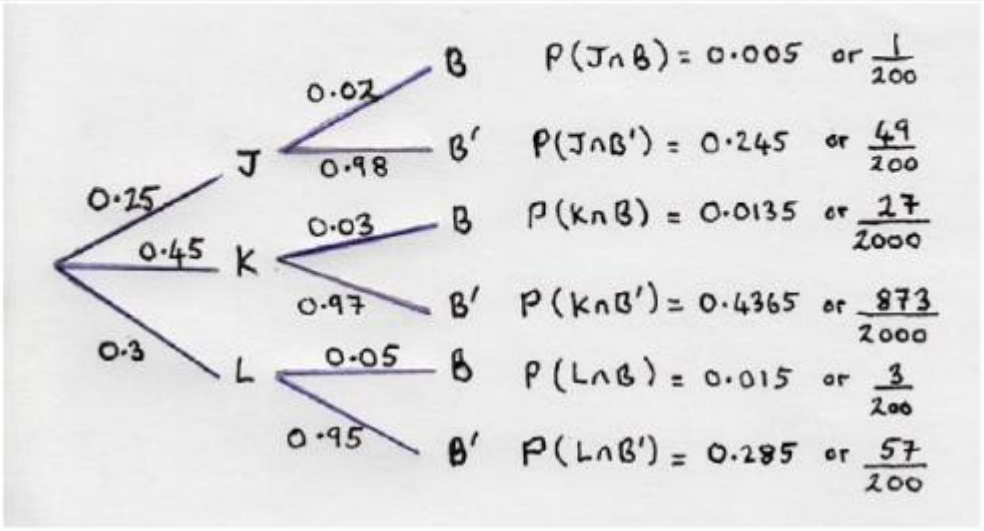
Year 1 Applied Chapter 5: Probability – Exam Questions (Answers)

Q1.

Question	Scheme	Marks
(a)	B, W or T, W [accept $B \cup T, W$ or $B \cap T, W$] [Condone P(B), P(W) etc]	B1
	Since there is no overlap between the events or cannot happen together (o.e.) (Accept comment in context e.g. "no one walks and takes the train")	B1 (2)
(b)	e.g. $P(B)=\frac{9}{25}$, $P(T)=\frac{8}{25}$, $P(B \cap T)=\frac{5}{25}$	M1
	$P(B \cap T) \neq P(B) \times P(T)$ [$0.2 \neq 0.36 \times 0.32 = 0.1152$ o.e.]	M1
	So B and T are not independent	A1cso (3)
(c)	[P(W) =] $\frac{7}{25}$ or 0.28	B1 (1)
(d)	[$P(B \cap T)$ =] $\frac{5}{25}$ or $\frac{1}{5}$ or 0.2	B1 (1)
(e)	[$P(T \mid B)$ =] $\frac{P(T \cap B)}{P(B)} = \frac{\text{"(d)"}}{(5+4)/25}$	M1
	$= \frac{5}{9}$ or 0.$\dot{5}$	A1 (2)
		[9]

	Notes
(a)	1st B1 for a suitable pair. Do not accept universally exclusive pairs such as B and B' etc
	2nd B1 for any correct statement. Accept use of symbols e.g.: $B \cap W = \varnothing$ or $P(T \cap W) = 0$ etc
	But $T \cap W = 0$ is B0 (since it is not a correct statement)
(b)	1st M1 for an attempt at all required probabilities with labels for a suitable test (allow one error). Accept use of A and B as long as they can be identified as B and T by correct probabilities Must be probabilities not integers such as 5, 9, 8 etc for both these M marks
	2nd M1 for $P(B) \times P(T)$ evaluated (correct for their probabilities)
	or $P(B \cap T) \neq P(B) \times P(T)$ stated or implied in symbols or using their probabilities.
	or $P(B \mid T) \neq P(B)$ or $P(T \mid B) \neq P(T)$ stated or implied in symbols or using their probabilities.
	A1 for a conclusion of not independent. Requires all probabilities used to be correct and seen. This A mark is dependent on both Ms
	NB $P(B \mid T)=\frac{5}{8}$ & $P(B)=\frac{9}{25}$ or $P(T \mid B)=\frac{5}{9}$ & $P(T)=\frac{8}{25}$ seen, followed by a correct conclusion scores 3/3
(e)	M1 for a correct ratio of probabilities e.g. $\frac{5/25}{(5+4)/25}$ or $\frac{5}{5+4}$ or
	A correct ratio expression and at least one correct (or correct f.t.) probability substituted.
	A1 for $\frac{5}{9}$ with no incorrect working seen but $\frac{5}{9}$ following from $P(B \mid T)$ is 0/2. $\frac{5}{9}$ alone is 2/2

Q2.

Question Number	Scheme	Marks
(a)		M1 A1 (2)
(b)	0.25×0.98, $= \mathbf{0.245}$ (or exact equiv. e.g. $\frac{49}{200}$)	M1A1 (2)
(c)	$0.25\times0.02+0.45\times0.03+0.3\times0.05$, $= \mathbf{0.0335}$ (or exact equiv. e.g. $\frac{67}{2000}$)	M1A1 (2)
(d)	$[P(J\cup L\mid B)] = \frac{0.25\times0.02+0.3\times0.05}{0.0335}$ or $\frac{0.0335-0.45\times0.03}{0.0335}$ $= 0.5970...$ awrt **0.597** (or $\frac{40}{67}$ or exact equiv.)	M1A1ft A1 (3)

	Notes	Total 9
	Allow fractions or percentages throughout this question	
(a)	Allow 3+6 tree diagram with the 6 correct "end" probs and labels to get 2/2 (1st, 3rd, 5th gets M1) M1 for (3+6) tree drawn with 0.25, 0.45, 0.02, 0.03, 0.05 on correct branches A1 for 0.3, 0.98, 0.97, 0.95 on the correct branches and labels, condone missing B's **Correct answer only scores full marks for parts (b), (c) and (d)** **When using "their probability p" for M1 and A1ft they must have $0 < p < 1$**	
(b)	M1 for $0.25\times$ 'their 0.98' o.e.	
(c)	M1 for $0.25\times$their $0.02+0.45\times$their $0.03+$their $0.3\times$their 0.05 Condone 1 transcription error. Or $1-(0.25\times$their $0.98+0.45\times$their $0.97+$their $0.3\times$their $0.95)$	
(d)	M1 for use of conditional probability with their (c) as denominator. Also exactly 2 products on num' and at least one correct (or correct ft) or their (c) – one of the products from their (c). Ignore an incorrect expression inside their probability statement A1ft for $\frac{0.25\times\text{their }0.02+\text{their }0.3\times\text{their }0.05}{\text{their(c)}}$ or $\frac{\text{their (c)}-0.45\times\text{their }0.03}{\text{their (c)}}$ or $\frac{0.02}{\text{their (c)}}$ A1 awrt 0.597 or exact fraction e.g. $\frac{40}{67}$	

Q3.

Question Number	Scheme	Marks
(a)	$[P(B \cap R') =]$ $\underline{0}$	B1 (1)
(b)	$P(B) = 0.27+0.33 = 0.6$, $P(D) = 0.27 + 0.15 + t$, $P(B \cap D)=0.27$	M1
	$[P(B) \times P(D) = P(B \cap D)$ gives$]$ $0.6 \times (0.42+t) = 0.27$	M1
	$0.42+t = \dfrac{0.27}{0.6}$ or $0.6t = 0.018$	A1
	$t = \underline{0.03}$	A1 (4)
(c)	$[u =]$ $1-(0.6+0.15+t)$	M1
	$u = \underline{0.22}$	A1ft (2)
(d)(i)	$\left[\dfrac{P(D \cap R \cap B)}{P(R \cap B)} =\right] = \dfrac{0.27}{0.27+0.33}$ or $P(D \mid R \cap B) = P(D \mid B) = P(D)$	M1
	$= \underline{0.45}$	A1
(ii)	$\left[\dfrac{P(D \cap [R \cap B'])}{P(R \cap B')} =\right] = \dfrac{0.15}{0.15+u}$	M1
	$= \dfrac{15}{37}$	A1 (4)
(e)	$40 \times$"0.45" and $37 \times "\dfrac{15}{37}"$	M1
	$= \underline{33}$	A1 (2)
		[13 marks]

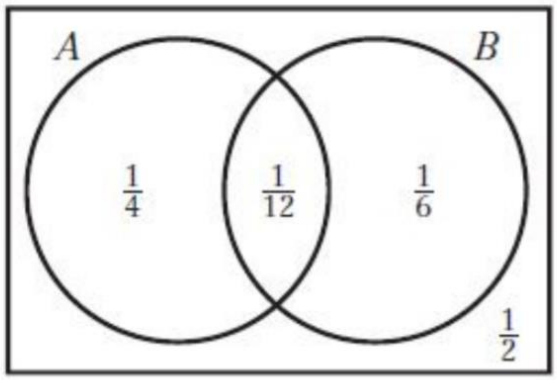
	Notes
(b)	1st M1 for attempting 3 suitable probabilities, one involving t (at least 2 correct) e.g. sight of 0.6, 0.27, 0.42 + t correctly labelled in terms of B,D,R or in a correct equation. May see e.g. $P(B \mid D) = \dfrac{0.27}{0.42+t}$
	2nd M1 for using the independence to form a linear equation in t. ft their probs if stated.
	1st A1 for solving leading to a correct equation as far as $p + t = q$ or $pt = q$
	2nd A1 for 0.03 or exact equivalent
(c)	M1 for a correct expression for u . Allow their t or just letter t in a correct expression
	A1ft for 0.22 (or exact equivalent) or ft their t. i.e. $u = 0.25 - t$ provided u & t are probs
	Can score M1A1ft provided their u + their t = 0.25 where u and t are both in [0, 1]
(d)(i)	M1 for a correct numerical ratio of probabilities
	A1 for 0.45 or exact equivalent (Answer only 2/2)
(ii)	M1 for a correct numerical ratio of probabilities, ft their u, provided u is a probability
	A1 for $\frac{15}{37}$ or $0.\dot{4}0\dot{5}$ or allow awrt 0.41 following a correct expression (Ans only 2/2)
(e)	M1 for a correct method for both 18 and 15 ft their 0.45 and their $\frac{15}{37}$ provided both in [0,1]
	NB $P(D) \times 77$ is M0
	A1 for 33 only
	NB $\frac{27}{33} \times 40 = 32.7\ldots$ which rounds to 33 but scores M0A0. **(Ans only send to review)**

Q4.

a $P(A \text{ and } B) = P(A) + P(B) - P(A \text{ or } B \text{ or both}) = \frac{1}{3} + \frac{1}{4} - \frac{1}{2} = \frac{1}{12}$

$P(A \text{ and not } B) = \frac{1}{3} - \frac{1}{12} = \frac{1}{4}$

$P(B \text{ and not } A) = \frac{1}{4} - \frac{1}{12} = \frac{1}{6}$



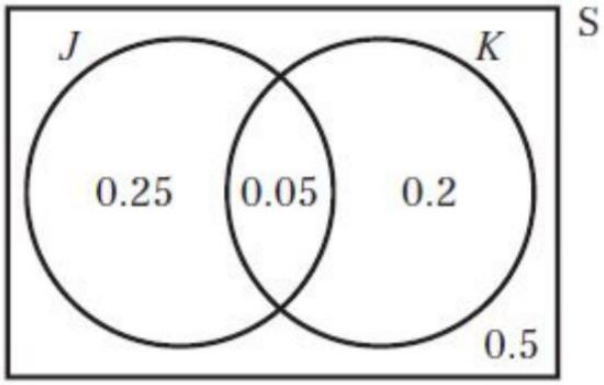
b $P(A \text{ and } B) = \frac{1}{12}$

$P(A) \times P(B) = \frac{1}{3} \times \frac{1}{4} = \frac{1}{12}$

As $P(A \text{ and } B) = P(A) \times P(B)$, A and B are independent events.

Q5.

a



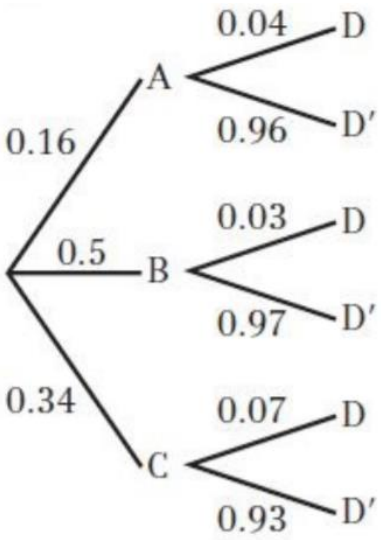
b $P(J \text{ and } K) = 0.05$

$P(J) \times P(K) = 0.3 \times 0.25 = 0.075$

As $P(J \text{ and } K) \neq P(J) \times P(K)$, the events J and K are not independent.

Q6.

a



i $P(B \text{ and defective}) = 0.5 \times 0.03 = 0.015$

ii $P(\text{defective}) = 0.16 \times 0.04 + 0.5 \times 0.03 + 0.34 \times 0.07 = 0.0452$