2.7 Statistics: Probability Depth

EDEXCEL 9MA0 · Calculator allowed · about 230 minutes · Write-in edition

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

A-Level Statistics: Probability Depth Practice

Original material written for Revision Library, styled on Edexcel AS/A-level Mathematics (9MA0) Statistics content.

This pack extends core probability skills to full A-level depth: Venn diagrams and set notation for two and three events, tree diagrams for dependent and independent trials, conditional probability, testing and proving independence algebraically, and probability models involving an unknown to be found from a given equation, including quadratics arising from probability statements. All contexts and figures are original.

1 For two events C and D, P(C) = 0.4, P(D) = 0.3 and P(C or D) = 0.58.

(a) Determine, showing your working, whether C and D are independent. **(3)**

(b) State the value of P(D | C). **(1)**

(Total for Question 1 is 4 marks)

2 At a college with 200 students in total, E is the event that a randomly chosen student studies Economics and B is the event that a randomly chosen student studies Business. It is known that 84 students study Economics, 90 students study Business, and 37 students study both Economics and Business.

(a) Find the number of students who study neither Economics nor Business. **(2)**

(b) Find P(not E and B), the probability that a randomly chosen student studies Business but not Economics. **(2)**

(c) Find P(E | B). **(2)**

(Total for Question 2 is 6 marks)

3 A gym in Cardiff has 120 members. Y is the event that a randomly chosen member attends yoga classes and P is the event that a randomly chosen member attends Pilates classes. Of the 120 members: 28 attend yoga only, 34 attend Pilates only, 22 attend both yoga and Pilates, and 36 attend neither.

(a) Find P(Y). **(1)**

(b) Find P(Y | P). **(2)**

(c) Find P(P | not Y). **(2)**

(d) Determine, showing your working, whether Y and P are independent. **(2)**

(Total for Question 3 is 7 marks)

4 A bag contains 9 counters: 5 red and 4 blue. Two counters are drawn at random from the bag, one after another, without replacement.

(a) Find the probability that both counters drawn are red. **(2)**

(b) Find the probability that exactly one of the two counters drawn is red. **(3)**

(c) Given that the first counter drawn is blue, find the probability that the second counter drawn is red. **(2)**

(Total for Question 4 is 7 marks)

5 For events F and G, P(F) = 0.6, P(G|F) = 0.25 and P(G|not F) = p, where p is a constant. It is given that P(G) = 0.34.

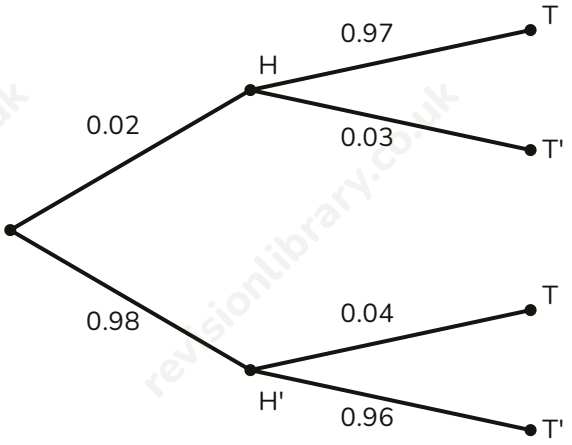
(a) Find the value of p. **(3)**

(b) Find P(F | G). **(3)**

(c) Find P(not F | not G). **(3)**

(Total for Question 5 is 9 marks)

6 A screening test is used to detect a medical condition in a large population, in which 2% of people have the condition. Let H be the event that a randomly chosen person has the condition, and T be the event that the test gives a positive result. If a person has the condition, the test gives a positive result with probability 0.97. If a person does not have the condition, the test still incorrectly gives a positive result with probability 0.04.



(a) State one assumption needed for the tree diagram model above to be valid. **(1)**

(b) Find P(T). **(3)**

(c) Find the probability that a randomly selected person does not have the condition, given that their test result is positive. **(4)**

(d) Comment on the usefulness of this test as a diagnostic tool, with reference to your answer to part (c). **(3)**

(Total for Question 6 is 11 marks)

7 A bag contains 6 red counters and 8 blue counters. Two counters are taken at random from the bag, one after the other, without replacement.

(a) Draw a tree diagram, labelling each branch with its probability, and state the probability that both counters are red. **(4)**

(b) Find the probability that the two counters are the same colour. **(2)**

(c) Given that the two counters are different colours, find the probability that the first counter was red. **(2)**

(Total for Question 7 is 8 marks)

8 119 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 5, 19, 10
Right-handed: 37, 20, 28

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

.....

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

.....

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

.....

(Total for Question 8 is 6 marks)

9 The events A and B are independent, with P(A) = 1/3 and P(B) = 2/7.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 2/7 and P(C or D) = 11/21. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 9 is 10 marks)

10 A bag contains 5 red counters and 5 blue counters. Two counters are taken at random from the bag, one after the other, without replacement.

(a) Draw a tree diagram, labelling each branch with its probability, and state the probability that both counters are red. **(4)**

(b) Find the probability that the two counters are the same colour. **(2)**

(c) Given that the two counters are different colours, find the probability that the first counter was red. **(2)**

(Total for Question 10 is 8 marks)

11 124 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 12, 30, 38
Right-handed: 25, 6, 13

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 11 is 6 marks)

12 A bag contains 4 red counters and 6 blue counters. Two counters are taken at random from the bag, one after the other, without replacement.

(a) Draw a tree diagram, labelling each branch with its probability, and state the probability that both counters are red. **(4)**

(b) Find the probability that the two counters are the same colour. **(2)**

(c) Given that the two counters are different colours, find the probability that the first counter was red. **(2)**

(Total for Question 12 is 8 marks)

13 The events A and B are independent, with P(A) = 1/3 and P(B) = 2/3.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 2/3 and P(C or D) = 7/9. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 13 is 10 marks)

14 184 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:

Sport: Swimming, Tennis, Golf

Left-handed: 39, 33, 23

Right-handed: 40, 22, 27

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 14 is 6 marks)

15 In a survey of 20 students, 9 study French (F) and 9 study Spanish (S). 3 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 15 is 9 marks)

16 168 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 29, 20, 26
Right-handed: 36, 33, 24

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 16 is 6 marks)

17 In a survey of 20 students, 8 study French (F) and 7 study Spanish (S). 3 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 17 is 9 marks)

18 170 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 12, 37, 40
Right-handed: 38, 20, 23

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 18 is 6 marks)

19 In a survey of 100 students, 8 study French (F) and 9 study Spanish (S). 3 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 19 is 9 marks)

20 The events A and B are independent, with P(A) = 1/5 and P(B) = 2/3.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 2/3 and P(C or D) = 11/15. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 20 is 10 marks)

21 The events A and B are independent, with P(A) = 2/5 and P(B) = 3/8.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 3/8 and P(C or D) = 5/8. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 21 is 10 marks)

22 In a survey of 100 students, 47 study French (F) and 48 study Spanish (S). 19 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 22 is 9 marks)

23 A machine in a factory produces electronic components. Each component produced is faulty, independently of all other components, with probability 0.04. A random sample of 3 components is checked.

(a) Find the probability that exactly one of the three components is faulty. **(3)**

(b) Find the probability that at least one of the three components is faulty. **(3)**

(c) State the probability that none of the three components is faulty. **(1)**

(d) Given that at least one of the three components is faulty, find the probability that exactly one of the three components is faulty. **(2)**

(Total for Question 23 is 9 marks)

Mark scheme · 2.7 Statistics: Probability Depth

Question 1

(a) P(C and D) = P(C) + P(D) - P(C or D) **M1**

(a) P(C and D) = 0.12, and P(C) x P(D) = 0.4 x 0.3 = 0.12 **A1**

(a) cso: since P(C and D) = P(C) x P(D) (both equal 0.12), C and D are independent **A1**

(a) Answer: Independent, since P(C and D) = 0.12 = P(C) x P(D)

(b) cao 0.3, using independence from part (a) so P(D | C) = P(D) **B1ft**

(b) Answer: P(D | C) = 0.3

Question 2

(a) n(E or B) = 84 + 90 - 37 **M1**

(a) cao 63, from 200 - 137 **A1**

(a) Answer: 63 students study neither Economics nor Business

(b) n(B) - n(E and B) = 90 - 37 **M1**

(b) cao 53/200 (= 0.265) **A1**

(b) Answer: P(not E and B) = 53/200 = 0.265

(c) n(E and B) / n(B), oe **M1**

(c) cao 37/90 (awrt 0.411) **A1**

(c) Answer: P(E | B) = 37/90 (awrt 0.411)

Question 3

(a) cao 50/120 (= 5/12, awrt 0.417) **B1**

(a) Answer: P(Y) = 5/12 (awrt 0.417)

(b) 22/(34+22), oe **M1**

(b) cao 11/28 (awrt 0.393) **A1**

(b) Answer: P(Y | P) = 11/28 (awrt 0.393)

(c) identify n(not Y) = 120 - 50 = 70 and n(P and not Y) = 34 **M1**

(c) cao 17/35 (awrt 0.486) **A1**

(c) Answer: P(P | not Y) = 17/35 (awrt 0.486)

(d) compute P(Y) x P(P) = (5/12) x (7/15), using P(P) = 56/120 = 7/15 **M1**

(d) cso: P(Y) x P(P) = 7/36 (awrt 0.194), which does not equal P(Y and P) = 11/60 (awrt 0.183), so Y and P are not independent **A1**

(d) Answer: Not independent, since P(Y)P(P) = 7/36 (awrt 0.194) not equal to P(Y and P) = 11/60 (awrt 0.183)

Question 4

(a) (5/9) x (4/8), oe **M1**

(a) cao 5/18 (awrt 0.278) **A1**

(a) Answer: P(both red) = 5/18 (awrt 0.278)

(b) P(red then blue) = (5/9) x (4/8), oe **M1**

(b) P(blue then red) = (4/9) x (5/8), oe, and adding the two paths **M1**

(b) cao 5/9 (awrt 0.556) **A1**

(b) Answer: P(exactly one red) = 5/9 (awrt 0.556)

(c) identify the remaining counters after one blue is removed: 5 red and 3 blue (8 left) **M1**

(c) cao 5/8 (= 0.625) **A1**

(c) Answer: P(second red | first blue) = 5/8 (= 0.625)

Question 5

(a) P(F and G) = P(F) x P(G|F) = 0.6 x 0.25 = 0.15 **M1**

(a) use P(G) = P(F and G) + P(not F) x p, i.e. 0.34 = 0.15 + 0.4p **M1**

(a) cao p = 0.475 **A1**

(a) Answer: p = 0.475

(b) identify P(F and G) = 0.15 (ft from a) **M1**

(b) divide by P(G) = 0.34 **M1**

(b) cao 15/34 (awrt 0.441) **A1**

(b) Answer: P(F | G) = 15/34 (awrt 0.441)

(c) P(F or G) = P(F) + P(G) - P(F and G) = 0.6 + 0.34 - 0.15 = 0.79, then P(not F and not G) = 1 - 0.79 **M1**

(c) P(not G) = 1 - 0.34 = 0.66, then divide: 0.21/0.66 **M1**

(c) cao 7/22 (awrt 0.318) **A1**

(c) Answer: P(not F | not G) = 7/22 (awrt 0.318)

Question 6

(a) e.g. whether one person has the condition (or tests positive) is independent of whether any other person has the condition (or tests positive), oe; or the given sensitivity and false-positive rate apply equally to every person tested, oe **B1**

(a) Answer: For example: the test result for one person is independent of the test result for any other person

(b) P(H) x P(T|H) = 0.02 x 0.97 **M1**

(b) P(not H) x P(T|not H) = 0.98 x 0.04, and add the two products **M1**

(b) cao 0.0586 **A1**

(b) Answer: P(T) = 0.0586

(c) identify P(not H and T) = 0.0392 **M1**

(c) divide by P(T), following through from part (b) **M1ft**

(c) 0.0392/0.0586 or exact fraction 196/293 **A1**

(c) awrt 0.669 **A1**

(c) Answer: P(not H | T) = 196/293 (awrt 0.669)

(d) despite a positive result, there is still a probability of about 0.669 (roughly two out of three) that the person does not have the condition, oe **B1**

(d) this is because the condition is rare (only 2% prevalence), so false positives from the large healthy population outnumber true positives from the small group who have the condition, oe **B1**

(d) conclusion: a single positive result alone is not sufficient to diagnose the condition; further/confirmatory testing would be needed, oe **B1**

(d) Answer: The test is not very reliable on its own for a rare condition: a positive result still leaves about a 0.669 chance the person is unaffected, because far more healthy people are tested than affected people, so their false positives dominate; confirmatory testing is needed

Question 7

(a) first branches 3/7 (red) and 4/7 (blue) **B1**

(a) second branches 5/13, 8/13 after red; 6/13, 7/13 after blue **B1**

(a) P(RR) = 3/7 x 5/13 **M1**

(a) 15/91 **A1**

(a) Answer: 15/91

(b) P(RR) + P(BB) **M1**

(b) 43/91 **A1**

(b) Answer: 43/91

(c) conditional probability: P(RB)/P(different) **M1**

(c) 1/2 **A1**

(c) Answer: 1/2

Question 8

(a) tennis total = 19 + 20 **M1**

(a) 39/119 = 39/119 **A1**

(a) Answer: 39/119

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 19/39 = 19/39 **A1**

(b) Answer: 19/39

(c) left-handed swimmers / all left-handed members **M1**

(c) 5/34 = 5/34 **A1**

(c) Answer: 5/34

Question 9

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 2/21 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 11/21 **A1**

(a) Answer: P(A and B) = 2/21, P(A or B) = 11/21

(b) forms p + 2/7 - 2/7p = 11/21 **M1**

(b) rearranges: p(1 - 2/7) = 5/21 **M1**

(b) P(C) = 1/3 **A1**

(b) Answer: P(C) = 1/3

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 1/3 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 1/3

Question 10

(a) first branches 1/2 (red) and 1/2 (blue) **B1**

(a) second branches 4/9, 5/9 after red; 5/9, 4/9 after blue **B1**

(a) P(RR) = 1/2 x 4/9 **M1**

(a) 2/9 **A1**

(a) Answer: 2/9

(b) P(RR) + P(BB) **M1**

(b) 4/9 **A1**

(b) Answer: 4/9

(c) conditional probability: P(RB)/P(different) **M1**

(c) 1/2 **A1**

(c) Answer: 1/2

Question 11

(a) tennis total = 30 + 6 **M1**

(a) 36/124 = 9/31 **A1**

(a) Answer: 9/31

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 30/36 = 5/6 **A1**

(b) Answer: 5/6

(c) left-handed swimmers / all left-handed members **M1**

(c) 12/80 = 3/20 **A1**

(c) Answer: 3/20

Question 12

(a) first branches 2/5 (red) and 3/5 (blue) **B1**

(a) second branches 1/3, 2/3 after red; 4/9, 5/9 after blue **B1**

(a) P(RR) = 2/5 x 1/3 **M1**

(a) 2/15 **A1**

(a) Answer: 2/15

(b) P(RR) + P(BB) **M1**

(b) 7/15 **A1**

(b) Answer: 7/15

(c) conditional probability: P(RB)/P(different) **M1**

(c) 1/2 **A1**

(c) Answer: 1/2

Question 13

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 2/9 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 7/9 **A1**

(a) Answer: P(A and B) = 2/9, P(A or B) = 7/9

(b) forms p + 2/3 - 2/3p = 7/9 **M1**

(b) rearranges: p(1 - 2/3) = 1/9 **M1**

(b) P(C) = 1/3 **A1**

(b) Answer: P(C) = 1/3

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 1/3 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 1/3

Question 14

(a) tennis total = 33 + 22 **M1**

(a) 55/184 = 55/184 **A1**

(a) Answer: 55/184

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 33/55 = 3/5 **A1**

(b) Answer: 3/5

(c) left-handed swimmers / all left-handed members **M1**

(c) 39/95 = 39/95 **A1**

(c) Answer: 39/95

Question 15

(a) F only = 9 - 3 **M1**

(a) F only 6, S only 6, both 3 **A1**

(a) neither = 20 - 6 - 6 - 3 = 5 **A1**

(a) Answer: F only 6, S only 6, both 3, neither 5

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 3/4 **A1**

(b) Answer: 3/4

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 1/3 **A1**

(c) Answer: 1/3

(d) compares P(F) x P(S) = 81/400 with P(F and S) = 3/20 **M1**

(d) not independent **A1**

(d) Answer: not independent

Question 16

(a) tennis total = 20 + 33 **M1**

(a) 53/168 = 53/168 **A1**

(a) Answer: 53/168

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 20/53 = 20/53 **A1**

(b) Answer: 20/53

(c) left-handed swimmers / all left-handed members **M1**

(c) 29/75 = 29/75 **A1**

(c) Answer: 29/75

Question 17

(a) F only = 8 - 3 **M1**

(a) F only 5, S only 4, both 3 **A1**

(a) neither = 20 - 5 - 4 - 3 = 8 **A1**

(a) Answer: F only 5, S only 4, both 3, neither 8

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 3/5 **A1**

(b) Answer: 3/5

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 3/7 **A1**

(c) Answer: 3/7

(d) compares P(F) x P(S) = 7/50 with P(F and S) = 3/20 **M1**

(d) not independent **A1**

(d) Answer: not independent

Question 18

(a) tennis total = 37 + 20 **M1**

(a) 57/170 = 57/170 **A1**

(a) Answer: 57/170

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 37/57 = 37/57 **A1**

(b) Answer: 37/57

(c) left-handed swimmers / all left-handed members **M1**

(c) 12/89 = 12/89 **A1**

(c) Answer: 12/89

Question 19

(a) F only = 8 - 3 **M1**

(a) F only 5, S only 6, both 3 **A1**

(a) neither = 100 - 5 - 6 - 3 = 86 **A1**

(a) Answer: F only 5, S only 6, both 3, neither 86

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 7/50 **A1**

(b) Answer: 7/50

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 1/3 **A1**

(c) Answer: 1/3

(d) compares P(F) x P(S) = 9/1250 with P(F and S) = 3/100 **M1**

(d) not independent **A1**

(d) Answer: not independent

Question 20

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 2/15 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 11/15 **A1**

(a) Answer: P(A and B) = 2/15, P(A or B) = 11/15

(b) forms p + 2/3 - 2/3p = 11/15 **M1**

(b) rearranges: p(1 - 2/3) = 1/15 **M1**

(b) P(C) = 1/5 **A1**

(b) Answer: P(C) = 1/5

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 1/5 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 1/5

Question 21

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 3/20 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 5/8 **A1**

(a) Answer: P(A and B) = 3/20, P(A or B) = 5/8

(b) forms p + 3/8 - 3/8p = 5/8 **M1**

(b) rearranges: p(1 - 3/8) = 1/4 **M1**

(b) P(C) = 2/5 **A1**

(b) Answer: P(C) = 2/5

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 2/5 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 2/5

Question 22

(a) F only = 47 - 19	**M1**
(a) F only 28, S only 29, both 19	**A1**
(a) neither = 100 - 28 - 29 - 19 = 24	**A1**
(a) Answer: F only 28, S only 29, both 19, neither 24	
(b) P(F union S) = P(F) + P(S) - P(F and S)	**M1**
(b) 19/25	**A1**
(b) Answer: 19/25	
(c) P(F | S) = P(F and S)/P(S)	**M1**
(c) 19/48	**A1**
(c) Answer: 19/48	
(d) compares P(F) x P(S) = 141/625 with P(F and S) = 19/100	**M1**
(d) not independent	**A1**
(d) Answer: not independent	

Question 23

(a) identify 3 ways of choosing which component is faulty, e.g. 3 x 0.04 x 0.96^2	**M1**
(a) correct substitution: 3 x 0.04 x 0.9216	**M1**
(a) awrt 0.111	**A1**
(a) Answer: P(exactly one faulty) = 0.111 (3 s.f.)	
(b) P(none faulty) = 0.96^3	**M1**
(b) 1 - P(none faulty)	**M1**
(b) awrt 0.115	**A1**
(b) Answer: P(at least one faulty) = 0.115 (3 s.f.)	
(c) cao awrt 0.885, following through from part (b) as 1 - their answer	**B1ft**
(c) Answer: P(none faulty) = 0.885 (3 s.f.)	
(d) their (a) / their (b), using the fact that 'exactly one' implies 'at least one'	**M1ft**
(d) awrt 0.959	**A1**
(d) Answer: P(exactly one | at least one) = awrt 0.959	