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4. Three bags **A**, **B** and **C** each contain coloured balls.

Bag **A** contains 4 red balls and 2 yellow balls only.
Bag **B** contains 4 red balls and 1 yellow ball only.
Bag **C** contains 6 red balls only.

In a game
Mike takes a ball at random from bag **A**, records the colour and places it in bag **C**.
He then takes a ball at random from bag **B**, records the colour and places it in bag **C**.
Finally, Mike takes a ball at random from bag **C** and records the colour.

(a) Complete the tree diagram on the page opposite, to illustrate the game by adding the remaining branches and all probabilities.

(3)

(b) Show that the probability that Mike records a yellow ball exactly twice is $\frac{1}{10}$

(3)

Given that Mike records exactly 2 yellow balls,

(c) find the probability that the ball drawn from bag **A** is red.

(2)

Mike plays this game a large number of times, each time starting with the bags containing balls as described above. The random variable X represents the number of yellow balls recorded in a single game.

(d) Find the probability distribution of X

(3)

(e) Find $E(X)$

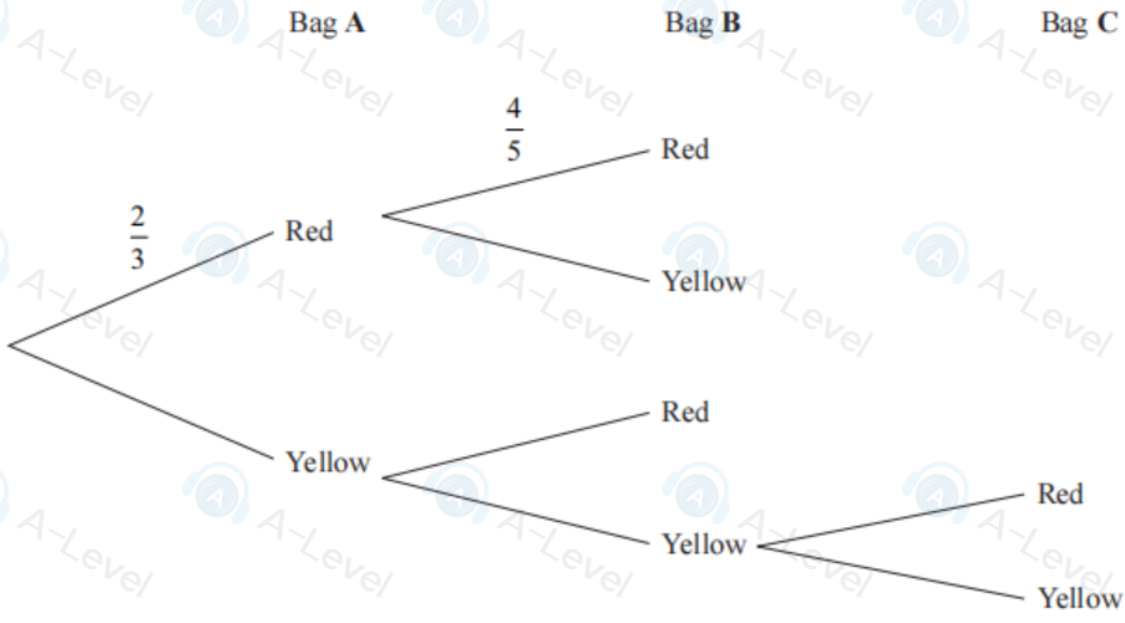
(2)

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Question 4 continued



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6. Three events A, B and C are such that

$$P(A) = \frac{2}{5} \qquad P(C) = \frac{1}{2} \qquad P(A \cup B) = \frac{5}{8}$$

Given that A and C are mutually exclusive find

(a) $P(A \cup C)$

(1)

Given that A and B are independent

(b) show that $P(B) = \frac{3}{8}$

(4)

(c) Find $P(A \mid B)$

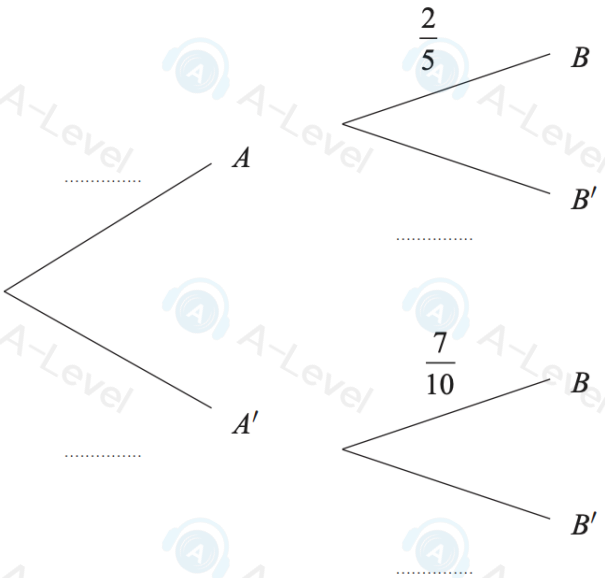
(1)

Given that $P(C' \cap B') = 0.3$

(d) draw a Venn diagram to represent the events A, B and C

(5)

4. The following incomplete tree diagram shows the relationships between the event A and the event B.



Given that $P(B) = \frac{9}{20}$

(a) find $P(A)$ and complete the tree diagram,

(6)

(b) find $P(A' \mid B')$.

(2)

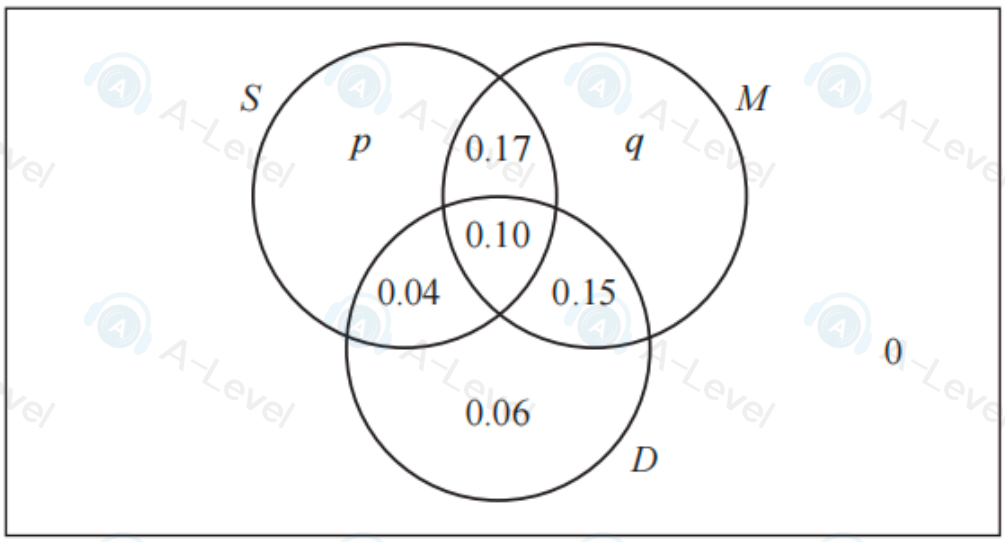
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6. The Venn diagram below shows the probabilities of customers having various combinations of a starter, main course or dessert at Polly's restaurant.

S = the event a customer has a starter.

M = the event a customer has a main course.

D = the event a customer has a dessert.



Given that the events S and D are statistically independent

(a) find the value of p.

(4)

(b) Hence find the value of q.

(2)

(c) Find

(i) $P(D \mid M \cap S)$

(ii) $P(D \mid M \cap S')$

(4)

One evening 63 customers are booked into Polly's restaurant for an office party. Polly has asked for their starter and main course orders before they arrive.

Of these 63 customers

27 ordered a main course and a starter,

36 ordered a main course without a starter.

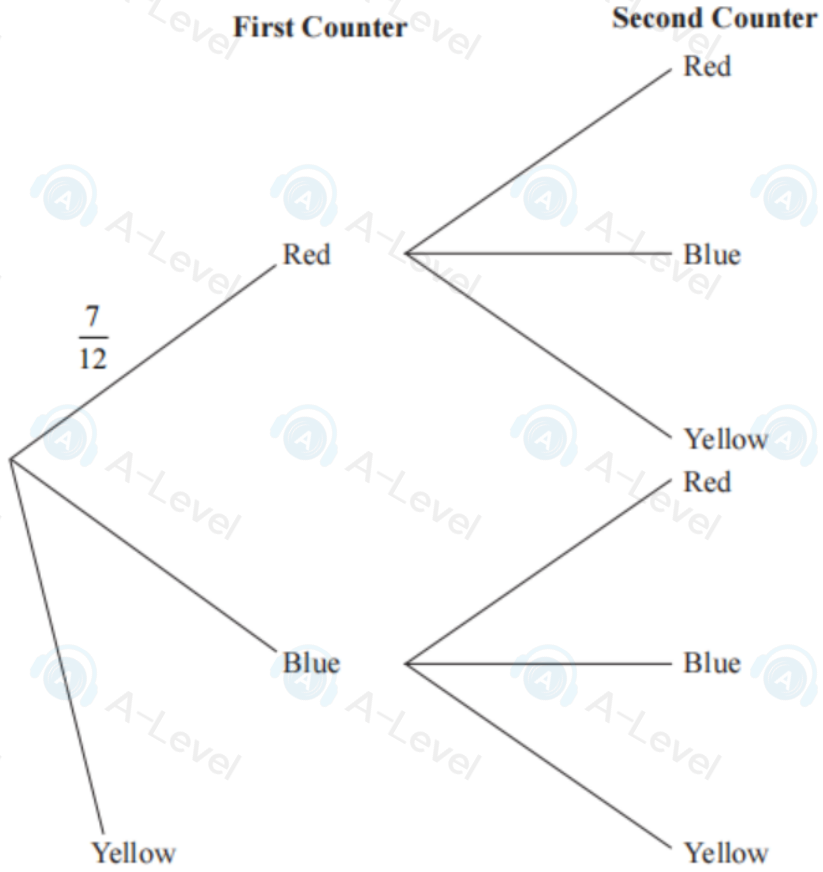
(d) Estimate the number of desserts that these 63 customers will have.

(2)

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1. There are 7 red counters, 3 blue counters and 2 yellow counters in a bag. Gina selects a counter at random from the bag and keeps it. If the counter is yellow she does not select any more counters. If the counter is not yellow she randomly selects a second counter from the bag.

(a) Complete the tree diagram.



(2)

Given that Gina has selected a yellow counter,

(b) find the probability that she has 2 counters.

(3)

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3. Hugo recorded the purchases of 80 customers in the ladies fashion department of a large store. His results were as follows

20 customers bought a coat
12 customers bought a coat and a scarf
23 customers bought a pair of gloves
13 customers bought a pair of gloves and a scarf
no customer bought a coat and a pair of gloves
14 customers did not buy a coat nor a scarf nor a pair of gloves.

(a) Draw a Venn diagram to represent all of this information.

(4)

(b) One of the 80 customers is selected at random.

(i) Find the probability that the customer bought a scarf.

(1)

(ii) Given that the customer bought a coat, find the probability that the customer also bought a scarf.

(2)

(iii) State, giving a reason, whether or not the event 'the customer bought a coat' and the event 'the customer bought a scarf' are statistically independent.

(2)

Hugo had asked the member of staff selling coats and the member of staff selling gloves to encourage customers also to buy a scarf.

(c) By considering suitable conditional probabilities, determine whether the member of staff selling coats or the member of staff selling gloves has the better performance at selling scarves to their customers. Give a reason for your answer.

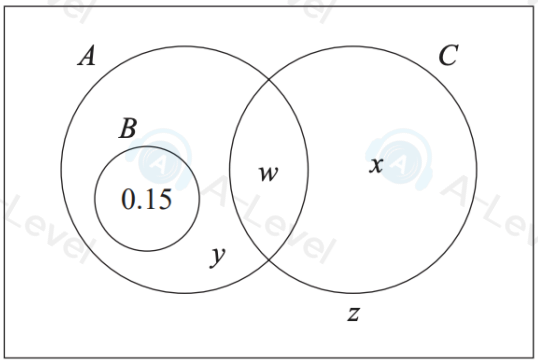
(3)

2. The Venn diagram, where w, x, y and z are probabilities, shows the probabilities of a group of students buying each of 3 magazines.

A represents the event that a student buys magazine A and $P(A) = 0.60$

B represents the event that a student buys magazine B and $P(B) = 0.15$

C represents the event that a student buys magazine C and $P(C) = 0.35$



(a) State which two of the three events A, B and C are mutually exclusive.

(1)

The events A and C are independent.

(b) Show that $w = 0.21$

(1)

(c) Find the value of x, the value of y and the value of z.

(4)

(d) Find the probability that a student selected at random buys only one of these magazines.

(1)

(e) Find the probability that a student selected at random buys magazine B or magazine C.

(1)

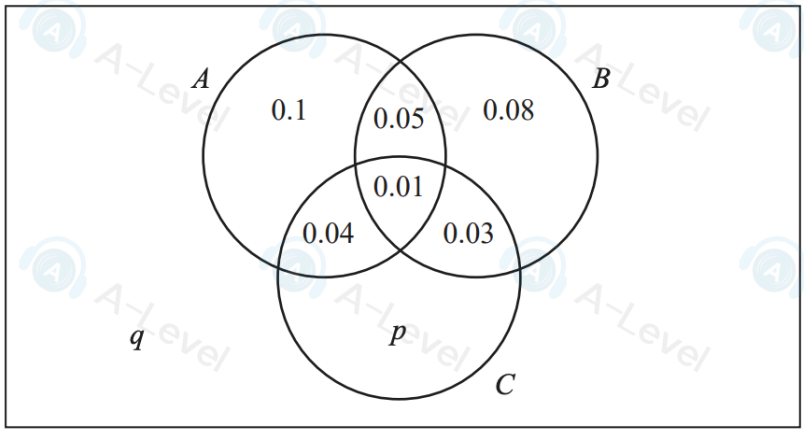
(f) Find $P(A \mid [B \cup C])$

(3)

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4. Pieces of wood cladding are produced by a timber merchant. There are three types of fault, A, B and C, that can appear in each piece of wood cladding.

The Venn diagram shows the probabilities of a piece of wood cladding having the various types of fault.



A piece of wood cladding is chosen at random.

(a) Find the probability that the piece of wood cladding has more than one type of fault.

(1)

Fault types A and C occur independently.

(b) Find the probability that the piece of wood cladding has no faults.

(4)

Given that the piece of wood cladding has fault A,

(c) find the probability that it also has fault B but not fault C.

(2)

Two pieces of the wood cladding are selected at random.

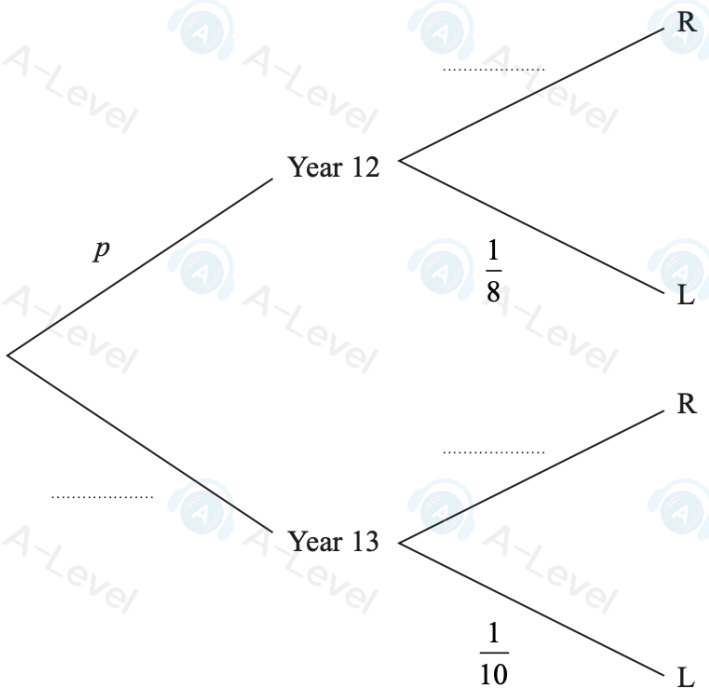
(d) Find the probability that both have exactly 2 types of fault.

(3)

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3. In a sixth form college each student in Year 12 and Year 13 is either left-handed (L) or right-handed (R).

The partially completed tree diagram, where p is a probability, gives information about these students.



(a) Complete the tree diagram, in terms of p where necessary.

(1)

The probability that a student is left-handed is 0.11

(b) Find the value of p

(3)

(c) Find the probability that a student selected at random is in Year 12 and left-handed.

(2)

Given that a student is right-handed,

(d) find the probability that the student is in Year 12

(2)

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