Grade 9 Mathematics Worksheet

Probability and relative frequency

Questions:

1. Suzanne and Boitumelo are playing a game. Suzanne has six buttons in a box. All the buttons have the same shape and size. There are 2 red buttons, 1 blue button and 3 purple buttons. Boitumelo flips a fair coin.

   a) Draw a probability tree diagram that shows all the probabilities for drawing a button and flipping a coin. Suzanne replaced the button into the box after every draw.

   b) What is the probability of drawing a blue button and flipping a head?

   c) Boitumelo now flips the coin **twice**. Adapt the tree diagram to accommodate the new probabilities.

   d) What is the probability of drawing a red button and flipping a head and a tail?

   e) What is the probability of drawing a red button and flipping a head and **then** a tail?

   f) The two girls start to play. Lovanya records the results. For the first 25 turns the results are as follows:
   RHH; RHT; BHT; PTT; PTH; RHH; PTH; BTH; BHH; RHT; RTH; PTT; PTH; PHH; BTH; BTT; RHT; BTH; PTT; PHT; PHH; BTH; PTH; RTT; RHT.

      i) What is the relative frequency of having a tail and a head in one turn?

      ii) What is the relative frequency of drawing a red button and flipping a head and a tail?

      iii) Compare your answer of (d) with the answer of (f (ii)).
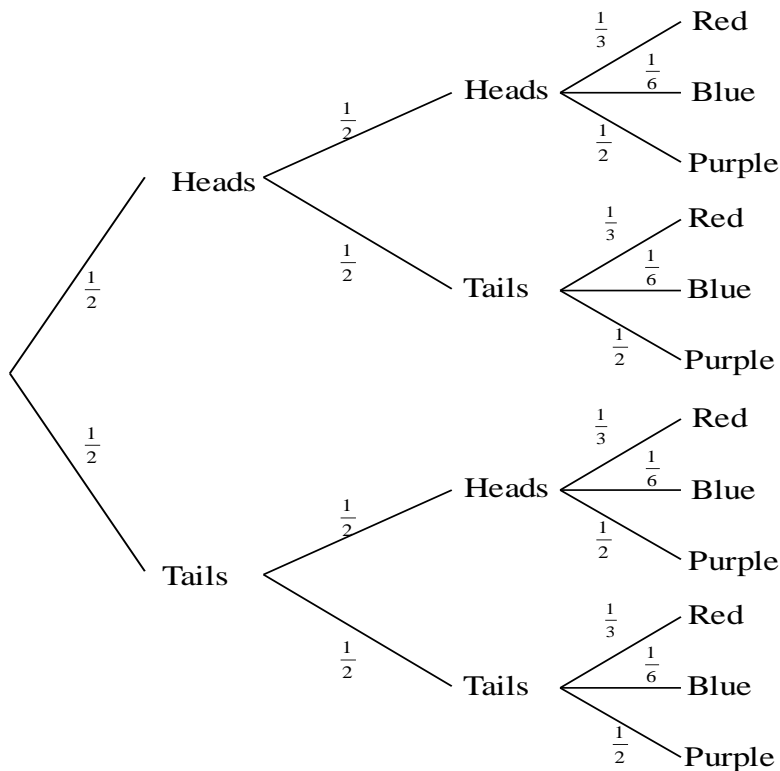
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Solution:

1.   a)
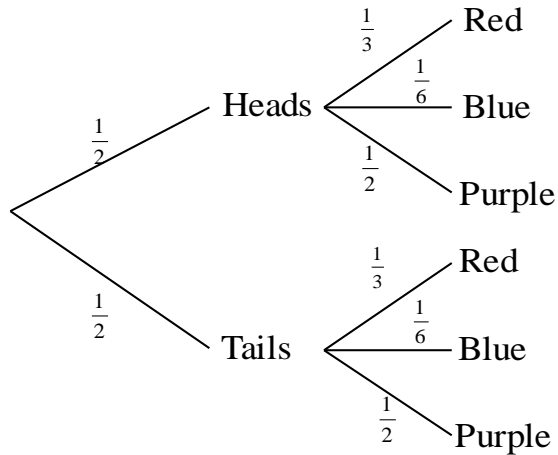
b)   P(H and B) = $\frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$

c)

d)   P(H and T and R) = P(HTR) + P(THR) = $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{3} + \frac{1}{2} \times \frac{1}{2} \times \frac{1}{3} = \frac{2}{12} = \frac{1}{6}$

e)   P(HTR) = $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{3} = \frac{1}{12}$

f)   i)

	Red	Blue	Purple	Heads	Tails	T&H	T&T	H&H
Freq	8	7	10	25	25	15	5	5
Rel Freq	$\frac{8}{25}$	$\frac{7}{25}$	$\frac{10}{25}$	$\frac{25}{50}$	$\frac{25}{50}$	$\frac{15}{25}$	$\frac{5}{25}$	$\frac{5}{25}$

So to have both a tail and a head in one go the relative frequency is $\frac{15}{25} = \frac{3}{5}$.

ii)   There are only 5 favourable outcomes that contain Red buttons, and Heads and Tails out of a total of 25 outcomes. So the relative frequency will be calculated as $\frac{5}{25} = \frac{1}{5}$.

iii)   The answer in (d) is based on the theoretical probability and thus is $\frac{1}{6}$. The answer in f(ii) is based on the outcomes of an experiment, and is thus the relative frequency (or experimental probability) and is $\frac{1}{5}$. The more outcomes we record in the experiment, the closer the relative frequency will move to the theoretical probability.

There are two elements in the sample space containing a Head, Tail and Red. They are HTR and THR.

Here the order is important. So first H then T and then R.

Note that the coin is tossed twice. So the total outcomes become 50.

Relative frequency is not the same as the theoretical probability. It is relative to the situation where we are now, so we need to count. In another experiment the probability will be the same, but the relative frequency in another experiment with exactly the same events will be totally different.