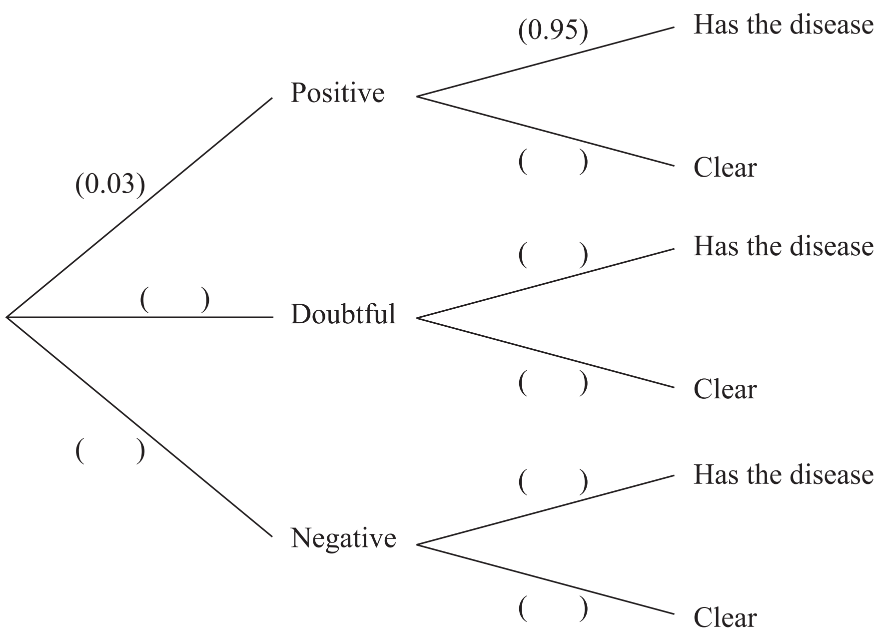
1 A screening test for a particular disease is applied to everyone in a large population. The test classifies people into three groups: ‘positive’, ‘doubtful’ and ‘negative’. Of the population, 3% is classified as positive, 6% as doubtful and the rest negative.

In fact, of the people who test positive, only 95% have the disease. Of the people who test doubtful, 10% have the disease. Of the people who test negative, 1% actually have the disease.

People who do not have the disease are described as ‘clear’.

(i) Copy and complete the tree diagram to show this information. [4]



(ii) Find the probability that a randomly selected person tests negative and is clear. [2]

(iii) Find the probability that a randomly selected person has the disease. [3]

(iv) Find the probability that a randomly selected person tests negative **given** that the person has the disease. [3]

(v) Comment briefly on what your answer to part **(iv)** indicates about the effectiveness of the screening test. [2]

Once the test has been carried out, those people who test doubtful are given a detailed medical examination. If a person has the disease the examination will correctly identify this in 98% of cases. If a person is clear, the examination will always correctly identify this.

(vi) A person is selected at random. Find the probability that this person either tests negative originally or tests doubtful and is then cleared in the detailed medical examination. [4]

2 Each day the probability that Ashwin wears a tie is 0.2. The probability that he wears a jacket is 0.4. If he wears a jacket, the probability that he wears a tie is 0.3.

(i) Find the probability that, on a randomly selected day, Ashwin wears a jacket and a tie. [2]

(ii) Draw a Venn diagram, using one circle for the event 'wears a jacket' and one circle for the event 'wears a tie'. Your diagram should include the probability for each region. [3]

(iii) Using your Venn diagram, or otherwise, find the probability that, on a randomly selected day, Ashwin

(A) wears either a jacket or a tie (or both),

(B) wears no tie or no jacket (or wears neither). [3]

3 Isobel plays football for a local team. Sometimes her parents attend matches to watch her play.

- A is the event that Isobel's parents watch a match.
- B is the event that Isobel scores in a match.

You are given that $\frac{3}{7}$ and $\mathrm{P}(A) = \frac{7}{10}$.

(i) Calculate $\mathrm{P}(A \cap B)$. [2]

The probability that Isobel does not score and her parents do not attend is 0.1.

(ii) Draw a Venn diagram showing the events A and B, and mark in the probability corresponding to each of the regions of your diagram. [2]

(iii) Are events A and B independent? Give a reason for your answer. [2]

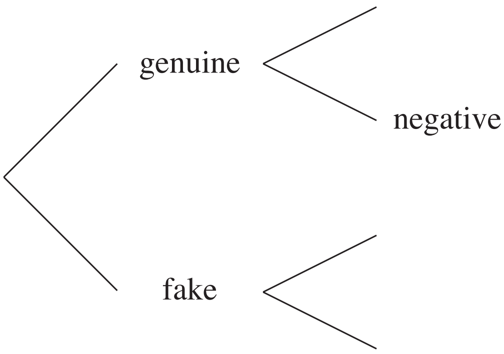
(iv) By comparing $\mathrm{P}(B \mid A)$ with $\mathrm{P}(B)$, explain why Isobel should ask her parents not to attend. [2]

4 It has been estimated that 90% of paintings offered for sale at a particular auction house are genuine, and that the other 10% are fakes. The auction house has a test to determine whether or not a given painting is genuine. If this test gives a positive result, it suggests that the painting is genuine. A negative result suggests that the painting is a fake.

If a painting is genuine, the probability that the test result is positive is 0.95.

If a painting is a fake, the probability that the test result is positive is 0.2.

(i) Copy and complete the probability tree diagram below, to illustrate the information above. [2]



Calculate the probabilities of the following events.

(ii) The test gives a positive result. [2]

(iii) The test gives a correct result. [2]

(iv) The painting is genuine, given a positive result. [3]

(v) The painting is a fake, given a negative result. [3]

A second test is more accurate, but very expensive. The auction house has a policy of only using this second test on those paintings with a negative result on the original test.

(vi) Using your answers to parts **(iv)** and **(v)**, explain why the auction house has this policy. [2]

The probability that the second test gives a correct result is 0.96 whether the painting is genuine or a fake.

(vii) Three paintings are independently offered for sale at the auction house. Calculate the probability that all three paintings are genuine, are judged to be fakes in the first test, but are judged to be genuine in the second test. [4]