Worksheet - Probability: outcomes and sample spaces

Year: Year 8 · 20

Show your working.

Question 1

Question 1 – The probability scale *(Section A · Skills practice)*

Probabilities are always between 0 (impossible) and 1 (certain). For each event, say where it would go on a probability scale and give a probability if you can.

a. Rolling a 7 on a normal six-sided die.
b. Getting heads when you flip a fair coin.
c. Picking a red card from a normal pack of 52 cards.
d. The sun rising in the UK tomorrow.
e. Rolling a number less than 7 on a six-sided die.

Question 2

Question 2 – Theoretical probability *(Section A · Skills practice)*

A fair six-sided die is rolled. Write each probability as a fraction in its simplest form.

a. A 5
b. An even number
c. A number greater than 4
d. A prime number
e. A number that is not a 3

Question 3

Question 3 – Counters in a bag *(Section A · Skills practice)*

A bag contains 5 red counters, 3 blue counters, 2 green counters and 10 yellow counters. One counter is taken out at random.

Colour	Red	Blue	Green	Yellow
Number	5	3	2	10

a. How many counters are in the bag?
b. What is the probability that the counter is red?
c. What is the probability that the counter is blue or green?
d. What is the probability that the counter is not yellow?

e. The bag also has some white counters. The probability of picking white is $\frac{1}{5}$. How many white counters are there?

Question 4

Question 4 – Expected number of outcomes *(Section A · Skills practice)*

Use the formula: expected number = probability × number of trials.

a. A fair die is rolled 120 times. How many sixes do you expect?
b. A spinner has a probability of 0.35 of landing on red. It is spun 200 times. How many reds do you expect?
c. The probability that a bus is late is $\frac{1}{8}$. How many late buses do you expect in 240 journeys?
d. Ali rolls a die 60 times and gets 14 fours. Compare this with the expected number.

Question 5

Question 5 – Relative frequency *(Section A · Skills practice)*

Priya flips a coin 50 times and records the results. Then Sam spins a biased spinner 100 times.

Event	Frequency	Total trials
Priya: heads	27	50
Sam: red	46	100

a. Find the relative frequency of heads in Priya's experiment.
b. Find the relative frequency of red in Sam's experiment.
c. Which experiment gives results closer to the theoretical value if red should be $\frac{1}{2}$?
d. Explain why doing more trials gives a better estimate.

Question 6

Question 6 – Listing outcomes *(Section A · Skills practice)*

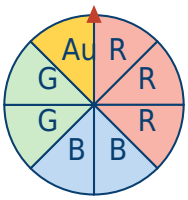
Write out all the possible outcomes systematically.

a. Flipping two coins (H or T for each).
b. Flipping three coins.
c. Choosing one flavour (vanilla, chocolate, strawberry) and one topping (nuts, sauce) for an ice cream.
d. How many outcomes does each part have? Is there a quick way to find the number?

Question 7

Question 7 – The school fair spinner *(Section B · Real-life practice)*

At the school fair, a stall has a spinner with 8 equal sections. 3 sections are red, 2 are blue, 2 are green and 1 is gold. You win a prize if it lands on gold, and a small sweet if it lands on blue.



a. Find the probability of landing on each colour.
b. Find the probability of winning a sweet or a prize.
c. 200 people play. How many prizes and sweets does the stall expect to give out?
d. The stall charges 50p per go and each prize costs £2. Will the stall make a profit from 200 plays if the sweets cost 5p each? Show your calculations.

Question 8

Question 8 – Choosing a school lunch *(Section B · Real-life practice)*

The school canteen offers a lunch deal: one main (pasta, pizza, curry or salad), one drink (water or juice) and one dessert (fruit or yoghurt).

a. List all the possible meals using a table or tree diagram for main and drink.
b. How many different meals are possible altogether?
c. Anya chooses at random. What is the probability that she gets pizza?
d. What is the probability that she gets curry with juice and fruit?
e. Leo never has dessert on Fridays. How many meals can he choose from?

Question 9

Question 9 – Football penalties *(Section B · Real-life practice)*

A football coach records how many penalties each of three players scores in practice.

Player	Scored	Taken
Ben	18	24
Carl	21	35
Dan	27	45

a. Find the relative frequency of scoring for each player as a decimal.
b. Who is the best penalty taker?
c. Dan takes 20 more penalties. How many does the coach expect him to score?
d. Carl's score rate improves to $\frac{4}{5}$. How many more would he score out of 35?

Question 10

Question 10 – The weather forecast *(Section B · Real-life practice)*

A weather website says the probability of rain on Saturday is 0.35 and on Sunday is 0.6. The probability of snow is 0.

a. What is the probability that it does not rain on Saturday?
b. What is the probability that it does not rain on Sunday?
c. Is it more likely to rain on Saturday or Sunday? By how much?
d. The forecast has been correct on 80% of days. Out of the last 150 forecasts, how many were correct?
e. Explain what a probability of 0 for snow means in this context.

Question 11

Question 11 – Raffle tickets *(Section B · Real-life practice)*

The PTA runs a raffle. 400 tickets are sold, numbered 1 to 400. One ticket is drawn at random for each prize. The first prize is a bicycle, the second a games console and the third a book token. Prizes are not replaced after being drawn.

a. Ahmed has 5 tickets. What is the probability that he wins the bicycle?
b. The console is drawn second, from the remaining 399 tickets. If Ahmed did not win the bicycle, what is the probability that he wins the console?
c. How many tickets would he need to have a probability of $\frac{1}{10}$ of winning the bicycle?
d. The PTA says, "Anyone with 40 tickets has a 1 in 10 chance." Is this correct? Explain.

Question 12

Question 12 – Quality control at a factory *(Section B · Real-life practice)*

A factory checks light bulbs. In one batch of 500 bulbs, 15 are faulty.

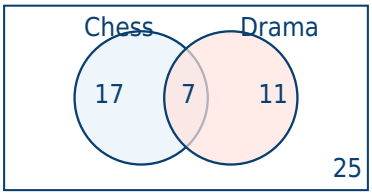
Batch	Bulbs tested	Faulty
A	500	15
B	800	28
C	1200	36

a. Find the relative frequency of a faulty bulb in each batch.
b. Combine all three batches to give the best estimate of the probability that a bulb is faulty.
c. The factory makes 20 000 bulbs in a week. How many are expected to be faulty?
d. The manager says that batch B is worse than the others. Is she right? Explain.

Question 13

Question 13 – School clubs Venn diagram *(Section B · Real-life practice)*

In Year 8, 60 pupils were asked about two after-school clubs. 24 attend the chess club, 18 attend the drama club and 7 attend both. The rest attend neither.



a. How many pupils attend only chess? Only drama?
b. How many attend neither club?
c. A pupil is chosen at random. What is the probability that they attend chess or drama?
d. What is the probability that a pupil attends exactly one club?

Question 14

Question 14 – The pack of cards *(Section B · Real-life practice)*

A standard pack has 52 cards in four suits (hearts and diamonds are red; clubs and spades are black). Each suit has an ace, 2 to 10, and a jack, queen and king (the jack, queen and king are called picture cards). One card is picked at random.

a. Find the probability that the card is a heart.
b. Find the probability that the card is a king.
c. Find the probability that it is a red card or a king.
d. Find the probability that it is not a picture card.
e. The card is replaced and the pack shuffled. This is done 104 times. How many hearts do you expect?

Question 15

Question 15 – Two dice sample space *(Section C · Problem solving)*

Two fair dice are rolled and the scores are added.

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

a. How many equally likely outcomes are there?
b. Find the probability of a total of 7.
c. Find the probability of a total less than 5.
d. Find the probability that the total is a multiple of 3.
e. Which total is the most likely, and what is its probability?

Question 16

Question 16 – Is the game fair? *(Section C · Problem solving)*

Rani and Tom play a game with two dice. Rani scores a point if the total is 6 or less. Tom scores a point if the total is 8 or more. Nobody scores on a total of 7.

a. Use the sample space to find the probability that Rani scores.
b. Find the probability that Tom scores.
c. Is the game fair? Explain.
d. Change the rule for Rani so that the game becomes fair.
e. The players play 72 times. Roughly how many points would each expect?

Question 17

Question 17 – Survey Venn diagram *(Section C · Problem solving)*

A survey of 50 teenagers asked who owns a games console (C) and who owns a tablet (T). 30 own a console, 28 own a tablet and 10 own neither.

a. How many own at least one of the two devices?
b. Use $n(C \cup T) = n(C) + n(T) - n(C \cap T)$ to find how many own both.
c. Draw (describe) the Venn diagram with numbers in each region.
d. What is the probability that a teenager chosen at random owns a console but not a tablet?
e. Given that a teenager owns a tablet, what is the probability that they also own a console?

Question 18

Question 18 – Letters and sets *(Section C · Problem solving)*

Look at these sets of numbers from 1 to 20: A = even numbers, B = multiples of 3, C = prime numbers.

a. List the numbers in sets A, B and C.
b. Find $A \cap B$ (numbers in both A and B).
c. Find $n(A \cup B)$ (numbers in either set).
d. A number from 1 to 20 is chosen at random. Find the probability that it is in $A \cap B$ and the probability that it is prime.
e. Is there a number in $A \cap C$? Explain.

Question 19

Question 19 – Two spinners *(Section C · Problem solving)*

Spinner A has numbers 1, 2, 3. Spinner B has numbers 1, 2, 3, 4. Both are fair. Each is spun once and the two numbers are multiplied.

a. Draw a sample space table and write down all the products.
b. How many outcomes are there?
c. Find the probability that the product is even.
d. Find the probability that the product is greater than 6.
e. Find the probability that the product is a square number.

Question 20

Question 20 – Challenge: the biased coin *(Section D · Challenge)*

A coin is biased. The probability of heads is p and the probability of tails is $1 - p$. In 200 flips, heads came up 130 times.

a. Estimate the probability of heads using relative frequency.
b. Estimate the probability of tails.
c. The coin is flipped twice. Estimate the probability of getting two heads.
d. Estimate the probability of getting one head and one tail (in either order).
e. Show that the four possible outcomes HH, HT, TH, TT have probabilities that add to 1.