Statistics 1 Probability Exam Questions Pack B

All questions taken from SpecB S1

5 Shahid, Tracy and Dwight are friends who all have birthdays during January. Assuming that each friend's birthday is equally likely to be on any one of the 31 days of January, find the probability that:

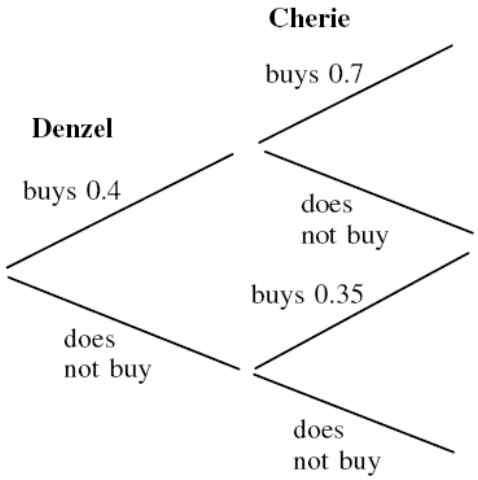
(a) Shahid's birthday is on January 3rd; *(1 mark)*

(b) both Shahid's and Tracy's birthdays are on January 3rd; *(2 marks)*

(c) all three friends' birthdays are on the same day; *(2 marks)*

(d) all three friends' birthdays are on different days. *(3 marks)*

6 Denzel and Cherie are friends who often go to the cinema together. On such visits there is a probability of 0.4 that Denzel will buy popcorn. The probability that Cherie will buy popcorn is 0.7 if Denzel buys popcorn and 0.35 if he does not.



(a) When Denzel and Cherie visit the cinema together:

(i) find the probability that both buy popcorn; *(2 marks)*

(ii) show that the probability that neither buys popcorn is 0.39; *(2 marks)*

(iii) find the probability that exactly one of them buys popcorn. *(2 marks)*

(b) Sohaib sometimes joins Denzel and Cherie on their cinema visits. On these occasions, the probability that Sohaib buys popcorn is 0.55 if both Denzel and Cherie buy popcorn and 0.25 if exactly one of Denzel and Cherie buys popcorn.

Find the probability that when Denzel, Cherie and Sohaib visit the cinema together:

(i) all three buy popcorn; *(2 marks)*

(ii) Cherie and Sohaib buy popcorn but Denzel does not. *(2 marks)*

7 Maurice works at home. At 2 pm he decides to take a break to buy a copy of the Chronicle newspaper. There are three nearby newsagents: Arif, Bob and Carol. However by 2 pm they may have sold all their Chronicles and so have none available. The independent probabilities that they have a Chronicle available at 2 pm are:

Arif 0.4 Bob 0.7 Carol 0.25

(a) State the probability that Bob does not have a Chronicle available at 2 pm. *(1 mark)*

(b) Find the probability that none of the three newsagents has a Chronicle available at 2 pm. *(3 marks)*

(c) (i) Find the probability that Bob does not have a Chronicle available at 2 pm but Arif does.

(ii) Find the probability that Carol does not have a Chronicle available at 2 pm but Arif does. *(3 marks)*

(d) Maurice decides to visit the newsagents in turn until he obtains a Chronicle or until he has visited all three. He tosses a coin. If it lands heads he will visit the three newsagents in the order Bob, Arif, Carol. If it lands tails he will visit them in the order Carol, Arif, Bob.

Find the probability that he will obtain a Chronicle from Arif. *(3 marks)*

7 Following a flood, 120 tins were recovered from Dharmesh's corner shop. Unfortunately the water had washed off all the labels. Of the tins, 50 contained pet food, 20 contained peas, 35 contained beans and the rest contained soup.

(a) Dharmesh selects a tin at random. Find the probability that it:

(i) contains soup; *(1 mark)*

(ii) does not contain pet food. *(1 mark)*

(b) Dharmesh selects two tins at random (without replacement). Find the probability that:

(i) both contain peas; *(2 marks)*

(ii) one contains pet food and the other contains peas. *(3 marks)*

(c) Dharmesh selects three tins at random (without replacement). Find the probability that one contains pet food, one contains peas and one contains beans. *(3 marks)*

(d) Find the probability that Dharmesh will have to open more than two tins before she finds one which does not contain pet food. *(3 marks)*

4 A school employs 75 teachers. The following table summarises their length of service at the school, classified by gender.

	Less than 3 years	**3 years to 8 years**	**More than 8 years**
Female	12	20	13
Male	8	15	7

(a) Find the probability that a randomly selected teacher:

(i) is female;

(ii) is female, given that the teacher has more than 8 years service;

(iii) is female, given that the teacher has less than 3 years service. *(4 marks)*

(b) State, giving a reason, whether or not the event of selecting a female teacher is independent of the event of selecting a teacher with less than 3 years service. *(2 marks)*

(c) Define an event which is mutually exclusive to the event of selecting a female teacher. *(2 marks)*

(d) Three teachers are selected at random without replacement. Find the probability that all three are:

(i) females with less than 3 years service;

(ii) of the same gender. *(5 marks)*

7 Transport inspectors carry out roadside safety tests on lorries.

(a) The probability of a randomly selected lorry failing the test is 0.25. A transport inspector chooses two lorries at random. Find the probability that:

(i) both will fail the test;

(ii) exactly one will pass the test. *(5 marks)*

(b) Of 12 lorries parked outside a transport café, four would fail if tested.

(i) An inspector chooses two of these twelve lorries at random. Find the probability that both will pass the test. *(2 marks)*

(ii) An inspector chooses three of these lorries at random. Find the probability that two will pass the test and one will fail the test. *(3 marks)*

(iii) An inspector chooses four of these lorries at random. Find the probability that at least one will fail the test. *(3 marks)*

3 A rugby club has three categories of membership: adult, social and junior. The number of members in each category, classified by gender, is shown in the table below.

	Adult	**Social**	**Junior**
Female	25	35	40
Male	95	25	80

One member is chosen, at random, to cut the ribbon at the opening of the new clubhouse.

(a) Find the probability that:

(i) a female member is chosen;

(ii) a junior member is chosen;

(iii) a junior member is chosen, given that a female member is chosen. *(4 marks)*

(b) V denotes the event that a female member is chosen.
W denotes the event that an adult member is chosen.
X denotes the event that a junior member is chosen.

For the events V, W and X:

(i) write down two which are mutually exclusive; *(1 mark)*

(ii) find two which are neither mutually exclusive nor independent. Justify your answer. *(3 marks)*

4 George and Jose are friends who play together after school. On fine days, they have a choice of playing computer games or going to the park. The probability that, on any fine day, they will prefer to play computer games is 0.8 for George and, independently, 0.7 for Jose.

(a) Find the probability that on a particular fine day:

(i) both George and Jose prefer to play computer games;

(ii) both George and Jose prefer to go to the park;

(iii) exactly one of George or Jose prefers to go to the park. *(5 marks)*

(b) Tony is another friend who plays with George and Jose after school. The probability that, on a fine day, Tony prefers to play computer games is 0.95 when George prefers to play computer games and 0.15 when George prefers to go to the park. Tony's preferences are independent of those of Jose.

Find the probability that on a particular fine day:

(i) all three boys prefer to play computer games;

(ii) two or more of the boys prefer to play computer games. *(5 marks)*

5 A petrol station sells three types of fuel: lead replacement petrol (LRP), unleaded petrol and diesel. The probability that a randomly selected customer will buy a particular fuel is shown in the table.

Fuel	Probability
LRP	0.15
Unleaded	0.65
Diesel	0.20

(a) Find the probability that of two randomly selected customers:

(i) both will buy diesel;

(ii) exactly one will buy diesel. *(5 marks)*

(b) Find the probability that of three randomly selected customers:

(i) all will buy unleaded;

(ii) exactly two will buy diesel;

(iii) one will buy LRP, one will buy unleaded and one will buy diesel. *(7 marks)*

5 A co-operative owns and runs a shop specialising in organic vegetables. The number of members of the co-operative, classified by age and sex, is given in the table below.

	Age (years)		
	Under 30	**30–49**	**50 and over**
Female	3	6	4
Male	2	8	5

(a) A member is selected at random to represent the co-operative at a meeting. Find the probability that the member selected is:

(i) female and aged under 30; *(1 mark)*

(ii) aged under 30; *(1 mark)*

(iii) aged under 30, given that the member is female. *(2 marks)*

(b) Two members are selected at random to represent the co-operative at another meeting. Find the probability that:

(i) both are females aged 30–49; *(2 marks)*

(ii) one is male and one is female. *(2 marks)*

(c) R denotes the event that the member selected in part (a) is female.

S denotes the event that the member selected in part (a) is aged under 30.

T denotes the event that the member selected in part (a) is aged 30–49.

(i) Write down two of the events R, S and T which are mutually exclusive. *(1 mark)*

(ii) State whether or not events R and S are independent. Justify your answer. *(2 marks)*

7 A bottle bank consists of three containers, one each for green, brown and clear bottles. A notice requests people using the bottle bank to place bottles in the appropriate container. However some mistakes are made. The following table summarises where the last 200 bottles taken to the bank were placed. For example 15 brown bottles were incorrectly placed in the container for green bottles.

		Colour of Bottle		
		Green	**Brown**	**Clear**
Container	**Green**	85	15	5
	Brown	4	45	6
	Clear	1	5	34

(a) One of the 200 bottles is chosen at random.

Find the probability that the chosen bottle is:

(i) green and correctly placed in the green container;

(ii) placed in the correct container;

(iii) placed in the correct container given that the bottle is clear. *(5 marks)*

(b) Three of the 200 bottles are chosen at random without replacement.

Find the probability that:

(i) the first bottle chosen is green;

(ii) all are green;

(iii) two are green and one is brown. *(8 marks)*

Statistics 1 Probability Exam Questions Pack B Mark Scheme

5(a)	$\frac{1}{31}$ or 0.0323	B1	1	0.0322 – 0.0323 any correct form
(b)	$\left(\frac{1}{31}\right)^2 = \frac{1}{961}$ or 0.00104	M1 A1	2	0.001 – 0.00105 any correct form
(c)	$\left(\frac{1}{31}\right)^2 = \frac{1}{961}$ or 0.00104	M1 A1	2	0.001 – 0.00105 any correct form
(d)	$\frac{30}{31}\times\frac{29}{31}=\frac{870}{961}$	M1		method – allow $\left(\frac{30}{31}\right)^2$
		M1		completely correct method
	= 0.905	A1	3	0.904 – 0.906 any correct form
	Total		**8**	

6(a) **(i)**	$0.4 \times 0.7 = 0.28$	M1 A1	2	Method 0.28 cao
(ii)	$(1 - 0.4)(1 - 0.35) = 0.39$	M1 A1	2	Method (answer given) 0.39 cao
(iii)	$1 - 0.28 - 0.39 = 0.33$	M1 A1	2	Method 0.33 cao
(b)(i)	$0.4 \times 0.7 \times 0.55 = 0.154$	M1 A1	2	Method 0.154 cao
(ii)	$0.6 \times 0.35 \times 0.25 = 0.0525$	M1 A1	2	Method 0.0525 (0.052 – 0.053)
	Total		**10**	

7(a)	0.3	B1	1	0.3 cao
(b)	$0.6 \times 0.3 \times 0.75 = 0.135$	M1 m1 A1	3	3 probabilities multiplied Correct method 0.135 cao
(c)(i)	$0.4 \times 0.3 + 0.12$	M1 A1		method – may be earned in (ii) 0.12 cao
(ii)	$0.75 \times 0.4 = 0.3$	A1	3	0.3 cao
(d)	$0.5 \times 0.12 + 0.5 \times 0.3 = 0.21$	M1 m1 A1	3	Use of 0.5 Correct method 0.21 cao
	Total		**10**	

7(a)(i)	$\frac{1}{8}=0.125$	B1		cao acf
(ii)	$\frac{7}{12}=0.583$	B1	2	0.583 (0.583 – 0.584) acf
(b)(i)	$\frac{20}{120}\times\frac{19}{119}=\frac{19}{714}=0.0266$	M1 A1	 2	Method – allow with replacement 0.02655-0.02665 acf
(ii)	$2\times\frac{50}{120}\times\frac{20}{119}=\frac{50}{357}=0.140$	B1 M1 A1	 3	2 Method – allow with replacement, 2 not required = 0.1395-0.1405 acf
(c)	$6\times\frac{50}{120}\times\frac{20}{119}\times\frac{35}{118}=\frac{125}{1003}=0.125$	B1 M1 A1	 3	6 (allow 3) Correct method – allow with replacement; disallow 3 0.124-0.125 acf
(d)	$\frac{50}{120}\times\frac{49}{119}=\frac{35}{204}=0.172$	M1 m1 A1	 3	Method – allow with replacement Completely correct method 0.171-0.172 acf
	Total		**13**	

4(a)(i)	P(female) = 45/75 = 0.6	M1		
(ii)	P(female|>8) = 13/20 = 0.65	M1		
(iii)	P(female|<3) = 12/20 = 0.6	M1 A1	 4	 acf
(b)	Independent P(female)=P(female|<3)	M1 A1	 2	comparison of P(female) with P(female|<3) or P(<3) with P(<3|female) or P(female) × P(<3|female) with P(female&<3) orP(<3) × P(female|<3) with P(female&<3) correct conclusion from correct probabilities
(c)	selecting a male teacher	B2,1	2	any mutually exclusive event
(d)(i)	$\frac{12}{75}\times\frac{11}{74}\times\frac{10}{73}=0.00326$	M1 A1		method- allow with replacement 0.00326 (0.00325 ~ 0.0033) or $\frac{44}{13505}$ acf
(ii)	$\frac{45}{75}\times\frac{44}{74}\times\frac{43}{73}+\frac{30}{75}\times\frac{29}{74}\times\frac{28}{73}=0.270$	M1 M1 A1	 5	attempt at P(all female) + P(all male) method for P(all female) and P(all male) - allow with replacement 0.270 (0.2695 ~ 0.271) or $\frac{730}{2701}$ acf
	Total		**13**	

7(a)(i)	$\frac{85}{200}=0.425$	B1		cao acf
(ii)	$\frac{164}{200}=0.820$	M1 A1		Method cao acf
(iii)	$\frac{34}{45}=0.756$	M1 A1	5	$0.756\ \ (0.755-0.756)$
(b)(i)	$\frac{90}{200}=0.450$	M1 A1		 cao acf
(ii)	$\frac{90\times89\times88}{(200\times199\times198)}=0.0894$	M1 m1 A1		Allow with replacement Completely correct method $0.0894(0.0894-0.0895)$ acf
(iii)	$\frac{3\times90\times89\times65}{(200\times199\times198)}=0.198$	B1 M1 A1	 8	For 3 Allow 6, allow with replacement $0.198(0.1975-0.199)$acf
	Total		**13**	

3(a)(i)	$\frac{1}{3}$ (0.33 or better)	M1		Method
(ii)	0.4	M1		Method
(iii)	0.4	M1 A1	 4	Clearly incorrect method M0 A1 all answers acf
(b)(i)	W,X	B1	1	W,X
(ii)	V,W Not mutually exclusive – same member may be female and adult Not independent $P(V \mid W) = \frac{5}{24}$ $\neq P(V)(\frac{1}{3})$	B1 E1 E1	 3	V,W Reason not mutually exclusive – can be obtained for V, X $P(V \mid W) \neq P(V)$
	Total		**8**	

4(a)(i)	$0.8 \times 0.7 = 0.56$	B1		0.56 cao
(ii)	$0.2 \times 0.3 = 0.06$	M1 A1		Method 0.06 cao
(iii)	$0.8 \times 0.3 + 0.2 \times 0.7 = 0.38$ (or $1 - 0.56 - 0.06 = 0.38$)	M1 A1	 5	Method - allow small slip 0.38 cao
(b)(i)	$0.8 \times 0.7 \times 0.95 = 0.532$	B1		0.532 cao
(ii)	$0.8 \times 0.3 \times 0.95 + 0.2 \times 0.7 \times 0.15 \ldots$ $\ldots + 0.8 \times 0.7 \times 0.05 + 0.532 = 0.809$	M1 M1 m1 A1	 5	Attempt at P(2) + P(3) or equivalent Reasonable attempt at evaluating P(2) (or P(1) if relevant) Completely correct method 0.809 cao
	Total		**10**	

5(a)(i)	$0.2\times0.2=0.04$	M1 A1		Method 0.04 cao acf
(ii)	$2\times0.2\times0.8=0.32$	B1 M1 A1	 5	2 0.2×0.8 used 0.32 cao acf
(b)(i)	$0.65^3=0.275$	B1		0.275 (0.274 to 0.275) acf
(ii)	$3\times0.2^2\times0.8=0.096$	B1 M1 A1	 	3 $0.2^2\times0.8$ 0.096 cao acf
(iii)	$6\times0.15\times0.65\times0.2=0.117$	B1 M1 A1	 7	6 Correct method (allow 3 instead of 6) 0.117 cao acf
	Total		**12**	

5(a)(i)	$\frac{3}{28}=0.107$	M1	1	
(ii)	$\frac{5}{28}=0.179$	M1	1	
(iii)	$\frac{3}{13}=0.231$	M1 A1	 2	$0.107\left(0.1065 \text{ to } 0.1075\right)$ $0.231\left(0.23 \text{ to } 0.231\right)$ $0.179\left(0.178 \text{ to } 0.179\right)$ all acf
(b)(i)	$\frac{6}{28}\times\frac{5}{27}=0.0397$	M1 A1	 2	allow with replacement 0.0397 (0.0396 to 0.04) acf
(ii)	$2\times\frac{15}{28}\times\frac{13}{27}=0.516$	M1 A1	 2	allow with replacement 0.516 (0.516 to 0.52) acf
(c)(i)	S,T	B1	1	S, T cao
(ii)	$P(S)\,P(S)\neq P(S\mid R)$ $(0.179\neq0.231)$ No **or** $P(R).P(S)\neq P(R\cap S)$ $\frac{13}{28}\cdot\frac{5}{28}=0.0829\neq\frac{3}{28}=0.107$ **or** $P(R)\neq P(R\mid S)$ $\left(\frac{13}{28}\neq\frac{3}{5}\right)$	M1 A1	 2	Reason No - needs numerical support
	Total		**11**	

7(a)(i)	$0.25\times0.25=0.0625$	M1 A1		Method $0.0625\ (0.062-0.063)$
(ii)	$2\times0.25\times0.75=0.375$	M1 M1 A1	 5	2 0.25×0.75 0.375 cao acf
(b)(i)	$\frac{8}{12}\times\frac{7}{11}=0.424\left(\frac{14}{33}\right)$	M1 A1	 2	Method – allow with replacement $0.424(0.424-0.425)$ acf
(ii)	$3\times\frac{8}{12}\times\frac{7}{11}\times\frac{4}{10}=0.509\left(\frac{28}{55}\right)$	M1 M1 A1	 3	3 $\frac{8}{12}\times\frac{7}{11}\times\frac{4}{10}$ $0.509\ (0.509-0.51)$ acf
(iii)	$1-\frac{8}{12}\times\frac{7}{11}\times\frac{6}{10}\times\frac{5}{9}=0.859\ \left(\frac{85}{99}\right)$	M1 m1 A1	 3	$1-P(0)$ or equivalent correct method $0.859(0.858-0.86)$ acf
	Total		**13**	