

4024 Probability Questions

Compiled by ; Mustafa Asif

40. Probability

- calculate the probability of a single event as either a fraction or a decimal
- understand that the probability of an event occurring = $1 -$ the probability of the event not occurring
- understand relative frequency as an estimate of probability
- calculate the probability of simple combined events using possibility diagrams and tree diagrams where appropriate

Probabilities should not be given as ratios.

Problems could be set involving extracting information from tables or graphs.

e.g. $P(\text{blue}) = 0.8$, find $P(\text{not blue})$

e.g. use results of experiments with a spinner to estimate the probability of a given outcome

e.g. use probability to estimate from a population

In possibility diagrams outcomes will be represented by points on a grid and in tree diagrams outcomes will be written at the end of branches and probabilities by the side of the branches.

For understanding

<https://www.youtube.com/watch?v= 2ZXGFEXLlg>

<https://www.youtube.com/watch?v=PGA7PCs2tFI>

<https://www.youtube.com/watch?v=uzkc-qNVoOk>

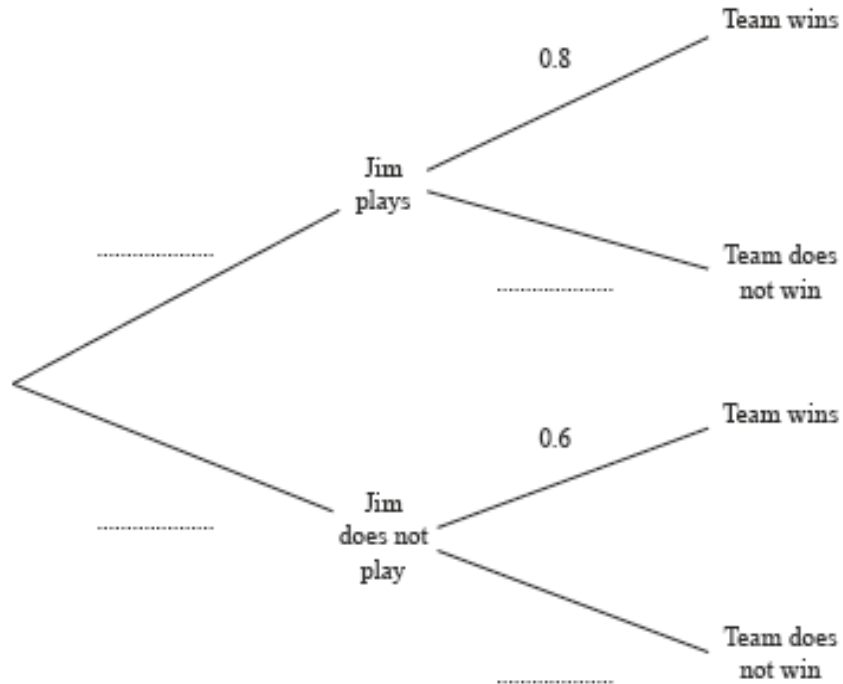
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M/J19/11/Q18

- 1 Jim plays for his local football team.
The probability that Jim plays in the next match is 0.7.

If Jim plays in the match, the probability of his team winning is 0.8.
If Jim does not play in the match, the probability of his team winning is 0.6.

- (a) Complete the tree diagram.



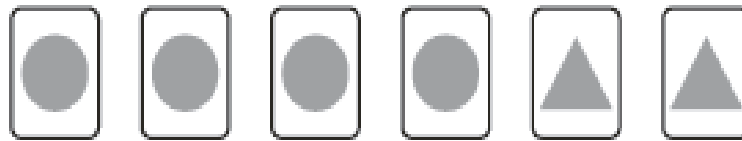
[2]

- (b) Calculate the probability that Jim's team wins their next match.

..... [2]

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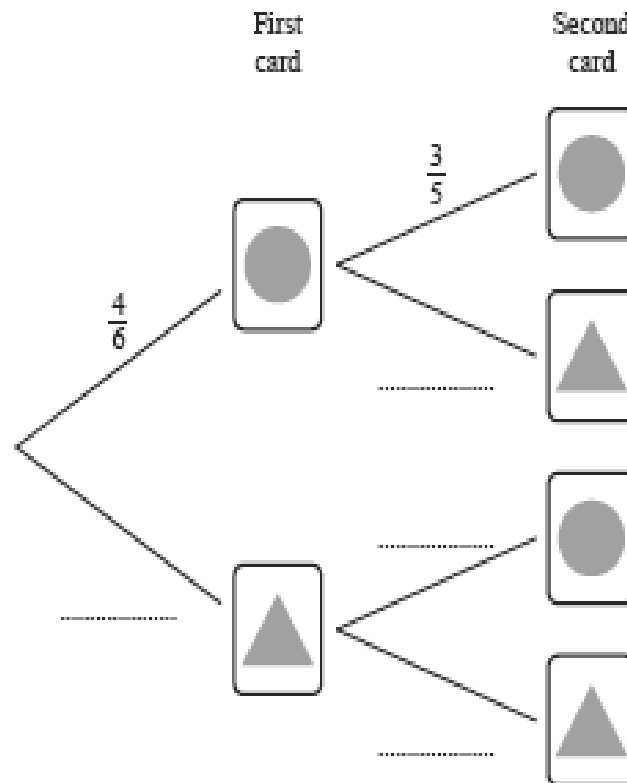
2



Nima has these six cards. Each card has a shape on it.
 She takes two cards at random without replacement.

M/J19/12/Q17

(a) Complete the tree diagram.



[2]

(b) Find the probability that the shapes on Nima's two cards are the same.
 Give your answer as a fraction.

..... [2]

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SM18/21

- 3 A machine puts beads of different colours and sizes into packets.
 The beads are selected at random from a large container and the selection of each bead for a packet is independent of all others.
 The table shows information on the contents of six packets.

Packet	1	2	3	4	5	6	Total
Total number of beads	15	14	19	18	16	18	100
Number of blue beads	6	5	8	6	8	7	

- (a) Calculate the relative frequency of the machine selecting a blue bead.

Answer [1]

- (b) Calculate how many blue beads you would expect in a packet of 30 beads.

Answer [1]

- (c) The probability that the machine selects a red bead is 0.17.

Calculate the probability that the machine does not select a red bead.

Answer [1]

- 4 A five-sided spinner is numbered 1, 2, 3, 4 and 5. O/N18/11/15
 Ashraf spun the spinner 200 times.
 The results are shown in the table.

Number spinner lands on	1	2	3	4	5
Frequency	30	25	50	55	40

- (a) Calculate the relative frequency that the spinner lands on 3.

Answer [1]

- (b) Meriam spins the spinner 20 times.

How many times would you expect the spinner to land on 3?

Answer [1]

- (c) Ashraf claims: "My results show that the spinner is fair".

Is his claim correct?

Give a reason for your answer.

..... because

..... [1]

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5



Bag A



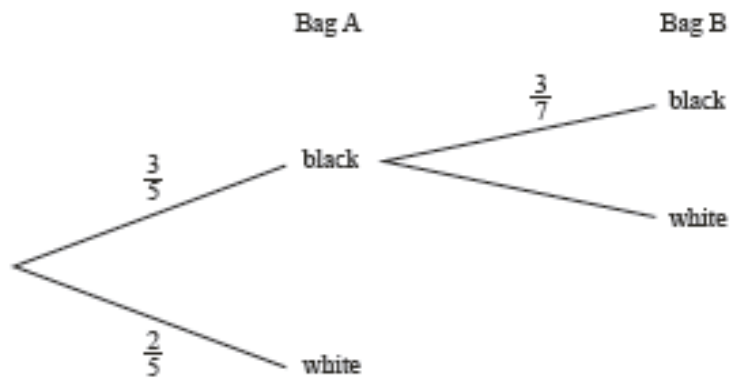
Bag B

Bag A contains 3 black and 2 white beads.
Bag B contains 2 black and 4 white beads.

O/N18/12/17

A bead is chosen, at random, from Bag A and placed in Bag B.
A bead is then chosen, at random, from Bag B.

(a) Complete the tree diagram.



[2]

(b) Find the probability that a black bead is taken from Bag B.

Answer [2]

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- 6 Basia records the colour of 100 cars passing the school gate.
Her results are recorded in the table.

M/J18/11/12

Colour of car	Black	Grey	Red	Blue	Other
Frequency	43	18	12	9	18

- (a) Use Basia's results to estimate the probability that the next car seen is a **blue** car.

Answer [1]

- (b) In the next hour, 500 cars pass the school gate.

Use Basia's results to estimate the number of these cars that are **red**.

Answer [1]

- (c) Colin records the colour of the next 100 cars passing the school gate.
His results are shown in the table below.

Colour of car	Black	Grey	Red	Blue	Other
Frequency	34	10	18	28	10

Use Basia's and Colin's combined results to estimate the number of **red** cars that would be seen when 500 cars pass the school gate.

Answer [1]

- (d) Which of the estimates in **part (b)** or in **part (c)** is likely to be the best?
Give a reason for your decision.

The best estimate is because

..... [1]

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- 7 A dice is thrown 400 times. M/J18/12/12
The results are shown in the table.

Number thrown	1	2	3	4	5	6
Frequency	65	80	70	75	50	60

- (a) Find the relative frequency of throwing the number 2.

Answer [1]

- (b) Imran throws the dice 1000 times.

How many times would you expect the number 2 to be thrown?

Answer [1]

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8

T R I G O N O M E T R Y

Twelve lettered tiles spelling the word TRIGONOMETRY are placed inside a bag.

- (a) A tile is taken at random from the bag. M/J18/21/4

Find the probability that the tile shows a letter R.
Give your answer as a fraction in its simplest form.

Answer [1]

- (b) All the tiles are placed back in the bag, a tile is then taken at random and placed on the table.
A second tile is taken at random and placed to the right of the first tile.
A third tile is taken at random and placed to the right of the second tile.

1st	2nd	3rd
<input type="text"/>	<input type="text"/>	<input type="text"/>

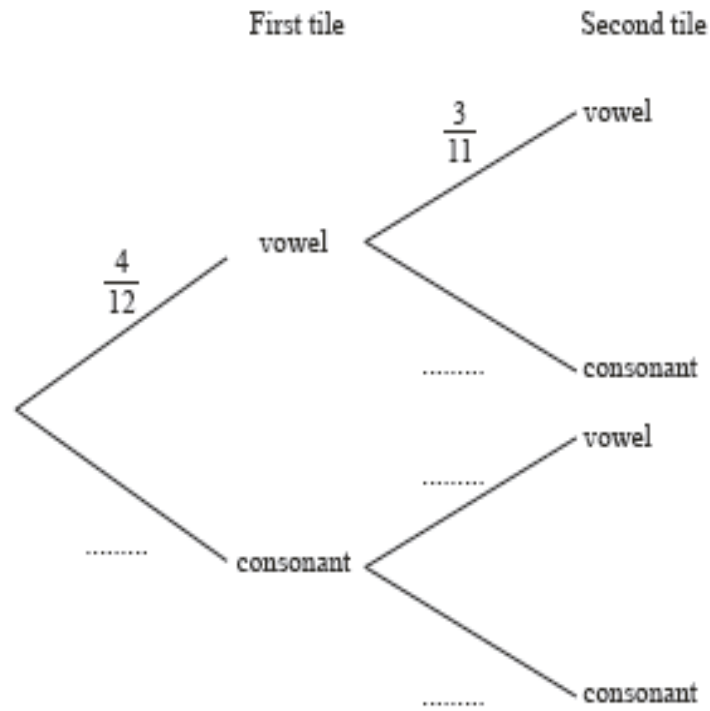
Find the probability that, in the order the tiles were placed on the table, they spell GET.

Answer [2]

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- (c) Vowels are the letters A, E, I, O and U.
 All other letters are consonants.
 All the twelve tiles are placed back in the bag and two tiles are taken at random, without replacement.

(i) Complete the tree diagram.



[2]

(ii) Find the probability that the tiles both show vowels.

Answer [1]

(iii) Find the probability that one tile shows a vowel and one tile shows a consonant.

Answer [2]

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9 The 262 students at a college each study one of the languages shown in the table.

	French	German	Spanish	Italian	Japanese	Total
Boys	27		48	19		123
Girls		32	54		12	
Total		53		30		262

(a) Complete the table. [3]

(b) Find the probability that

(i) a girl, chosen at random, studies Spanish,

..... [1]

(ii) a boy, chosen at random, studies French or Italian,

..... [1]

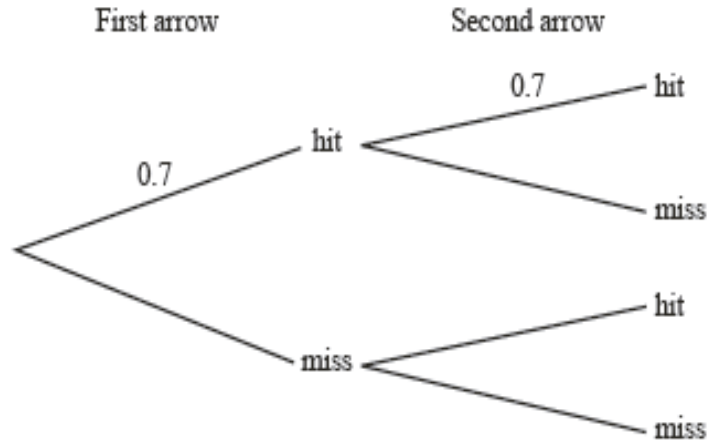
(iii) a student, chosen at random, does not study German.

..... [1]

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10 Each time an archer fires an arrow, the probability that she hits the target is 0.7 .
She fires two arrows.

(a) Complete the tree diagram.



[1]

(b) Find the probability that

(i) she hits the target twice,

Answer [1]

(ii) she hits the target exactly once.

Answer [1]

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11 Adam has a bag containing 9 balls, numbered from 1 to

O/N17/21/4

- (a) Adam takes a ball at random from the bag and replaces it.

Find the probability that the ball has an odd number.

Answer [1]

- (b) Adam takes a ball from the 9 balls in the bag, notes the number and replaces it. He then takes a second ball from the bag, notes the number and replaces it.

- (i) Work out the probability that both numbers are odd.

Answer [1]

- (ii) Work out the probability that one number is odd and the other is even.

Answer [2]

- (c) Adam now takes two balls from the 9 balls in the bag, **without replacement**.

Work out the probability that the two numbers are either both odd or both even.

Answer [3]

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- 12 A bag contains red and blue pegs. M/J17/11/9
 There are 40 pegs in the bag.
 The probability of choosing a red peg from the bag is 0.4 .

(a) Work out the number of red pegs in the bag.

Answer [1]

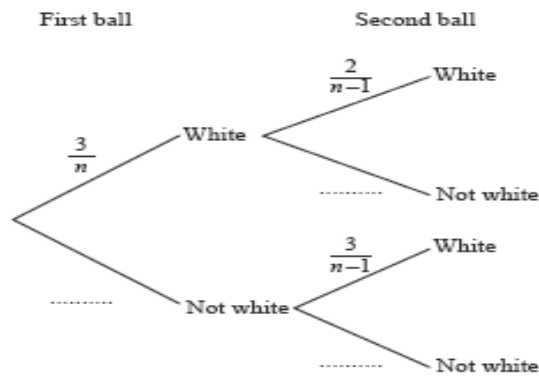
(b) More red pegs are added to the bag.

Work out the number of red pegs that must be added to the bag so that the probability of choosing a **blue** peg is 0.2 .

Answer [2]

- 13 A bag contains n balls. M/J17/12/24
 3 of the balls are white.
 Two balls are taken from the bag, at random, without replacement.

(a) Complete the tree diagram.



[2]

- (b) The probability that both balls are white is $\frac{1}{15}$.
 Show that $n^2 - n - 90 = 0$.

[2]

(c) Find the value of n .

Answer [2]

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- 14 Rowena spins two fair spinners, each numbered 1 to 4.
Her score is the value when the numbers on the two spinners are multiplied together.
The table shows some of Rowena's possible scores.

M/J17/22/3

×	1	2	3	4
1	1	2	3	4
2	2	4		
3				
4				

- (a) Complete the table of possible scores. [2]
- (b) Find the probability that Rowena's score is less than 4.

Answer [1]

- (c) Find the probability that Rowena's score is an even number.
Give your answer as a fraction in its lowest terms.

Answer [2]

- (d) Phoebe says that Rowena's score is more likely to be a square number than a factor of 6.

Is she correct?
Show your working.

Answer

[2]

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15

1

2

3

4

O/N16/1218

Four cards are marked with the numbers 1, 2, 3 and 4.
One card is chosen at random.
A second card is then chosen, at random, from the remaining three cards.
The sum of the numbers on the two chosen cards is calculated.

(a) Complete the table to show the possible outcomes.

		First card			
		1	2	3	4
Second card	1				
	2				
	3				
	4				

[1]

(b) What is the probability that the sum is less than 2?

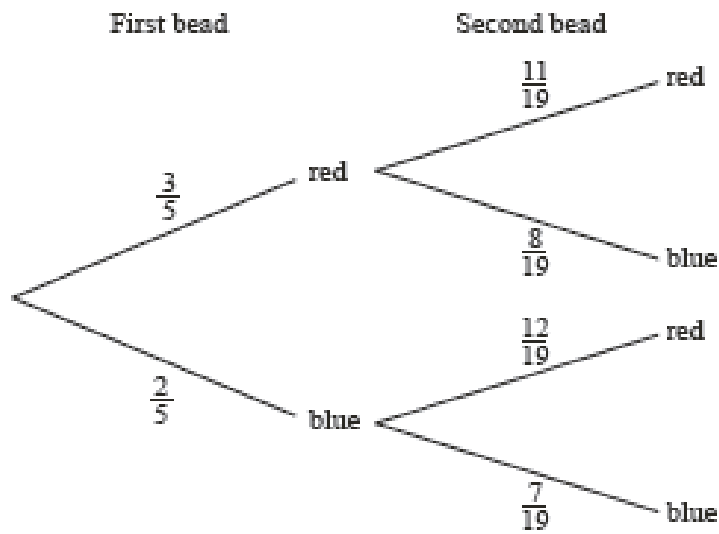
Answer [1]

(c) What is the probability that the sum is greater than 5?

Answer [1]

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- 16 A bag contains R red beads and B blue beads. O/N16/21/10(b)
 Two beads are chosen, at random, without replacement.
 The tree diagram shows the possible outcomes and their probabilities.



- (i) Calculate the probability that both beads are red.

Answer [1]

- (ii) Calculate the probability that the two beads are different colours.

Answer [2]

- (iii) What is the value of R ?

Answer [1]

- (iv) Of the red beads, half have a yellow spot.

Calculate the probability that, of the two chosen beads, neither has a yellow spot.

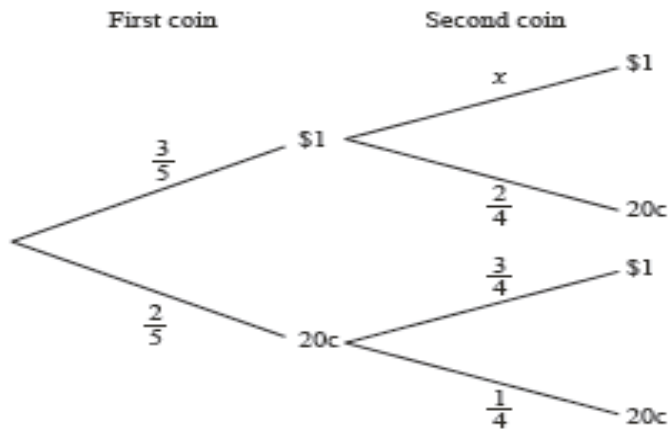
Answer [2]

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- 17 Amira has three \$1 coins and two 20c coins in her purse.
She picks out coins at random, one after the other.
The coins are not replaced.

The tree diagram shows the possible outcomes and their probabilities when picking out two coins.

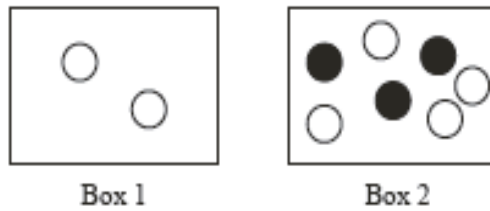
O/N16/22/11(b)



- (i) Find x .
- Answer* [1]
- (ii) Find the probability that the total value of the two coins picked out is 40 cents.
- Answer* [1]
- (iii) Find the probability that the total value of the two coins picked out is \$1.20 .
- Answer* [2]
- (iv) At a car park, the charge is \$1.40 .
Amira picks out three coins, one after the other.
Find the probability that the total value of the three coins is \$1.40 .
- Answer* [2]

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18



Box 1 contains 2 white balls. Box 2 contains 4 white balls and 3 black balls.

(a) Ann chooses, at random, one ball from each box.

M/J16/11/Q26

(i) Find the probability that these balls are both black.

Answer [1]

(ii) Find the probability that these balls have different colours.

Answer [1]

(b) From the original contents of **Box 2**, Belle chooses, at random, two balls without replacement.

Find the probability that these balls are both white.

Answer [1]

(c) Carla chooses one of the boxes at random.

With the original box contents, she then chooses, at random, one ball from this box.

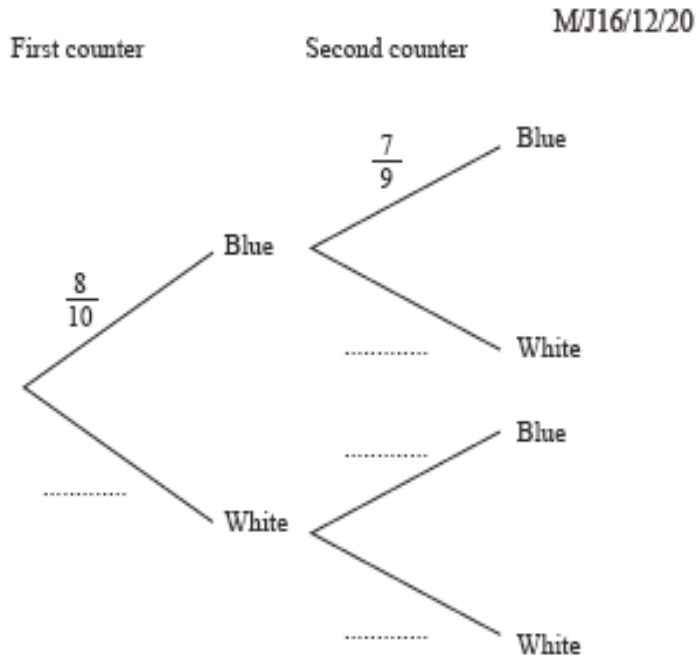
Find the probability that the ball is white.

Answer [2]

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19 A bag contains 10 counters of which 8 are blue and 2 are white.
 Two counters are taken from the bag at random without replacement.

(a) Complete the tree diagram to show the possible outcomes and their probabilities.



[1]

(b) Find, as a fraction, the probability that

(i) both counters are blue,

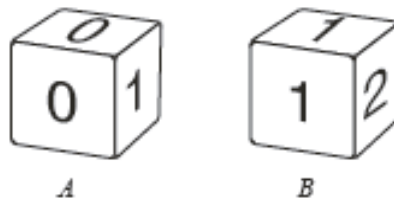
Answer [1]

(ii) one counter is blue and the other is white.

Answer [2]

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20



The diagram shows two fair dice.
The numbers on dice *A* are 0, 0, 1, 1, 1, 3.
The numbers on dice *B* are 1, 1, 2, 2, 2, 3.
When a dice is rolled, the score is the number on the top face.

- (a) Dice *A* is rolled once.

Find the probability that the score is not 3.

..... [1]

- (b) Dice *A* is rolled twice.

Find the probability that the score is 0 both times.

..... [2]

- (c) Dice *A* is rolled 60 times.

Calculate an estimate of the number of times the score is 0.

..... [1]

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15

- (d) Dice A and dice B are each rolled once.
The product of the scores is recorded.

(i) Complete the possibility diagram.

3	0	0				
2	0	0				
2	0	0				
2	0	0				
1	0	0				
1	0	0	1	1	1	3
	0	0	1	1	1	3

Dice A

[2]

- (ii) Find the probability that the product of the scores is

(a) 2,

..... [1]

(b) greater than 3.

..... [1]

- (e) Eva keeps rolling dice B until 1 is scored.

Find the probability that this happens on the 5th roll.

..... [2]

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21

Humanities: Geography (G)
History (H)
Religious studies (R)

Science: Physics (P)
Chemistry (C)
Biology (B)

A student has to choose one humanities subject and two different science subjects.

(a) Complete the table to show the possible outcomes.

M/J17/21/3

<i>Answer</i>	Humanities	Science
	G	P and C
	G	P and B

[2]

(b) Khalif chooses his subjects at random.

(i) Find the probability that he chooses Geography.

Answer [1]

(ii) Find the probability that he chooses Physics.

Answer [1]

(iii) Find the probability that he chooses both Religious studies and Chemistry.

Answer [1]

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Mark Scheme

1(a)	[0].7, [0].3, [0].2, [0].4 correctly placed	2	M1 for two or three correct
1(b)	[0].74 oe	2	M1 for 0.7×0.8 or 0.3×0.6 oe

2(a)	$\frac{2}{6}$ on first branch $\frac{2}{5}, \frac{4}{5}, \frac{1}{5}$ on second set	2	B1 for two or three completed correctly
2(b)	$\frac{14}{30}$ oe	2	M1 for $\frac{4}{6} \times \frac{3}{5}$ oe or <i>their</i> $\frac{2}{6} \times \text{their} \frac{1}{5}$ oe

Question	Answer	Marks	Part marks
3(a)	0.4 oe	1	
3(b)	12 or <i>their</i> (a) $\times 30$ ft	1	
3(c)	0.83	1	

4(a)	$\frac{50}{200}$ oe	1	
4(b)	5	1	FT $20 \times \text{their (a)}$ provided <i>their (a)</i> < 1 .
4(c)	No, with a supporting reason	1	e.g.: [has been spun enough times for results to be reliable.]; results are significantly different from those for a fair spinner.

5(a)	$\frac{4}{7}$	1	
	$\frac{2}{7}$ (black) and $\frac{5}{7}$ (white) with two branches and both labels	1	
5(b)	$\frac{13}{35}$ oe	2	FT $\frac{3}{5} \times \frac{3}{7} + \frac{2}{5} \times (\text{their} \frac{2}{7})$ or M1 for $\frac{3}{5} \times \frac{3}{7}$; or for $\frac{2}{5} \times (\text{their} \frac{2}{7})$

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6(a)	$\frac{9}{100}$ oe	1	
6(b)	60	1	
6(c)	75	1	
6(d)	(c) because based on a larger sample oe	1	

7(a)	$\frac{80}{400}$ oe	1	
7(b)	200	1	FT (<i>their(a)</i>) \times 1000 where $0 < \textit{their (a)} < 1$

8(a)	$\frac{1}{6}$ cao	1	
8(b)	$\frac{1}{660}$ oe	2	M1 for $\frac{1}{12} \times \frac{1}{11} \times \frac{2}{10}$ oe or SC1 for $\frac{1}{12} \times \frac{1}{12} \times \frac{2}{12}$ or answer $\frac{1}{864}$ or $\frac{1}{12}, \frac{1}{11}, \frac{2}{10}$
8(c)(i)	$\frac{8}{12}, \frac{8}{11}, \frac{4}{11}, \frac{7}{11}$ oe correctly placed	2	B1 for two correct
8(c)(ii)	$\frac{1}{11}$ oe	1	
8(c)(iii)	$\frac{16}{33}$ oe	2	M1 for $\frac{4}{12} \times \frac{8}{11}$ or $\frac{8}{12} \times \frac{4}{11}$ oe

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9(a)	<table border="1" style="margin: auto; border-collapse: collapse;"> <thead> <tr> <th></th> <th>F</th> <th>G</th> <th>S</th> <th>I</th> <th>J</th> <th>Tot</th> </tr> </thead> <tbody> <tr> <th>B</th> <td></td> <td>21</td> <td></td> <td></td> <td>8</td> <td></td> </tr> <tr> <th>G</th> <td>30</td> <td></td> <td></td> <td>11</td> <td></td> <td>139</td> </tr> <tr> <th>Tot</th> <td>57</td> <td></td> <td>102</td> <td></td> <td>20</td> <td></td> </tr> </tbody> </table>		F	G	S	I	J	Tot	B		21			8		G	30			11		139	Tot	57		102		20		3	B2 for 6 or 7 correct or B1 for 3, 4 or 5 correct
	F	G	S	I	J	Tot																									
B		21			8																										
G	30			11		139																									
Tot	57		102		20																										
9b(i)	$\frac{54}{139}$ oe isw <i>their</i>	1	FT <i>their</i> table																												
9(b)(ii)	$\frac{46}{123}$ oe isw	1																													
9(b)(iii)	$\frac{209}{262}$ oe isw	1																													
10(a)	Probabilities 0.7 and 0.3 on the correct branches	1																													
10(b)(i)	0.49 oe	1																													
10(b)(ii)	0.42 oe	1	FT from their diagram, provided their diagram probabilities are less than 1, and $0 < \text{ans.} < 1$.																												
11(a)	$\frac{5}{9}$ oe	1																													
11(b)(i)	$\frac{25}{81}$ oe	1																													
11(b)(ii)	$\frac{40}{81}$ oe	2	M1 for $\frac{\text{their } 5}{9} \times \frac{(9 - \text{their } 5)}{9}$ soi or $\frac{\text{their } 5}{9} \times \frac{4}{9}$																												
11(c)	$\frac{4}{9}$ oe nfww	3	M2 for $\frac{5}{9} \times \frac{4}{8} + \frac{4}{9} \times \frac{3}{8}$ or M1 for $\frac{4}{9} \times \frac{3}{8}$ or $\frac{5}{9} \times \frac{4}{8}$																												
12(a)	16	1																													
12b)	80	2	B1 for 120 or 96 seen or M1 for $\frac{24}{40+x} = \frac{1}{5}$ or $\frac{16+x}{40+x} = \frac{4}{5}$ oe																												

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13(a)	Correctly completed tree diagram $\frac{n-3}{n-1}$ oe $\frac{n-3}{n}$ oe $\frac{n-4}{n-1}$ oe	2	C1 for one correct probability correctly positioned
13(b)	$\frac{3}{n} \times \frac{2}{n-1} = \frac{1}{15}$	M1	
	Correct rearrangement with at least one further step to reach $n^2 - n - 90 = 0$	A1	
13(c)	10	2	B1 for solutions 10, -9 seen or M1 for $(n-10)(n+9) [= 0]$ or for $\frac{1 \pm \sqrt{(-1)^2 - 4 \times 1 \times -90}}{2 \times 1}$ or better

14(a)	- - - - - - 6 8 3 6 9 12 4 8 12 16	2	B1 for at least 6 correct
14(b)	$\frac{5}{16}$ or 0.3125 or 31.25%	1	FT <i>their</i> complete table (decimals or percentages correct to at least 3sf)

14(c)	$\frac{3}{4}$ cao	2	B1 for $\frac{12}{16}$ or $\frac{6}{8}$ or <i>their</i> $\frac{12}{16}$ oe
14(d)	No with square 6 and factors 7 seen or square $\frac{6}{16}$ and factors $\frac{7}{16}$ seen or 1 4 4 4 9 16 and 1 2 2 3 3 6 6 seen or $1^2 2^2 2^2 3^2 4^2$ and 1 2 2 3 3 6 6 seen	2	B1 for square $\frac{6}{16}$ or factors $\frac{7}{16}$ or 1 4 4 4 9 16 seen or $1^2 2^2 2^2 3^2 4^2$ seen or 1 2 2 3 3 6 6 seen or square 6 and factors 7

15	(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>-</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>3</td><td>-</td><td>5</td><td>6</td></tr> <tr><td>4</td><td>5</td><td>-</td><td>7</td></tr> <tr><td>5</td><td>6</td><td>7</td><td>-</td></tr> </table>	-	3	4	5	3	-	5	6	4	5	-	7	5	6	7	-	1	
	-	3	4	5																
	3	-	5	6																
4	5	-	7																	
5	6	7	-																	
(b)	0	1																		
(c)	$\frac{4}{12}$ oe ; or FT <i>their</i> table	1✓																		

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16 (i)	$\frac{33}{95}$ oe	1	
(ii)	$\frac{48}{95}$ oe	2	M1 for $\frac{3}{5} \times \frac{8}{19} + \frac{2}{5} \times \frac{12}{19}$ Or SC1 for answer $\frac{24}{95}$
(iii)	12 cao	1	
(iv)	$\frac{91}{190}$ oe	2	M1 for $\frac{k}{n} \times \frac{k-1}{n-1}$ where $n > k > 1$

17 (i)	$\frac{2}{4}$ oe	1	
(ii)	$\frac{2}{20}$ oe	1	
(iii)	$\frac{12}{20}$ oe	2	B1 for $\frac{3}{5} \times \frac{2}{4}$ or $\frac{2}{5} \times \frac{3}{4}$ seen
(iv)	$\frac{18}{60}$ oe	2	B1 for any correct sequence of three coins, $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3}$ or $\frac{2}{5} \times \frac{3}{4} \times \frac{1}{3}$ or $\frac{2}{5} \times \frac{1}{4} \times \frac{3}{3}$

18 (a) (i)	0	1	
(ii)	$\frac{3}{7}$	1	
(b)	$\frac{2}{7}$ oe	1	
(c)	$\frac{11}{14}$ oe	2*	M1 for $\frac{1}{2} \times 1 + \frac{1}{2} \times \frac{4}{7}$

19 (a)	$\frac{2}{10}, \frac{2}{9}, \frac{8}{9}, \frac{1}{9}$ correctly positioned	1	
(b) (i)	$\frac{56}{90}$ oe	1*	
(ii)	$\frac{32}{90}$ oe	2ft*	M1 for $\frac{8}{10} \times \frac{2}{9} + \frac{2}{10} \times \frac{8}{9}$ ft <i>their</i> tree diagram with fractions < 1

4024 Probability Questions
Compiled by ; Mustafa Asif

20(a)	$\frac{5}{6}$	1	
20(b)	$\frac{4}{36}$ oe	2	M1 for $\frac{2}{6} \times \frac{2}{6}$
20(c)	20	1	

20(d)(i)	Diagram completed correctly x x 3 3 3 9 x x 2 2 2 6 x x 2 2 2 6 x x 2 2 2 6 x x 1 1 1 3	2	B1 for 3 correct columns or for 4 correct rows
20(d)(ii)(a)	$\frac{9}{36}$ oe	1FT	FT their (d)(i)
20(d)(ii)(b)	$\frac{4}{36}$ oe	1FT	FT their (d)(i)
20(e)	$\frac{512}{7776}$ oe	2	M1 for $\left(\frac{4}{6}\right)^k \times \frac{2}{6}$ oe $k = 3, 4$ or 5 only

21(a)	GCB, HPC, HPB, HCB, RPC,RPB, RCB	2	B1 for 5 correct and none incorrect or for 6 correct
21(b)(i)	$\frac{3}{9}$ or $\frac{1}{3}$ or 0.333(..) or 33.3(..)%	1	FT dep on B1 scored in (a)
21(b)(ii)	$\frac{6}{9}$ or $\frac{2}{3}$ or 0.666 – 0.667 or 66.6% – 66.7%	1	FT dep on B1 scored in (a)
21(b)(iii)	$\frac{2}{9}$ or 0.222(...) or 22.2(...)%	1	FT dep on B1 scored in (a) After 0 scored in (i) (ii) and (iii), SC1 for $\frac{3}{k}, \frac{6}{k}, \frac{2}{k}$