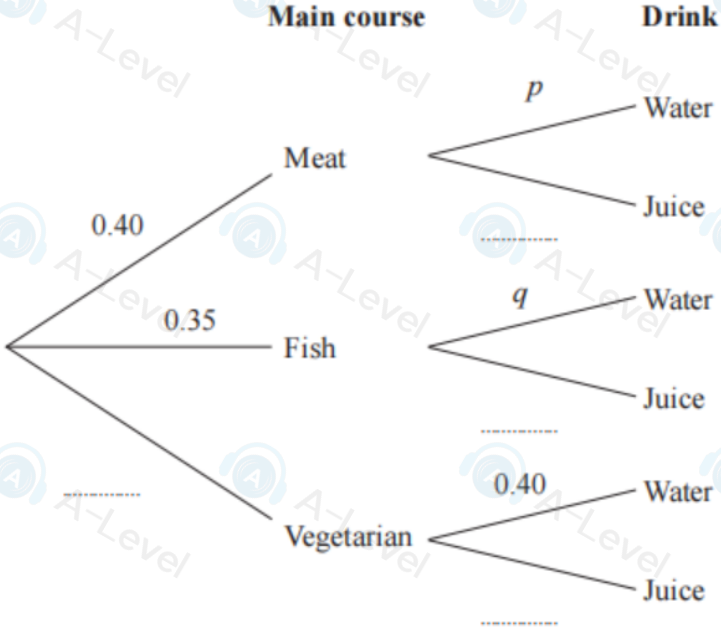
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**2.** In a school canteen, students can choose from a main course of meat ($M$), fish ($F$) or vegetarian ($V$). They can then choose a drink of either water ($W$) or juice ($J$).

The partially completed tree diagram, where $p$ and $q$ are probabilities, shows the probabilities of these choices for a randomly selected student.




(a) Complete the tree diagram, giving your answers in terms of $p$ and $q$ where appropriate.

**(2)**

(b) Find an expression, in terms of $p$ and $q$, for the probability that a randomly selected student chooses water to drink.

**(1)**

The events "choosing a vegetarian main course" and "choosing water to drink" are independent.

(c) Find a linear equation in terms of $p$ and $q$.

**(2)**

A student who has chosen juice to drink is selected at random. The probability that they chose fish for their main course is $\frac{7}{30}$

(d) Find the value of $p$ and the value of $q$.

**(5)**

The canteen manager claims that students who choose water to drink are most likely to choose a fish main course.

(e) State, showing your working clearly, whether or not the manager's claim is correct.

**(3)**

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**4.** The events $H$ and $W$ are such that

$$P(H) = \frac{3}{8} \qquad P(H \cup W) = \frac{3}{4}$$

Given that $H$ and $W$ are independent,

(a) show that $P(W) = \frac{3}{5}$

**(4)**

The event $N$ is such that

$$P(N) = \frac{1}{15} \qquad P(H \cap N) = P(N)$$

(b) Find $P(N' | H)$

**(2)**

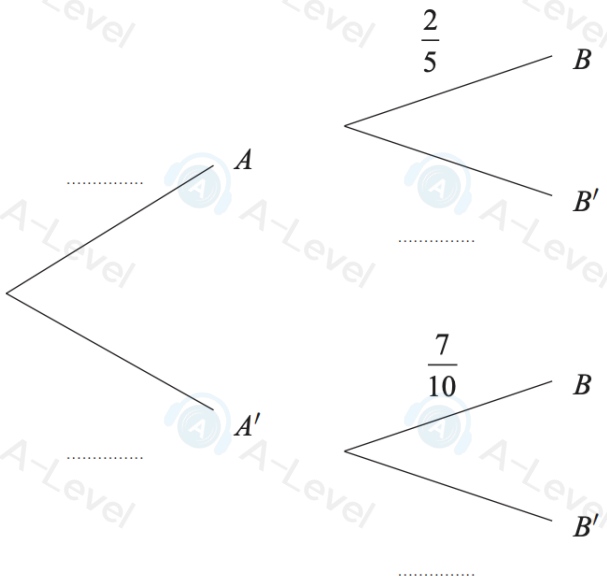
Given that $W$ and $N$ are mutually exclusive,

(c) draw a Venn diagram to represent the events $H$, $W$ and $N$ giving the exact probabilities of each region in the Venn diagram.

**(5)**

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**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 $P(A' | B')$.

**(2)**

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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 $E(X)$

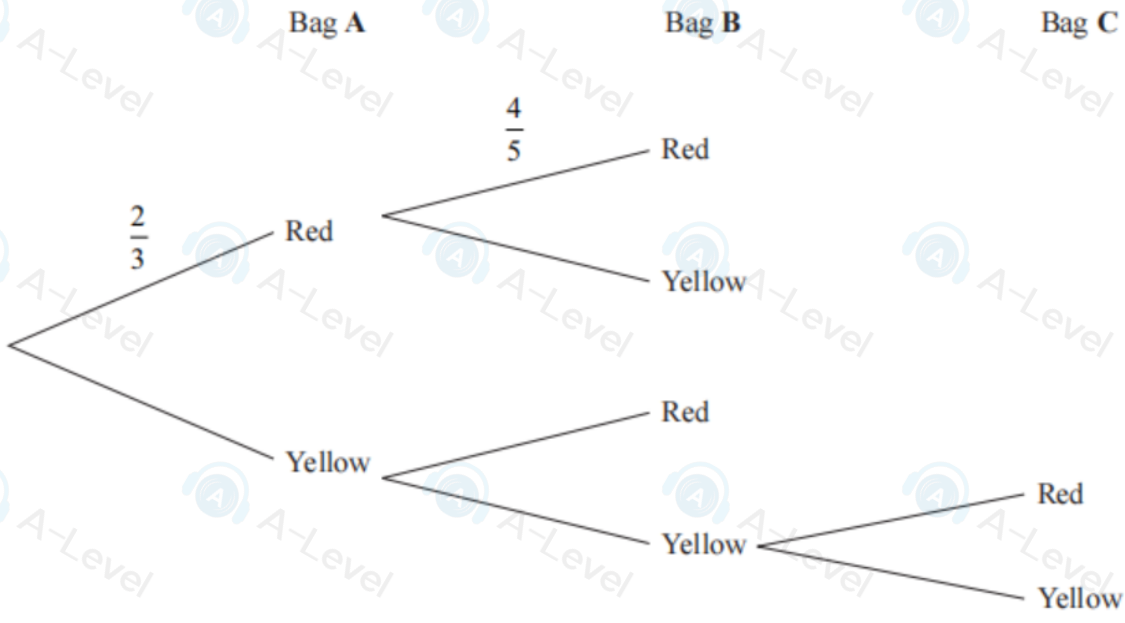
**(2)**

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**Question 4 continued**




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