# Statistics Year 2 exam questions Edexcel



Arancha Ruiz

## June 2023 Question 5

**5.** Tisam is playing a game.
She uses a ball, a cup and a spinner.

The random variable $X$ represents the number the spinner lands on when it is spun.
The probability distribution of $X$ is given in the following table

| $x$ | 20 | 50 | 80 | 100 |
|---|---|---|---|---|
| $\mathrm{P}(X = x)$ | $a$ | $b$ | $c$ | $d$ |

where $a$, $b$, $c$ and $d$ are probabilities.

To play the game

- the spinner is spun to obtain a value of $x$
- Tisam then stands $x$ cm from the cup and tries to throw the ball into the cup

The event $S$ represents the event that Tisam successfully throws the ball into the cup.

To model this game Tisam assumes that

- $\mathrm{P}(S \mid \{X = x\}) = \dfrac{k}{x}$ where $k$ is a constant
- $\mathrm{P}(S \cap \{X = x\})$ should be the same whatever value of $x$ is obtained from the spinner

Using Tisam's model,

(a) show that $c = \dfrac{8}{5}b$

**(2)**

(b) find the probability distribution of $X$

**(5)**

Nav tries, a large number of times, to throw the ball into the cup from a distance of 100 cm.
He successfully gets the ball in the cup 30% of the time.

(c) State, giving a reason, why Tisam's model of this game is not suitable to describe Nav playing the game for all values of $X$

**(1)**

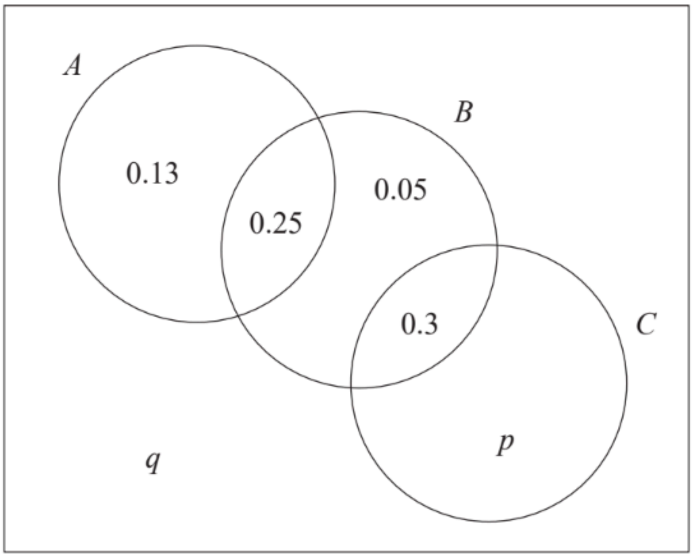
**ANSWER**

| Qu 5 | Scheme | Marks | AO |
|---|---|---|---|
| (a) | $\mathrm{P}(S \cap \{X=50\}) = \mathrm{P}(S \cap \{X=80\})$[= a constant, $V$] $\Rightarrow b \times \dfrac{k}{50} = c \times \dfrac{k}{80}$<br>May see: $\dfrac{k}{50} = \dfrac{V}{b}$ and $\dfrac{k}{80} = \dfrac{V}{c}$ (condone any letter for $V$ even $S$) | M1 | 3.1a |
| | So $\quad c = \dfrac{8}{5}b$ * | A1cso* | 1.1b |
| | | (2) | |
| (b) | $d = 2b$ **or** $a = \dfrac{2}{5}b$ **or** $c = 4a$ **or** $d = 5a$ **or** $d = \dfrac{5}{4}c$ | M1<br>A1 | 2.1<br>3.3 |
| | $\dfrac{2}{5}b + b + \dfrac{8}{5}b + 2b = 1$ | M1 | 2.1 |
| | $\Rightarrow 5b = 1$ so $b = \dfrac{1}{5}$ (o.e.) | A1 | 1.1b |
| | $a = \dfrac{2}{25} \quad b = \dfrac{1}{5} \quad c = \dfrac{8}{25} \quad d = \dfrac{2}{5}$ | A1 | 3.2a |
| | | (5) | |
| (c) | [Experiment suggests for Nav] $\mathrm{P}(S \mid \{X=100\}) = 0.3 \Rightarrow k = 30$<br>**or** $0.3 = \dfrac{V}{0.4} \Rightarrow V = 0.12$<br>So model won't work since<br>$\mathrm{P}(S \mid X=20) = \dfrac{30}{20}$ or $\dfrac{0.12}{0.08}$ and so would be greater than 1 | B1 | 2.4 |
| | | (1) | |
| | | **(8 marks)** | |

Arancha Ruiz

## June 2023 Question 1

**1.** The Venn diagram, where $p$ and $q$ are probabilities, shows the three events $A$, $B$ and $C$ and their associated probabilities.




(a) Find P($A$)

**(1)**

The events $B$ and $C$ are independent.

(b) Find the value of $p$ and the value of $q$

**(3)**

(c) Find $P(A|B')$

**(2)**

**ANSWER**

| Qu 1 | Scheme | Marks | AO |
|---|---|---|---|
| **(a)** | [0.13 + 0.25 = ] **0.38** | B1 | 1.1b |
| | | **(1)** | |
| **(b)** | Independence implies: | | |
| | e.g. $\left[\mathrm{P}(B \cap C) = \mathrm{P}(B) \times \mathrm{P}(C) \quad \Rightarrow\right] \quad 0.3 = (0.3 + 0.05 + 0.25) \times (0.3 + p)$ | M1 | 1.1b |
| | So $p = \underline{\mathbf{0.2}}$ | A1 | 1.1b |
| | [Sum of probabilities = 1 gives] $q = \underline{\mathbf{0.07}}$ | B1ft | 1.1b |
| | | **(3)** | |
| **(c)** | $[\mathrm{P}(A \mid B') =] \dfrac{\mathrm{P}(A \cap B')}{\mathrm{P}(B')}$ or $\dfrac{0.13}{(1-0.6) \text{ or } (0.13 + \text{"}0.2\text{"} + \text{"}0.07\text{"})}$ | M1 | 1.1b |
| | $= \dfrac{13}{40}$ or $\underline{\mathbf{0.325}}$ | A1 | 1.1b |
| | | **(2)** | |
| | | **(6 marks)** | |

## June 2022 Question 5

**5.** A company has 1825 employees.
The employees are classified as professional, skilled or elementary.

The following table shows

- the number of employees in each classification
- the two areas, $A$ or $B$, where the employees live

| | $A$ | $B$ |
|---|---|---|
| **Professional** | 740 | 380 |
| **Skilled** | 275 | 90 |
| **Elementary** | 260 | 80 |

An employee is chosen at random.

Find the probability that this employee

(a) is skilled,

**(1)**

(b) lives in area $B$ and is not a professional.

**(1)**

Some classifications of employees are more likely to work from home.

- 65% of professional employees in both area $A$ and area $B$ work from home
- 40% of skilled employees in both area $A$ and area $B$ work from home
- 5% of elementary employees in both area $A$ and area $B$ work from home
- Event $F$ is that the employee is a professional
- Event $H$ is that the employee works from home
- Event $R$ is that the employee is from area $A$

(c) Using this information, complete the Venn diagram on the opposite page.

**(4)**

(d) Find $P(R' \cap F)$

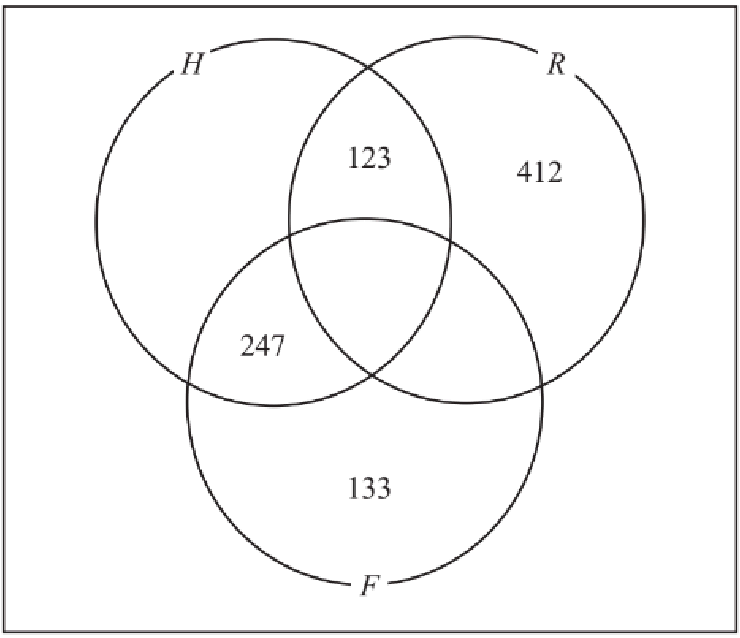
**(1)**

(e) Find $P([H \cup R]')$

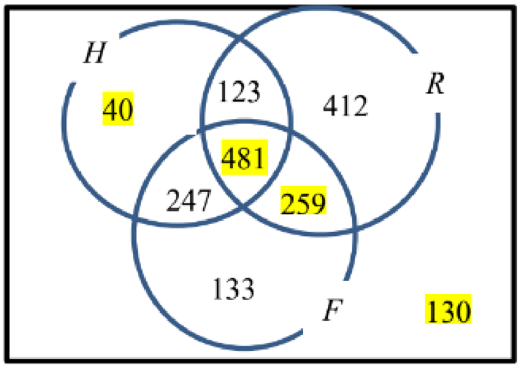
**(1)**

(f) Find $P(F \mid H)$

**(2)**



## ANSWER

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 5(a) | $\frac{365}{1825}$ or $\frac{1}{5}$ or 0.2 oe | B1 | 1.1b |
| | | **(1)** | |
| (b) | $\frac{170}{1825}$ or $\frac{34}{365}$ or awrt 0.093 | B1 | 1.1b |
| | | **(1)** | |
| (c) | $90\times0.4+80\times0.05[=40]$ or $90\times0.6+80\times0.95[=130]$ or $740\times0.65[=481]$ or $740\times0.35[=259]$ | M1 | 3.1b |
| |  | B1<br>B1<br>A1 | 1.1b<br>1.1b<br>1.1b |
| | | **(4)** | |
| (d) | $P(R'\cap F)=\frac{380}{1825}\left[=\frac{76}{365}=0.208...\right]$ oe awrt 0.208 | B1 | 1.1b |
| | | **(1)** | |
| (e) | $\left[\frac{133\ +\ "130"}{1825}=\right]\frac{"263"}{1825}$ awrt 0.144 | B1ft | 1.1b |
| | | **(1)** | |
| (f) | $\frac{247+"481"}{247+"481"+123+"40"}$ | M1 | 3.4 |
| | $=\frac{728}{891}$ awrt 0.817 | A1 | 1.1b |
| | | **(2)** | |
| | **Notes:** | | **(10 marks)** |

## November 2021 question 1

**1.** (a) State one disadvantage of using quota sampling compared with simple random sampling.

**(1)**

In a university 8% of students are members of the university dance club.

A random sample of 36 students is taken from the university.

The random variable $X$ represents the number of these students who are members of the dance club.

(b) Using a suitable model for $X$, find

(i) $P(X = 4)$

(ii) $P(X \geqslant 7)$

**(3)**

Only 40% of the university dance club members can dance the tango.

(c) Find the probability that a student is a member of the university dance club and can dance the tango.

**(1)**

A random sample of 50 students is taken from the university.

(d) Find the probability that fewer than 3 of these students are members of the university dance club and can dance the tango.

**(2)**

## ANSWER

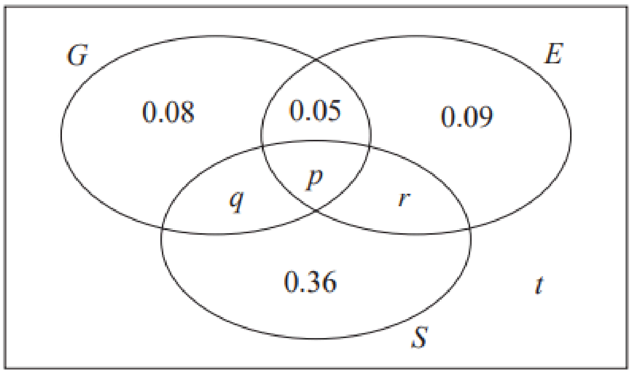
| Qu 1 | Scheme | Marks | AO |
|---|---|---|---|
| **(a)** | **Disadvantage:** e.g. Not random; cannot use (reliably) for inferences | B1 | 1.1b |
| | | **(1)** | |
| **(b)** | [Sight or correct use of] $X \sim \mathrm{B}(36, 0.08)$ | M1 | 3.3 |
| **(i)** | $\mathrm{P}(X = 4) = 0.167387\ldots$ awrt $\underline{\mathbf{0.167}}$ | A1 | 1.1b |
| **(ii)** | $[\mathrm{P}(X \geqslant 7) = 1 - \mathrm{P}(X \leqslant 6) =]$ $0.022233\ldots$ awrt $\underline{\mathbf{0.0222}}$ | A1 | 1.1b |
| | | **(3)** | |
| **(c)** | P(In dance club and dance tango) = $0.4 \times 0.08 = \underline{\mathbf{0.032}}$ or $\underline{\underline{\frac{4}{125}}}$ or $\underline{\mathbf{3.2\%}}$ | B1 | 1.1b |
| | | **(1)** | |
| **(d)** | [Let $T$ = those who can dance the Tango. Sight or use of] $T \sim \mathrm{B}(50, \text{“}0.032\text{”})$ | M1 | 3.3 |
| | $[\mathrm{P}(T < 3) = \mathrm{P}(T \leqslant 2) =]$ $0.7850815\ldots$ awrt $\underline{\mathbf{0.785}}$ | A1 | 1.1b |
| | | **(2)** | |
| | | **(7 marks)** | |

## November 2021 question 4

**4.** A large college produces three magazines.
One magazine is about green issues, one is about equality and one is about sports.
A student at the college is selected at random and the events $G$, $E$ and $S$ are defined as follows

$G$ is the event that the student reads the magazine about green issues
$E$ is the event that the student reads the magazine about equality
$S$ is the event that the student reads the magazine about sports

The Venn diagram, where $p$, $q$, $r$ and $t$ are probabilities, gives the probability for each subset.




(a) Find the proportion of students in the college who read exactly one of these magazines.

**(1)**

No students read all three magazines and $\mathrm{P}(G) = 0.25$

(b) Find

(i) the value of $p$

(ii) the value of $q$

**(3)**

Given that $\mathrm{P}(S \mid E) = \frac{5}{12}$

(c) find

(i) the value of $r$

(ii) the value of $t$

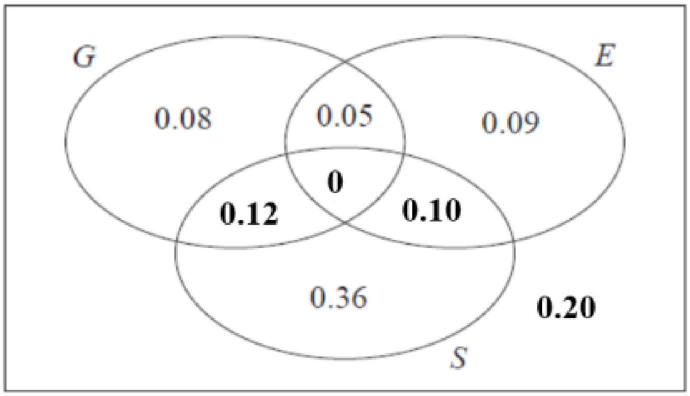
**(4)**

(d) Determine whether or not the events $(S \cap E')$ and $G$ are independent.
Show your working clearly.

**(3)**

ANSWER

| Qu 4 | Scheme | Marks | AO |
|---|---|---|---|
| (a) | $0.08 + 0.09 + 0.36 = \underline{\mathbf{0.53}}$ | B1 | 1.1b |
| | | (1) | |
| (b)(i) | $\left[\mathrm{P}(G \cap E \cap S) = 0 \quad \Rightarrow\right] \quad \underline{\mathbf{p = 0}}$ | B1 | 1.1b |
| (ii) | $[\mathrm{P}(G) = 0.25 \Rightarrow]\ 0.08 + 0.05 + q + "p" = 0.25$ | M1 | 1.1b |
| | $\underline{\mathbf{q = 0.12}}$ | A1 | 1.1b |
| | | (3) | |
| (c)(i) | $\left[\mathrm{P}(S \mid E) = \frac{5}{12} \quad \Rightarrow\right] \frac{r + "p"}{r + "p" + 0.09 + 0.05} = \frac{5}{12}$ | M1<br>A1ft | 3.1a<br>1.1b |
| | $[12r = 5r + 5 \times 0.14 \quad \Rightarrow] \quad \underline{\mathbf{r = 0.10}}$ | A1 | 1.1b |
| (ii) | $[0.08 + 0.05 + "0.12" + "0" + 0.09 + "0.10" + 0.36 + t = 1 \quad \Rightarrow] \quad \underline{\mathbf{t = 0.20}}$ | B1ft | 1.1b |
| | | (4) | |
| (d) | $\mathrm{P}(S \cap E') = 0.36 + \text{“}q\text{”}\ [= 0.48]$ | B1ft | 1.1b |
| | $\mathrm{P}\left(\left[(S \cap E')\right] \cap G\right) = "q"[=0.12]$ **and** $\mathrm{P}(G) = 0.25$ **and** $\mathrm{P}(S \cap E') \times \mathrm{P}(G) = "0.48" \times \frac{1}{4}$ or $0.12$ | M1 | 2.1 |
| | $\mathrm{P}(S \cap E') \times \mathrm{P}(G) = 0.12 = \mathrm{P}\left(\left[(S \cap E')\right] \cap G\right)$ so **are independent** | A1 | 2.2a |
| | | (3) | |
| | | (11 marks) | |



## November 2021 question 6

**6.** The discrete random variable $X$ has the following probability distribution

| $x$ | $a$ | $b$ | $c$ |
|---|---|---|---|
| $\mathrm{P}(X = x)$ | $\log_{36} a$ | $\log_{36} b$ | $\log_{36} c$ |

where

- $a$, $b$ and $c$ are distinct integers $(a < b < c)$
- all the probabilities are greater than zero

(a) Find

(i) the value of $a$

(ii) the value of $b$

(iii) the value of $c$

Show your working clearly.

**(5)**

The independent random variables $X_1$ and $X_2$ each have the same distribution as $X$

(b) Find $\mathrm{P}(X_1 = X_2)$

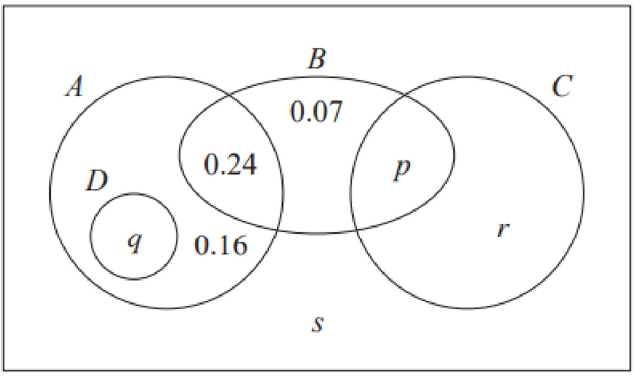
**(2)**

**ANSWER**

| Qu 6 | Scheme | Marks | AO |
|---|---|---|---|
| (a) | [Sum of probs = 1 implies] $\log_{36} a + \log_{36} b + \log_{36} c = 1$ | M1 | 3.1a |
| | $\Rightarrow \log_{36}(abc) = 1$ so $abc = 36$ | A1 | 3.4 |
| | All probabilities greater than 0 implies each of $a$, $b$ and $c$ $> 1$ | B1 | 2.2a |
| | $36 = 2^2 \times 3^2$ (or 3 numbers that multiply to give 36 e.g. 2, 2, 9 etc ) | dM1 | 2.1 |
| | Since $a$, $b$ and $c$ are distinct must be **2, 3, 6** **($a = 2, b = 3, c = 6$)** | A1 | 3.2a |
| | | **(5)** | |
| (b) | $(\log_{36} a)^2 + (\log_{36} b)^2 + (\log_{36} c)^2$ | M1 | 3.4 |
| | [= 0.0374137…+ 0.09398737…+0.25] | | |
| | $= 0.38140\ldots$ awrt **0.381** | A1 | 1.1b |
| | | **(2)** | |
| | | **( 7 marks)** | |

## October 2020 question 1

1. The Venn diagram shows the probabilities associated with four events, $A$, $B$, $C$ and $D$




(a) Write down any pair of mutually exclusive events from $A$, $B$, $C$ and $D$ **(1)**

Given that $\mathrm{P}(B) = 0.4$

(b) find the value of $p$ **(1)**

Given also that $A$ and $B$ are independent

(c) find the value of $q$ **(2)**

Given further that $\mathrm{P}(B' \mid C) = 0.64$

(d) find

(i) the value of $r$

(ii) the value of $s$

**(4)**

## ANSWER

| Qu 1 | Scheme | Marks | AO |
|---|---|---|---|
| **(a)** | $A, C$ <u>or</u> $D, B$ <u>or</u> $D, C$ | B1 **(1)** | 1.2 |
| **(b)** | $[p = 0.4 - 0.07 - 0.24 = ]$ $\underline{\mathbf{0.09}}$ | B1 **(1)** | 1.1b |
| **(c)** | $A$ and $B$ independent implies | | 1.1b |
| | $\text{P}(A) \times 0.4 = 0.24$ <u>or</u> $(q + 0.16 + 0.24) \times 0.4 = 0.24$ | M1 | |
| | so $\text{P}(A) = 0.6$ and $q = \underline{\mathbf{0.20}}$ | A1cso **(2)** | 1.1b |
| **(d)(i)** | $\text{P}(B' \mid C) = 0.64$ gives $\frac{r}{r+p} = 0.64$ <u>or</u> $\frac{r}{r + "0.09"} = 0.64$ | M1 | 3.1a |
| | $r = 0.64r + 0.64$ "$p$" so $0.36r = 0.0576$ so $r = \underline{\mathbf{0.16}}$ | A1 | 1.1b |
| **(ii)** | Using sum of probabilities = 1 e.g. "0.6" + 0.07 + "0.25" + $s$ = 1 | M1 | 1.1b |
| | so $s = \underline{\mathbf{0.08}}$ | A1 **(4)** | 1.1b |
| | | **( 8 marks)** | |

## October 2020 question 4

**4.** The discrete random variable $D$ has the following probability distribution

| $d$ | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| $P(D = d)$ | $\frac{k}{10}$ | $\frac{k}{20}$ | $\frac{k}{30}$ | $\frac{k}{40}$ | $\frac{k}{50}$ |

where $k$ is a constant.

(a) Show that the value of $k$ is $\frac{600}{137}$

**(2)**

The random variables $D_1$ and $D_2$ are independent and each have the same distribution as $D$.

(b) Find $P(D_1 + D_2 = 80)$
Give your answer to 3 significant figures.

**(3)**

A single observation of $D$ is made.

The value obtained, $d$, is the common difference of an arithmetic sequence.

The first 4 terms of this arithmetic sequence are the angles, measured in degrees, of quadrilateral $Q$

(c) Find the exact probability that the smallest angle of $Q$ is more than 50°

**(5)**

**ANSWER**

| Qu 4 | Scheme | Marks | AO |
|---|---|---|---|
| **(a)** | $\frac{k}{10}+\frac{k}{20}+\frac{k}{30}+\frac{k}{40}+\frac{k}{50}=1$ or $\frac{1}{600}(60k+30k+20k+15k+12k)=1$ | M1 | 1.1b |
| | So $k=\frac{600}{137}$ (*) | A1cso | 1.1b |
| | | **(2)** | |
| **(b)** | (Cases are:) $D_1=30, D_2=50$ and $D_1=50, D_2=30$ and $D_1=40, D_2=40$ | M1 | 2.1 |
| | $\text{P}(D_1+D_2=80)=\frac{k}{50}\times\frac{k}{30}\times 2+\left(\frac{k}{40}\right)^2$ | M1 | 3.4 |
| | $=0.0375619\ldots$ awrt $\underline{\mathbf{0.0376}}$ | A1 | 1.1b |
| | | **(3)** | |
| **(c)** | Angles are: $a$, $a+d$, $a+2d$, $a+3d$ | M1 | 3.1a |
| | $S_4 = a + (a+d) + (a+2d) + (a+3d) = 360$ | M1 | 2.1 |
| | $2a+3d=180$ (o.e.) | A1 | 2.2a |
| | Smallest angle is $a>50$ consider cases:<br>$d=10$ so $a=75$ <u>or</u> $d=20$ so $a=60$ [ $d=30$ gives $a=45$ no good] | M1 | 3.1b |
| | $\text{P}(D=10 \text{ or } 20)=\frac{3k}{20}=\underline{\underline{\frac{90}{137}}}$ | A1 | 1.1b |
| | | **(5)** | |
| | | **( 10 marks)** | |

## June 2019 question 1

**1.** Three bags, $A$, $B$ and $C$, each contain 1 red marble and some green marbles.

Bag $A$ contains 1 red marble and 9 green marbles only
Bag $B$ contains 1 red marble and 4 green marbles only
Bag $C$ contains 1 red marble and 2 green marbles only

Sasha selects at random one marble from bag $A$.
If he selects a red marble, he stops selecting.
If the marble is green, he continues by selecting at random one marble from bag $B$.
If he selects a red marble, he stops selecting.
If the marble is green, he continues by selecting at random one marble from bag $C$.

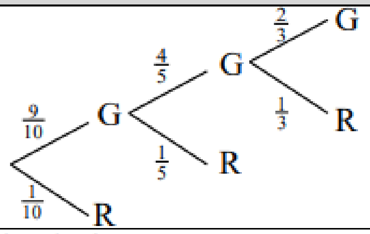
(a) Draw a tree diagram to represent this information.
**(2)**

(b) Find the probability that Sasha selects 3 green marbles.
**(2)**

(c) Find the probability that Sasha selects at least 1 marble of each colour.
**(2)**

(d) Given that Sasha selects a red marble, find the probability that he selects it from bag $B$.
**(2)**

## ANSWER

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| **1(a)** |  | B1<br>dB1 | 1.1b<br>1.1b |
| | | **(2)** | |
| **(b)** | $\frac{9}{10}\times\frac{4}{5}\times\frac{2}{3}$ | M1 | 1.1b |
| | $=\frac{12}{25}(=0.48)$ | A1 | 1.1b |
| | | **(2)** | |
| **(c)** | $\frac{9}{10}\times\frac{1}{5}+\frac{9}{10}\times\frac{4}{5}\times\frac{1}{3}$ or $1-\left(\frac{1}{10}+\frac{9}{10}\times\frac{4}{5}\times\frac{2}{3}\right)$ | M1 | 3.1b |
| | $=\frac{21}{50}\ (=0.42)$ | A1 | 1.1b |
| | | **(2)** | |
| **(d)** | [P(Red from $B$\|Red selected) ] $=\dfrac{\frac{9}{10}\times\frac{1}{5}}{\frac{1}{10}+\frac{9}{10}\times\frac{1}{5}+\frac{9}{10}\times\frac{4}{5}\times\frac{1}{3}}\left[=\dfrac{\frac{9}{50}}{\frac{13}{25}}\right]$ | M1 | 3.1b |
| | $=\frac{9}{26}$ | A1 | 1.1b |
| | | **(2)** | |
| | | | **(8 marks)** |