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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 $E(X)$

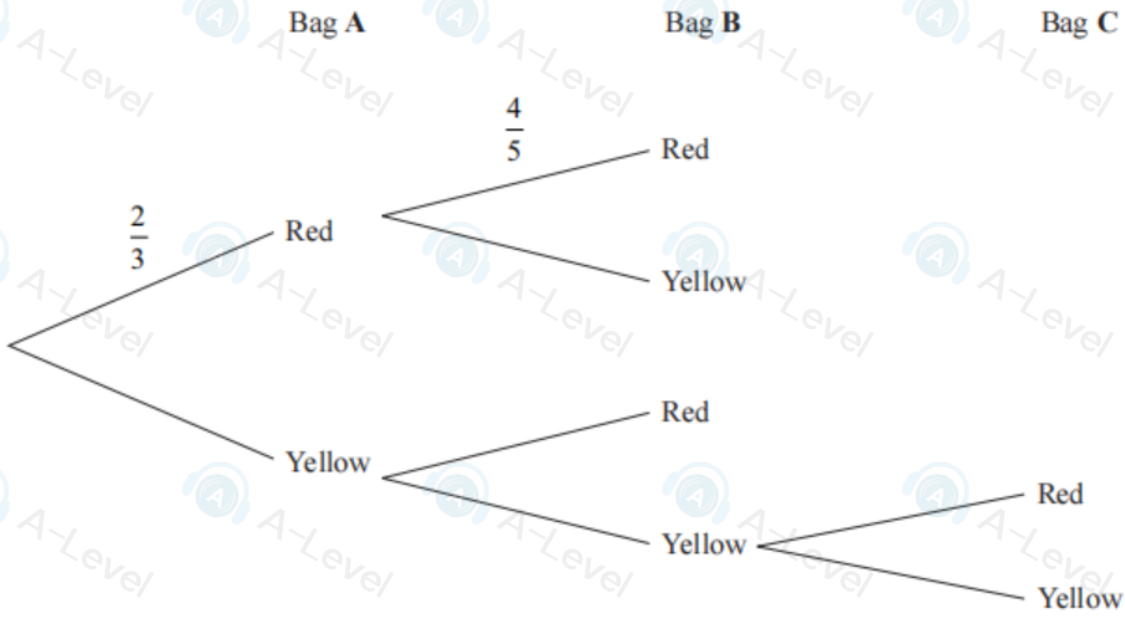
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Question 4 continued



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3. A random sample of 100 carrots is taken from a farm and their lengths, Lcm, recorded. The data are summarised in the following table.

Length, Lcm	Frequency, f	Class mid point, $x$cm
$5 \leqslant L < 8$	5	6.5
$8 \leqslant L < 10$	13	9
$10 \leqslant L < 12$	16	11
$12 \leqslant L < 15$	25	13.5
$15 \leqslant L < 20$	30	17.5
$20 \leqslant L < 28$	11	24

A histogram is drawn to represent these data.
The bar representing the class $5 \leqslant L < 8$ is 1.5 cm wide and 1 cm high.

(a) Find the width and height of the bar representing the class $15 \leqslant L < 20$

(3)

(b) Use linear interpolation to estimate the median length of these carrots.

(2)

(c) Estimate

(i) the mean length of these carrots,

(2)

(ii) the standard deviation of the lengths of these carrots.

(3)

A supermarket will only buy carrots with length between 9 cm and 22 cm.

(d) Estimate the proportion of carrots from the farm that the supermarket will buy.

(2)

Any carrots that the supermarket does not buy are sold as animal feed.

The farm makes a profit of 2.2 pence on each carrot sold to the supermarket, a profit of 0.8 pence on each carrot longer than 22 cm and a loss of 1.2 pence on each carrot shorter than 9 cm.

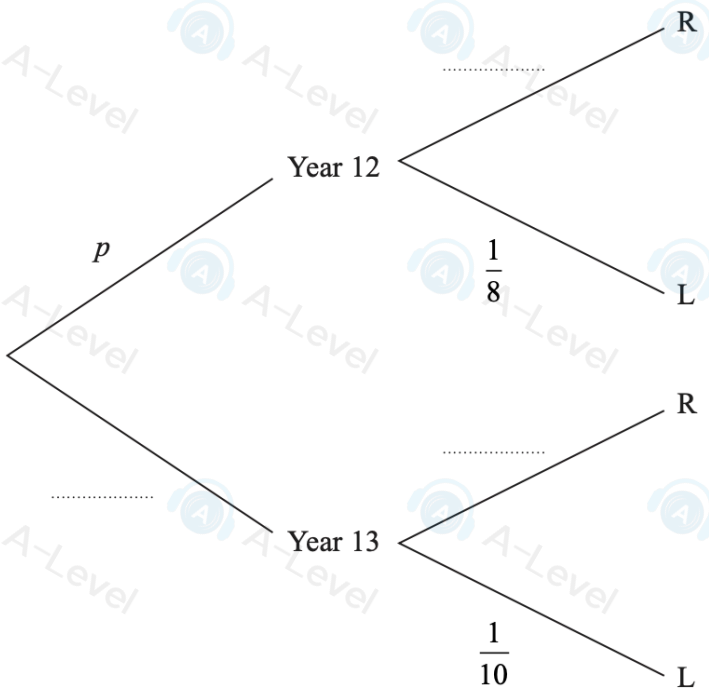
(e) Find an estimate of the mean profit per carrot made by the farm.

(2)

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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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2: Students in class A and class B sit a statistics test.

There are 24 students in class A and 30 students in class B

The marks, x, for students in each class are summarised in the table below.

	n	$\bar{x}$	$\sum x^2$
Class A	24	47	66 876
Class B	30	b	73 826

The two classes are combined into one group of 54 students.
The mean mark for all 54 students is 45

(a) Show that $b = 43.4$

(2)

(b) Find the standard deviation of the marks for all 54 students.

(2)

Following moderation, each student in class B has their mark increased by 2

(c) Without further calculations state, giving a reason in each case, the effect this will have on

(i) the variance of the marks for class B

(ii) the mean mark for all 54 students

(iii) the standard deviation of the marks for all 54 students.

(3)

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3. Jim records the length, l mm, of 81 salmon. The data are coded using $x = l - 600$ and the following summary statistics are obtained.

$$n = 81 \qquad \sum x = 3711 \qquad \sum x^2 = 475\,181$$

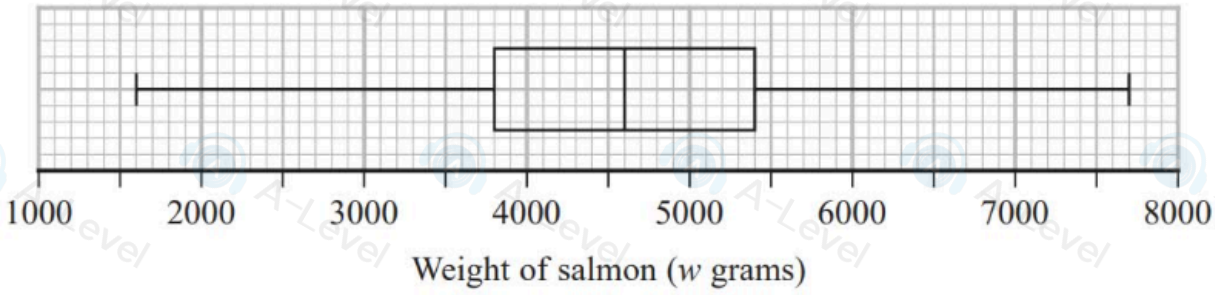
(a) Find the mean length of these salmon.

(3)

(b) Find the variance of the lengths of these salmon.

(2)

The weight, w grams, of each of the 81 salmon is recorded to the nearest gram.
The recorded results for the 81 salmon are summarised in the box plot below.



Weight of salmon (w grams)

(c) Find the maximum number of salmon that have weights in the interval

$$4600 < w \leqslant 7700$$

(1)

Raj says that the box plot is incorrect as Jim has not included outliers.

For these data an outlier is defined as a value that is more than

$1.5 \times$ IQR above the upper quartile or $1.5 \times$ IQR below the lower quartile

(d) Show that there are no outliers.

(3)

3. Gill buys a bag of logs to use in her stove. The lengths, $l$cm, of the 88 logs in the bag are summarised in the table below.

Length (l)	Frequency (f)
$15 < l \leqslant 20$	19
$20 < l \leqslant 25$	35
$25 < l \leqslant 27$	16
$27 < l \leqslant 30$	15
$30 < l \leqslant 40$	3

A histogram is drawn to represent these data.
The bar representing logs with length $27 < l \leqslant 30$ has a width of 1.5 cm and a height of 4 cm.

(a) Calculate the width and height of the bar representing log lengths of $20 < l \leqslant 25$

(3)

(b) Use linear interpolation to estimate the median of l

(2)

The maximum length of log Gill can use in her stove is 26 cm.
Gill estimates, using linear interpolation, that x logs from the bag will fit into her stove.

(c) Show that $x = 62$

(1)

Gill randomly selects 4 logs from the bag.

(d) Using $x = 62$, find the probability that all 4 logs will fit into her stove.

(2)

The weights, W grams, of the logs in the bag are coded using $y = 0.5w - 255$ and summarised by

$$n = 88 \qquad \sum y = 924 \qquad \sum y^2 = 12\,862$$

(e) Calculate

(i) the mean of W

(3)

(ii) the variance of W

(3)

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7. In a large college, $\frac{3}{5}$ of the students are male, $\frac{3}{10}$ of the students are left handed and $\frac{1}{5}$ of the male students are left handed.

A student is chosen at random.

(a) Given that the student is left handed, find the probability that the student is male.

(2)

(b) Given that the student is female, find the probability that she is left handed.

(3)

(c) Find the probability that the randomly chosen student is male and right handed.

(2)

Two students are chosen at random.

(d) Find the probability that one student is left handed and one is right handed.

(2)

2. The time taken to complete a puzzle, in minutes, is recorded for each person in a club. The times are summarised in a grouped frequency distribution and represented by a histogram.

One of the class intervals has a frequency of 20 and is shown by a bar of width 1.5 cm and height 12 cm on the histogram. The total area under the histogram is 94.5 cm^2

Find the number of people in the club.

(3)

3. (i) Bob shops at a market each week. The event that

Bob buys carrots is denoted by C

Bob buys onions is denoted by O

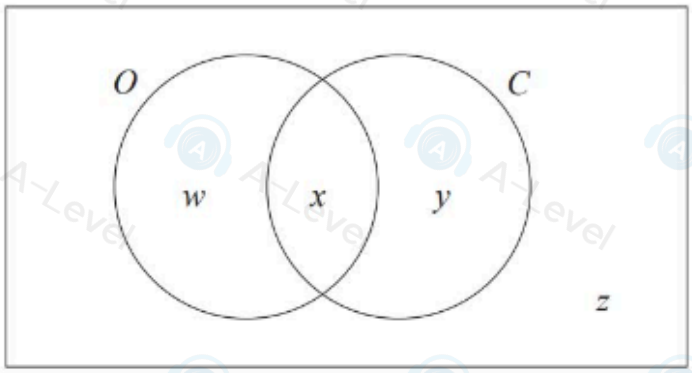
At each visit, Bob may buy neither, or one, or both of these items. The probability that

Bob buys carrots is 0.65

Bob does **not** buy onions is 0.3

Bob buys onions but not carrots is 0.15

The Venn diagram below represents the events C and O



where w, x, y and z are probabilities.

(a) Find the value of w, the value of x, the value of y and the value of z

(4)

For one visit to the market,

(b) find the probability that Bob buys either carrots or onions but not both.

(1)

(c) Show that the events C and O are **not** independent.

(2)

(ii) F, G and H are 3 events. F and H are mutually exclusive. F and G are independent.

Given that

$$\mathrm{P}(F) = \frac{2}{7} \qquad \mathrm{P}(H) = \frac{1}{4} \qquad \mathrm{P}(F \cup G) = \frac{5}{8}$$

(a) find $\mathrm{P}(F \cup H)$

(1)

(b) find $\mathrm{P}(G)$

(3)

(c) find $\mathrm{P}(F \cap G)$

(1)