

Probability

Foundation and Higher tiers

Total marks: 97

Marks

- M** Method mark, for a correct method. It can be implied by a correct answer.
- A** Accuracy mark, for a correct answer. It needs the method mark before it.
- B** A mark for a correct value or statement, with or without working.
- ft** Follow through: the mark is given for using an earlier wrong answer correctly.
- oe** Or equivalent.
- [a, b]** Any value from a to b inclusive.

Questions

Q	Skill	Spec	Tier	Grade	Calculator	Marks
1	The probability scale	P3	Foundation	1	No	2
2	Probability from a spinner	P3 P7	Foundation	2	No	3
3	Listing outcomes	P7	Foundation	2	No	3
4	Sample space diagrams	P7	Foundation	3	No	3
5	Probability from a two-way table	P1 P3	Foundation	3	No	3
6	Probabilities that sum to 1	P4 P3	Foundation	4	No	4
7	Listing outcomes	P7 P6	Foundation	4	No	3
8	Expected outcomes	P2	Foundation	5	No	4
9	Relative frequency and sample size	P5 P3	Common	5	No	4
10	Probability with algebra	P4	Foundation	5	No	4
11	Mutually exclusive events	P4 P7	Foundation	5	No	2
12	Working backwards from a probability	P3 R8	Foundation	6	No	3
13	Probabilities that sum to 1, with decimals	P4	Foundation	2	Yes	3
14	Probabilities that sum to 1	P4	Foundation	2	Yes	4
15	Probability as a percentage	P3	Foundation	2	Yes	3
16	Expected outcomes	P2 P4	Foundation	3	Yes	3

Q	Skill	Spec	Tier	Grade	Calculator	Marks
17	Relative frequency	P3 P2	Foundation	3	Yes	3
18	Probability from a two-way table	P1 P3	Foundation	3	Yes	4
19	Expected outcomes	P2	Foundation	3	Yes	3
20	Judging reliability from the number of trials	P5 P3	Common	3	Yes	3
21	Estimating from a sample	P2 P3	Foundation	4	Yes	4
22	Probabilities that sum to 1	P4	Foundation	4	Yes	3
23	Expected outcomes and cost	P2	Foundation	4	Yes	3
24	Relative frequency	P3 P2	Foundation	5	Yes	3
25	Expected outcomes and money	P2	Foundation	6	Yes	4
26	Missing probabilities, then two independent events	P4 P8	Common	7	Yes	5
27	Forming and solving a quadratic from probabilities	P4 A18	Higher	8	Yes	5
28	At least three, and at least one, from independent events	P8	Common	9	Yes	6
	Total					97

Question 1 P3 · Foundation · Grade 1 · 2 marks

Q	Answer	Mark	Comments
1	A at $\frac{1}{2}$, B at 1, C between $\frac{1}{2}$ and 1 (nearer 1), D at 0	B2	C must be nearer to 1 than to $\frac{1}{2}$. B1 for two or three correct

Question 2 P3 P7 · Foundation · Grade 2 · 3 marks

Q	Answer	Mark	Comments
2(a)	$\frac{3}{8}$	B1	oe, e.g. 0.375 or 37.5%
2(b)	$\frac{5}{8}$	B1	oe
2(c)	Yes with a reason	B1	e.g. there are two 2s and only one 4, or $\frac{2}{8}$ and $\frac{1}{8}$

Question 3 P7 · Foundation · Grade 2 · 3 marks

Q	Answer	Mark	Comments
3(a)	mango and milk mango and yoghurt kiwi and milk kiwi and yoghurt banana and milk banana and yoghurt	B2	all 6 with no repeats. B1 for at least 4 correct
3(b)	$\frac{2}{3}$	B1ft	oe, e.g. $\frac{4}{6}$, ft their list

Question 4 P7 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
4(a)	1: 1, 2, 3, 4 3: 3, 6, 9, 12 5: 5, 10, 15, 20	B2	rows for 1, 3 and 5 on Spinner B. All 7 missing scores correct. B1 for at least 5 correct
4(b)	$\frac{5}{12}$	B1ft	oe, ft their table

Question 5 P1 P3 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
5(a)	Year 10 theatre 25 Year 11: museum 22, zoo 29, total 65 Theatre total 39	B2	B1 for at least three correct
5(b)	$\frac{29}{120}$	B1ft	oe, ft their table

Question 6 P4 P3 · Foundation · Grade 4 · 4 marks

Q	Answer	Mark	Comments
6(a)	$\frac{46}{200}$	M1	oe
	daisy 0.23	A1	
	poppy 0.27	B1ft	ft 0.5 – their daisy
6(b)	70	B1	

Question 7 P7 P6 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
7(a)	Ava and Ben Ava and Cal Ava and Dee Ben and Cal Ben and Dee Cal and Dee	B2	all 6 pairs and no repeats. B1 for at least 4 correct pairs
7(b)	$\frac{1}{2}$	B1ft	oe, ft their list

Question 8 P2 · Foundation · Grade 5 · 4 marks

Q	Answer	Mark	Comments
8	120×0.6 or 72	M1	oe, the money taken
	$120 \div 10$ or 12 (wins of £3) or $\frac{2}{10} \times 120$ or 24 (wins of £1)	M1	oe
	$72 - (12 \times 3 + 24 \times 1)$	M1	oe, or $72 - 60$
	£12	A1	

Question 9 P5 P3 · Common · Grade 5 · 4 marks

Q	Answer	Mark	Comments
9(a)	Asha, with a reason	B1	e.g. she spun it more times
9(b)	$\frac{8+69}{20+300}$	M1	oe
	$\frac{77}{320}$	A1	oe, e.g. 0.240625
9(c)	No, with a reason	B1	e.g. their estimate is close to $\frac{1}{4}$ or 0.25, or 80 reds expected in 320 spins and 77 is close

Question 10 P4 · Foundation · Grade 5 · 4 marks

Q	Answer	Mark	Comments
10(a)	$2x + x + 0.1 + 0.3 = 1$	M1	oe
	0.2	A1	
10(b)	(their $x + 0.1$) $\times 60$	M1	oe
	18	A1ft	ft their x

Question 11 P4 P7 · Foundation · Grade 5 · 2 marks

Q	Answer	Mark	Comments
11(a)	6 is in both events, so it is counted twice	B1	oe, e.g. the events are not mutually exclusive
11(b)	$\frac{2}{3}$	B1	oe, e.g. $\frac{4}{6}$

Question 12 P3 R8 · Foundation · Grade 6 · 3 marks

Q	Answer	Mark	Comments
12	$\frac{3k}{10k-15} = \frac{2}{5}$	M1	oe
	$15k = 20k - 30$ or $k = 6$	M1	oe, or 18 black and 42 white
	60	A1	

Question 13 P4 · Foundation · Grade 2 · 3 marks

Q	Answer	Mark	Comments
13(a)	$1 - (0.38 + 0.415 + 0.07)$ or $1 - 0.865$	M1	oe
	0.135	A1	oe
13(b)	0.585	B1	oe

Question 14 P4 · Foundation · Grade 2 · 4 marks

Q	Answer	Mark	Comments
14(a)	$1 - (0.235 + 0.17 + 0.348)$ or $1 - 0.753$	M1	oe
	0.247	A1	oe
14(b)	car	B1ft	ft their (a)
14(c)	0.405	B1	oe

Question 15 P3 · Foundation · Grade 2 · 3 marks

Q	Answer	Mark	Comments
15(a)	$\frac{87}{248}$	B1	oe, e.g. 0.35...
15(b)	$\frac{97}{248}$ or 0.391...	M1	oe
	39.1	A1	accept 39.1 or [39.11, 39.12]

Question 16 P2 P4 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
16	1 – 0.035 or 0.965, or $0.035 \times 412 (= 14.42)$	M1	oe
	0.965×412 or $412 - 14.42$	M1	oe
	398	A1	accept 397.58 or 397.6, not 397

Question 17 P3 P2 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
17(a)	$\frac{37}{160}$	B1	oe, e.g. 0.23125
17(b)	$90 \times \frac{37}{160}$ or 90×0.23125	M1	oe, ft their (a)
	21	A1	accept 20.8125 or 20.8

Question 18 P1 P3 · Foundation · Grade 3 · 4 marks

Q	Answer	Mark	Comments
18(a)	Under 30: bike 61, total 263 30 and over: car 173, train 129 Car total 257, bike total 112	B2	all 6 correct. B1 for at least three correct
18(b)	$\frac{173}{616}$	M1	oe, ft their table
	28.1	A1	accept 28.1 or [28.08, 28.09]

Question 19 P2 · Foundation · Grade 3 · 3 marks

Q	Answer	Mark	Comments
19(a)	$4 \times 36 \times 0.93$ or 144×0.93	M1	oe
	134	A1	accept 133.92 or 133.9
19(b)	No, with a reason	B1	e.g. it is only an estimate, or the number that grow can vary

Question 20 P5 P3 · Common · Grade 3 · 3 marks

Q	Answer	Mark	Comments
20(a)	only 30 rolls, or not enough rolls	B1	oe, such as he needs to roll it more times
20(b)	$\frac{9+104}{30+600}$ or $\frac{113}{630}$	M1	oe
	0.18	A1	accept [0.179, 0.18]

Question 21 P2 P3 · Foundation · Grade 4 · 4 marks

Q	Answer	Mark	Comments
21(a)	$\frac{9}{150} \times 2400$	M1	oe, or $2400 \div 150 = 16$
	144	A1	
21(b)	$\frac{9}{150} \times 100$	M1	oe, or 5% of 150 = 7.5
	No with 6%	A1	or No with $9 > 7.5$

Question 22 P4 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
22	$1 - (0.226 + 0.302)$ or 0.472	M1	oe
	$0.472 \div 4$ or 0.118	M1	oe, e.g. $x + 3x = 0.472$
	0.354	A1	oe

Question 23 P2 · Foundation · Grade 4 · 3 marks

Q	Answer	Mark	Comments
23	0.042×1850 or 77.7	M1	oe, the expected number of repairs
	their 77.7×13.75	M1	oe, e.g. $1850 \times 13.75 \times 0.042$
	No with £1068.38	A1	accept No with £1068.37 or £1068.4, or No with £1072.50 from 78 repairs

Question 24 P3 P2 · Foundation · Grade 5 · 3 marks

Q	Answer	Mark	Comments
24(a)	$\frac{23}{80}$	B1	oe, e.g. 0.2875
24(b)	$115 \div \frac{23}{80}$ or $115 \div 0.2875$	M1	oe, ft their (a)
	400	A1	

Question 25 P2 · Foundation · Grade 6 · 4 marks

Q	Answer	Mark	Comments
25	0.084×3500 or 294	M1	oe, the expected number of claims
	their 294×186.40 or 54 801.60	M1	oe, the expected cost of claims
	$(25\ 000 + \text{their } 54\ 801.60) \div 3500$ or 22.80045...	M1	oe
	£22.81	A1	not £22.80, which gives a profit below £25 000

Question 26 P4 P8 · Common · Grade 7 · 5 marks

Q	Answer	Mark	Comments
26(a)	$(1 - 0.17 - 0.29 - 0.13) \div 2$ or $0.41 \div 2$	M1	oe, e.g. $f + f + 0.13 = 0.54$
	0.205	A1	
26(b)	one of 0.17^2 , 0.29^2 , 0.335^2 or 0.205^2	M1	oe, ft their (a), blue tit their (a) + 0.13
	$0.17^2 + 0.29^2 + 0.335^2 + 0.205^2$	M1	oe, all four and no others
	0.267	A1	accept 0.26725

Question 27 P4 A18 · Higher · Grade 8 · 5 marks

Q	Answer	Mark	Comments
27(a)	$x^2 + x + 0.71 = 1$	M1	oe
	$\frac{-1 \pm \sqrt{1 + 4 \times 0.29}}{2}$	M1	oe, correct substitution into the formula for $x^2 + x - 0.29 = 0$
	0.235	A1	accept [0.2348, 0.2349], the negative root rejected or not given
27(b)	their $0.235^2 \times 3200$	M1	oe
	176	A1ft	accept [176, 177]

Question 28 P8 · Common · Grade 9 · 6 marks

Q	Answer	Mark	Comments
28(a)	0.915^4 or 0.7009...	M1	oe, all four start
	$4 \times 0.915^3 \times 0.085$ or 0.2605...	M1	oe, exactly three start
	0.961	A1	accept 0.961 or [0.9614, 0.9615]
28(b)	$1 - 0.085^n > 0.99999$ or $0.085^n < 0.00001$	M1	oe, or 0.085^n worked out for a value of n
	$0.085^4 = 0.0000522...$ and $0.085^5 = 0.00000444...$	M1	oe, e.g. $1 - 0.085^4 = 0.99994...$ and $1 - 0.085^5 = 0.999995...$
	5	A1	with both values seen