M1.

$\frac{9}{27}$ or $\frac{18}{27}$ or fraction with denominator 22

oe

                                                  M1

$\frac{9}{27} \times \frac{8}{22}$ or $\frac{72}{594}$ or

$\frac{18}{27} \times \frac{7}{22}$ or $\frac{126}{594}$

oe

                                                  M1

their $\frac{72}{594}$ + their $\frac{126}{594}$ or $\frac{198}{594}$

oe
dep on 2nd M1

                                                M1dep

Clear indication that $\frac{198}{594}$ and $\frac{9}{27}$ are equivalent fractions

                                                  A1

                                                          [4]

M2.

Alternative method 1   red
42 seen or used
or probability (red and red) = $\frac{42}{90}$
or $\frac{r}{10} \times \frac{r-1}{9}$

or $1 - (\frac{r}{10} \times \frac{r-1}{9})$

oe

$\frac{7}{15}$ or 0.46 or 0.466... or 0.47

or 46% or 46.6… or 47%

B1

$\frac{7}{10} \times \frac{6}{9}$ or $42 = 7 \times 6$

or $(\frac{r}{10} \times \frac{r-1}{9}) = \frac{42}{90}$

or $1 - (\frac{r}{10} \times \frac{r-1}{9}) = \frac{48}{90}$

or $r(r-1) = 42$

or $r^2 - r = 42$

oe

M1

7 red

A1

Alternative method 2   blue

$\frac{b}{10} \times \frac{b-1}{9} + 2 \times \frac{b}{10} \times \frac{10-b}{9}$

oe

B1

$\frac{b}{10} \times \frac{b-1}{9} + 2 \times \frac{b}{10} \times \frac{10-b}{9} = \frac{48}{90}$

or $b^2 - 19b = -48$

or $b^2 - 19b + 48 = 0$

or $b = 3$

oe

M1

7 red

A1

Additional Guidance
7 with no working scores full marks

[3]

M3.(a)   Fully correct

$$\frac{6}{9}$$

$$\frac{7}{10}$$

$$\frac{3}{9}$$

$$\frac{7}{9}$$

$$\frac{3}{10}$$

$$\frac{2}{9}$$

oe

B2   *all pairs of probabilities add to 1 with one right hand side pair correct*

       or

       four correct probabilities in correct positions

B1   *two correct probabilities in correct positions*

Accept decimals or percentages rounded or truncated to 2 significant figures or better

B3

(b)   their $\frac{7}{10}$ × their $\frac{3}{9}$ or

    their $\frac{3}{10}$ × their $\frac{7}{9}$ or

    $\frac{21}{90}$ or $\frac{7}{30}$ *oe*

Multiplies along one of the two relevant branches using their probabilities (0 < p < 1)

M1

their $\frac{7}{10}$ × their $\frac{3}{9}$ × 2   or

their $\frac{3}{10}$ × their $\frac{7}{9}$ × 2   or

their $\frac{7}{10}$ × their $\frac{3}{9}$ + their $\frac{3}{10}$ × their $\frac{7}{9}$

> *Doubles their product of a correct branch*
> *or*
> *adds the products of the two relevant branches using their probabilities*

M1dep

$\frac{42}{90}$ or $\frac{21}{45}$ or $\frac{7}{15}$ or

$0.4\dot{6}$ or 0.47

> *ft their tree diagram if B2 scored in part (a)*
> *oe*
> *SC2* $\frac{21}{50}$ *oe*   *SC1* $\frac{21}{100}$ *oe*

A1ft

[6]

M4.

Alternative method 1

$\frac{2}{6}$ or $\frac{1}{3}$

or

$\frac{5}{6}$

M1

$\frac{7}{9} \times \frac{2}{6}$ or $\frac{14}{54}$

or

$\dfrac{2}{9} \times \dfrac{5}{6}$ or $\dfrac{10}{54}$

oe

M1

Their $\dfrac{14}{54}$ + their $\dfrac{10}{54}$

dep on M1M1 and a correct method for both probabilities

M1dep

$\dfrac{24}{54}$ or $\dfrac{4}{9}$

oe $0.\dot{4}$

A1

Alternative method 2

$\dfrac{4}{6}$ or $\dfrac{2}{3}$

or

$\dfrac{1}{6}$

oe

M1

$\dfrac{7}{9} \times \dfrac{4}{6}$ or $\dfrac{28}{54}$

or

$\dfrac{2}{9} \times \dfrac{1}{6}$ or $\dfrac{2}{54}$

oe

M1

1 − (their $\dfrac{28}{54}$ + their $\dfrac{2}{54}$)

dep on M1M1 and a correct method for both probabilities

M1dep

$\dfrac{24}{54}$ or $\dfrac{4}{9}$

oe 0.4̇

A1

[4]

M5.(a)   Each group in the sample is in the same proportion (as the population)
oe Must refer to the idea of proportion
Strand (i) Vocabulary

Q1

Additional Guidance

Use of word proportion(al), ratio, relative is usually worth a mark

The word 'fair' without reference to idea of proportionate is not enough

...distributed equally between sections	B0
...splitting the data fairly	B0
...grouped sample. Strata means group	B0
...in the same ratio as the whole group	B1
...relative in size to the group	B1
...choosing fair proportions	B1
	B1
...the same percentage of each group	B1

(b) $\dfrac{35}{35+220+45} \times 60$

    oe $35 \div 5$

                                                      M1

7

May be implied by $\dfrac{7}{60}$

                                                      A1

$\dfrac{\text{their } 7}{60}$ and $\dfrac{\text{their } 7-1}{59}$

Condone $\dfrac{\text{their } 7}{60} \times \dfrac{\text{their } 7-1}{60}$ or $\dfrac{\text{their } 7}{60} \times \dfrac{\text{their } 7}{59}$ or $\dfrac{35}{300} \times \dfrac{34}{299}$

                                                      M1

$\dfrac{42}{3540}$ or $\dfrac{7}{590}$

or 0.0118(...) or 0.0119 or 0.012

    oe

    ft their $\dfrac{\text{their } 7}{60} \times \dfrac{\text{their } 7-1}{59}$

    SC2 $\dfrac{119}{8970}$ or 0.013... oe

                                                    A1ft

                                                          [5]

M6.

$\dfrac{7}{11}$ $(\times)$ $\dfrac{6}{10}$ $\left(=\dfrac{42}{110}\right)$

    or

$\dfrac{4}{11}$ $(\times)$ $\dfrac{3}{10}$ $\left(=\dfrac{12}{110}\right)$

        oe

        Can be on tree diagram

                                                      M1

$\dfrac{7}{11}$ $(\times)$ $\dfrac{6}{10}$ $\left(=\dfrac{42}{110}\right)$

    and

$\dfrac{4}{11}$ $(\times)$ $\dfrac{3}{10}$ $\left(=\dfrac{12}{110}\right)$

                                                      M1

Their $\dfrac{42}{110}$ + their $\dfrac{12}{110}$

Dep on M2

M1Dep

$\dfrac{54}{110}$

oe $\dfrac{27}{55}$

SC2 $\dfrac{54}{121}$ *or* $\dfrac{65}{110}$ $\left(=\dfrac{13}{22}\right)$

SC1 $\dfrac{65}{121}$

A1

Alternative

$\dfrac{7}{11} (\times) \dfrac{4}{10} \left(\dfrac{28}{110}\right)$

or

$\dfrac{4}{11} (\times) \dfrac{7}{10} \left(=\dfrac{28}{110}\right)$

oe
Can be on tree diagram

M1

$\dfrac{7}{11} (\times) \dfrac{4}{10} \left(\dfrac{28}{110}\right)$

and

$\dfrac{4}{11} (\times) \dfrac{7}{10} \left(=\dfrac{28}{110}\right)$

$\dfrac{28}{110} \times 2 \left(=\dfrac{56}{110}\right)$

M1

$1 - \left(\text{their } \dfrac{28}{110} + \text{their } \dfrac{28}{110}\right)$

Dep on M2

M1Dep

$\dfrac{54}{110}$

oe $\dfrac{27}{55}$

SC2 $\dfrac{54}{121}$ or $\dfrac{65}{110}$ $\left(=\dfrac{13}{22}\right)$

SC1 $\dfrac{65}{121}$

A1

[4]

M7. $\dfrac{5}{12} \times \dfrac{7}{11}$ or $\dfrac{35}{132}$

or $\dfrac{7}{12} \times \dfrac{5}{11}$ or $\dfrac{35}{132}$ *oe*

Tree diagram showing the 6 probabilities

$\dfrac{5}{12} \times \dfrac{4}{11}$ or $\dfrac{20}{132}$

or $\dfrac{7}{12} \times \dfrac{6}{11}$ or $\dfrac{21}{66}$

M1

$\dfrac{5}{12} \times \dfrac{7}{11} + \dfrac{7}{12} \times \dfrac{5}{11}$ *oe*

$1 - \left(\dfrac{5}{12} \times \dfrac{4}{11} + \dfrac{7}{12} \times \dfrac{6}{11}\right)$

M1dep

$\dfrac{70}{132}$ or $\dfrac{35}{66}$ *oe*

Decimals must be accurate to at least 2 d.p.

SC1 for $\dfrac{70}{144}$ or $\dfrac{35}{72}$

A1

Alternative Method

0.416… × 0.636…

)

or 0.583… × 0.454…   *oe*

> *Tree diagram showing the 6 probabilities*
> *0.416… × 0.363… or 0.583… × 0.545…*

M1

0.416… × 0.636…+ 0.583… × 0.454…   *oe*

> *1 − (0.416… × 0.363… + 0.583… × 0.545…)*

M1dep

0.53(…)   *oe*

> *Decimals must be accurate to at least 2 d.p.*
> *SC1 for 0.486… or 0.49*

A1
[3]

M8.

$\dfrac{4}{10}$ **and** $\dfrac{3}{9}$

M1

$\dfrac{4}{10} \times \dfrac{3}{9}$

M1

$\dfrac{12}{90}$

> *oe* $\dfrac{2}{15}$
>
> *SC1* $\dfrac{12}{100}$ *or* $\dfrac{16}{90}$ *oe*

A1
[3]

M9.(a) $\dfrac{3}{4}$ or $\dfrac{4}{5}$ seen

> *oe decimal or percentage*

M1

1

$\dfrac{3}{4} \times \dfrac{4}{5}$

oe decimal or percentage

M1dep

$\dfrac{3}{5}$ or $\dfrac{12}{20}$

oe
0.6 or 60%

A1

(b) $\quad \dfrac{3}{4} \times \dfrac{1}{5}$ or $\dfrac{3}{20}$

Hit then miss

M1

$\dfrac{1}{4} \times \dfrac{4}{5}$ or $\dfrac{4}{20}$ or $\dfrac{1}{5}$

Miss then hit

M1

$\dfrac{3}{20} + \dfrac{4}{20}$

dependent on both previous marks

M1dep

$\dfrac{7}{20}$

oe
0.35 or 35%

A1

Alternative method

$\frac{1}{4} \times \frac{1}{5}$ or $\frac{1}{20}$

Miss then miss

M1

$\frac{1}{20} +$ their $\frac{12}{20}$

ft from their (a)

M1

$1 - \frac{1}{20} -$ their $\frac{12}{20}$

oe

M1dep

$\frac{7}{20}$

oe
0.35 or 35%

A1
[7]

M10. (a) $\frac{1}{10} \times \frac{9}{10}$ or $\frac{9}{10} \times \frac{1}{10}$ or $\frac{1}{10} \times \frac{1}{10}$

oe

M1

$\frac{1}{10} \times \frac{9}{10} + \frac{9}{10} \times \frac{1}{10} + \frac{1}{10} \times \frac{1}{10}$

oe

M1 dep

$\frac{9}{100} + \frac{9}{100} + \frac{1}{100}$ or $\frac{18}{100} + \frac{9}{100}$

oe

A1

Alternative method 1

3

$$\frac{9}{10} \times \frac{9}{10}$$

oe

M1

$$1 - \frac{9}{10} \times \frac{9}{10}$$

oe

M1 dep

$$1 - \frac{81}{100}$$

oe

A1

Alternative method 2

Use of sample space diagram

M1

Indication of correct pairs

M1 dep

$$\frac{19}{100} \quad \text{or} \quad 19 \text{ out of } 100$$

A1

(b) $$\frac{1}{10}\left(\times \frac{9}{9}\right) \text{ or } \frac{9}{10} \times \frac{1}{9}$$

oe

M1

$$\frac{1}{10}\left(\times \frac{9}{9}\right) + \frac{9}{10} \times \frac{1}{9}$$

oe

M1 dep

$$\frac{18}{90}$$

oe

A1

Alternative method 1

$$\frac{9}{10} \times \frac{8}{9}$$

oe

$$1 - \frac{9}{10} \times \frac{8}{9}$$

M1

oe

M1 dep

$$\frac{18}{90}$$

oe

A1

Alternative method 2

Use of sample space diagram

M1

Indication of correct pairs

M1 dep

$$\frac{18}{90} \quad \text{or} \quad \frac{9}{45}$$

oe

A1

[6]

M11. $\frac{4}{12} \times \frac{x}{11}$

oe

M1

$\frac{4}{12} \times \frac{4}{11}$ or $\frac{4}{12} \times \frac{8}{11}$ or $\frac{4}{12} \times \frac{3}{11}$

or $\frac{4}{33}$ or $\frac{8}{33}$ or $\frac{1}{11}$

0.12(12..) or 0.24(24…) or 0.09(0909…)

M1

$\frac{4}{12} \times \frac{4}{11} \times 6$ or $\frac{4}{12} \times \frac{8}{11} \times 3$

or

$1 - (3 \times \frac{\frac{4}{12} \times \frac{3}{11}}{})$

oe

M1

$\frac{8}{11}$ oe

or $\frac{24}{33}$ or $\frac{96}{132}$

or 0.73 or better

oe

If replacement used award SC2 for $\frac{2}{3}$ *or* $\frac{8}{12}$

or SC1 for

$\frac{4}{12} \times \frac{4}{12}$ or $\frac{1}{9}$

or $\frac{4}{12} \times \frac{8}{12}$ or $\frac{2}{9}$

A1

Alternative method

Choose 1ˢᵗ counter in 12 ways

M1

Choose 2ⁿᵈ counter in 8 ways (any of the other two colours)

M1

$\frac{12 \times 8}{12 \times 11}$

or $1 \times \frac{8}{11}$

oe

M1

$$\frac{8}{11}$$

oe $\frac{96}{132}$

A1

[4]

M12.   Indication that they need to swap 20p and 10p

B1

$$\frac{1}{5} \text{ or } \frac{2}{4}$$

oe

M1

$$\frac{1}{5} \times \frac{2}{4}$$

oe   *Condone* $\frac{1}{5} \times \frac{2}{3}$

M1 dep

$$\frac{2}{20}$$

oe   *eg* $\frac{1}{10}$

SC3 $\frac{2}{15}$ *oe*

A1

[4]