text{At least one retest given accepted})$ $= \frac{P(\text{At least one retest and accepted})}{P(\text{Accepted})}$ $= \frac{0.3 \times 0.2 + 0.3 \times 0.3 \times 0.4}{0.296} = \frac{0.096}{0.296}$ $= 0.324$	<p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>For numerator</p> <p>For denominator</p> <p>FT their 0.296 and 0.096 Allow 0.32 with working</p> <p>Allow 12/37 oe</p>

Question		Answer	Marks	Guidance
4	(i)	Because $P(L   R) \neq P(L)$	E1  [1]	If two or more methods given and only one correct, do not award the mark  Allow $0.45 \neq 0.15$  Either $P(L \cap R) (= 0.099) \neq P(L) \times P(R)$ , provided 0.099 in (ii)  or $0.099 \neq 0.15 \times 0.22 (= 0.033)$  Look out for complement methods, etc
	(ii)	$P(L \cap R) = P(L   R) \times P(R) = 0.45 \times 0.22 = 0.099$	M1 A1 [2]	For product CAO  Allow if done correctly in part(i) Allow 99/1000
	(iii)		G1  G1  G1  [3]	<p>For two labelled intersecting circles, provided no incorrect labelling.</p> <p>For at least 2 correct probabilities. FT their <math>P(L \cap R)</math> from part (ii) provided <math>\leq 0.15</math></p> <p>For remaining probabilities. FT their <math>P(L \cap R)</math> providing probabilities between 0 and 1.</p> <p>Condone labels such as <math>P(L)</math> etc Allow other shapes in place of circles No need for 'box'  FT from 0.033 in (ii) gives 0.117, 0.033, 0.187, 0.663 In general <math>0.15 - x, x, 0.22 - x, 0.63 + x</math> May also see 0.0825, 0.0675, 0.1525, 0.6975</p>

5	(i)	$P(L \cap W) = P(L W) \times P(W) = 0.4 \times 0.07 = 0.028$	M1 A1 [2]	For $P(L W) \times P(W)$ cao	
	(ii)		B1 B1 B1 [3]	For two labelled intersecting circles For at least 2 correct probabilities. For remaining probabilities	FT their 0.028 provided < 0.038
	(iii)	$P(L \cap W) = 0.028, P(L) \times P(W) = 0.038 \times 0.07 = 0.00266$ <p>Not equal so not independent</p>	M1 A1 E1* dep on M1 [3]	For correct use of $P(L) \times P(W)$ If $P(L)$ wrong, max M1A0E0. No marks if $P(W)$ wrong For 0.00266 Allow 'they are dependent' Do not award E1 if $P(L \cap W)$ wrong	Or EG $P(L W) = 0.4, P(L) = 0.038$ Not equal so not independent M1 is for comparing with some attempt at numbers $P(L W)$ with $P(L)$ , A1 for 0.038 If $P(L)$ wrong, max M1A0E0

6	(i)	$\left(\frac{5}{6}\right)^2 \times \frac{1}{6} = \frac{25}{216} (= 0.116)$	M1 M1 A1 <b>[3]</b>	For 5/6 (or 1 – 1/6) seen  For whole product cao	If extra term or whole number factor present give M1M0A0  Allow 0.12 with working
	(ii)	$1 - \left(\frac{5}{6}\right)^{10} = 1 - 0.1615 = 0.8385$	M1   A1 <b>[2]</b>	For $(5/6)^{10}$ (without extra terms)   cao	Allow 0.838 or 0.839 without working and 0.84 with working. For addition $P(X = 1) + \dots + P(X = 10)$ give M1A1 for 0.84 or better, otherwise M0A0

Question		Answer	Marks	Guidance
7	(i)	$P(\text{All blue}) = \frac{30}{50} \times \frac{29}{49} \times \frac{28}{48} = 0.2071$ <p><b>OR</b></p> $\binom{30}{3} / \binom{50}{3} = 4060/19600 = 29/140 = 0.2071$ <p>M2 for the complete method</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>SC2 for P(All red) = 0.0582</p> <p><b>[3]</b></p>	<p>For <math>\frac{30}{50}</math> × (as part of a triple product)</p> <p>For product of other two fractions</p> <p>CAO</p> <p>Allow unsimplified fraction as final answer 24360/117600 oe</p> <p>(30/50)<sup>3</sup> = 0.216 scores M1M0A0  <math>\frac{k}{50} \times \frac{(k-1)}{49} \times \frac{(k-2)}{48}</math> for values of k other than 30 scores M1M0A0  Zero for binomial unless simplifies to (3/5)<sup>3</sup></p> <p>Correct working but then multiplied or divided by some factor scores M1M0A0  Accept 0.21 with working and 0.207 without working  Allow unsimplified fraction as final answer 24360/117600 oe</p>
	(ii)	$P(\text{All red}) = \frac{20}{50} \times \frac{19}{49} \times \frac{18}{48} = 0.0582 \text{ or } \binom{20}{3} / \binom{50}{3} = 0.0582$ <p>P(At least one of each colour)</p> $= 1 - (0.2071 + 0.0582) = 0.7347$ <p>or <math>1 - \left( \frac{29}{140} + \frac{57}{980} \right) = 1 - \frac{260}{980} = 1 - \frac{13}{49} = \frac{36}{49}</math></p> <p><b>OR</b></p> <p>P(2b,1r)+P(1b,2r)</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p><b>[3]</b></p> <p>(M1)</p>	<p>For P(All red)</p> <p>For 1 - (0.2071 + 0.0582)</p> <p>CAO</p> <p>For either <math>\frac{30}{50} \times \frac{29}{49} \times \frac{20}{48}</math>  or <math>\frac{20}{50} \times \frac{19}{49} \times \frac{30}{48}</math></p> <p>SC2 for <math>1 - (30/50)^3 - (20/50)^3 = 1 - 0.216 - 0.064 = 0.72</math>, providing consistent with (i) . If not consistent with (i) M0M0A0</p> <p>Allow 0.73 with working  Allow unsimplified fraction as final answer 86400/117600 oe  Allow M1 for <math>3 \times (30/50)^2 \times (20/50)</math> or <math>3 \times (30/50) \times (20/50)^2</math> and second M1 for sum of both if = 0.72  If not consistent with (i) M0M0A0</p>

Question		Answer	Marks	Guidance
8	(i)	$X \sim B(30, 0.85)$  $P(X = 29) = \binom{30}{29} \times 0.85^{29} \times 0.15^1 = 30 \times 0.0013466 = 0.0404$	M1  M1  A1 <b>[3]</b>	For $0.85^{29} \times 0.15^1 = 0.0013466$  For $\binom{30}{29} \times p^{29} \times q^1$  CAO  With $p + q = 1$  Allow 0.04 w/w If further working (EG $P(X=29) - P(X=28)$ ) give M2A0
	(ii)	$P(X = 30) = 0.85^{30} = 0.0076$ $P(X \geq 29) = 0.0404 + 0.0076 = 0.0480$	M1 M1   A1 <b>[3]</b>	For $0.85^{30}$ For $P(X = 29) + P(X = 30)$ (not necessarily correct, but both attempts at binomial, including coefficient in (i)) CAO  Allow eg $0.04 + 0.0076 = 0.0476$ Allow 0.05 with working
	(iii)	Expected number = $10 \times 0.0480 = 0.480$	M1 A1   <b>[2]</b>	For $10 \times$ their (ii) FT their (ii) but if answer to (ii) leads to a whole number for (iii) give M1A0  <b>provided (ii) between 0 and 1</b> Do not allow answer rounded to 0 or 1.