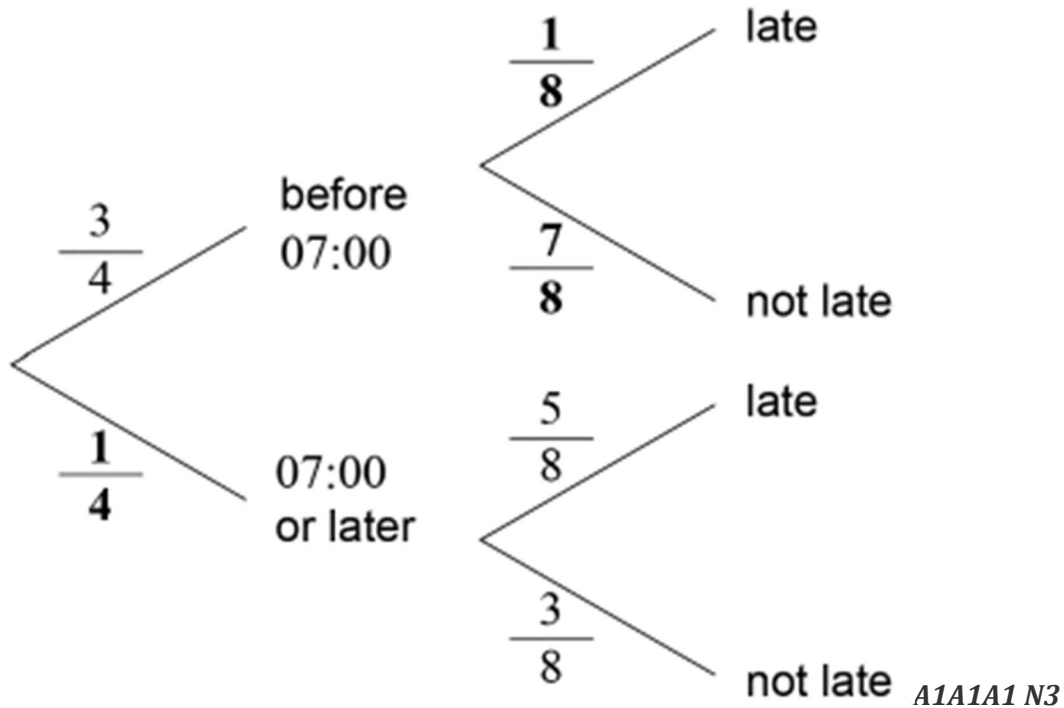


Statistics and Probability Review – Day 1

1a. [3 marks]

Markscheme



Note: Award **A1** for each bold fraction.

[3 marks]

1b. [2 marks]

Markscheme

multiplying along correct branches **(A1)**

eg $\frac{3}{4} \times \frac{1}{8}$

$P(\text{leaves before 07:00} \cap \text{late}) = \frac{3}{32}$ **A1 N2**

[2 marks]

1c. [3 marks]

Markscheme

multiplying along other "late" branch (M1)

$$\text{eg } \frac{1}{4} \times \frac{5}{8}$$

adding probabilities of two mutually exclusive late paths (A1)

$$\text{eg } \left(\frac{3}{4} \times \frac{1}{8}\right) + \left(\frac{1}{4} \times \frac{5}{8}\right), \frac{3}{32} + \frac{5}{32}$$

$$P(L) = \frac{8}{32} \left(= \frac{1}{4}\right) \quad \text{A1 N2}$$

[3 marks]

1d. [3 marks]

Markscheme

recognizing conditional probability (seen anywhere) (M1)

$$\text{eg } P(A|B), P(\text{before 7|late})$$

correct substitution of **their** values into formula (A1)

$$\frac{\frac{3}{32}}{\frac{1}{4}}$$

eg

$$P(\text{left before 07:00|late}) = \frac{3}{8} \quad \text{A1 N2}$$

[3 marks]

1e. [3 marks]

Markscheme

valid approach (M1)

$$\text{eg } 1 - P(\text{not late twice}), P(\text{late once}) + P(\text{late twice})$$

correct working (A1)

$$\text{eg } 1 - \left(\frac{3}{4} \times \frac{3}{4}\right), 2 \times \frac{1}{4} \times \frac{3}{4} + \frac{1}{4} \times \frac{1}{4}$$

$$\frac{7}{16} \quad \text{A1 N2}$$

[3 marks]

2a. [2 marks]

Markscheme

evidence of summing to 1 **(M1)**

eg $0.28 + k + 1.5 + 0.3 = 1$, $0.73 + k = 1$

$k = 0.27$ **A1 N2**

[2 marks]

2b. [2 marks]

Markscheme

correct substitution into formula for $E(X)$ **(A1)**

eg $1 \times 0.28 + 2 \times k + 3 \times 0.15 + 4 \times 0.3$

$E(X) = 2.47$ (exact) **A1 N2**

[2 marks]

2c. [2 marks]

Markscheme

valid approach **(M1)**

eg np , 80×0.15

12 **A1 N2**

[2 marks]

3a. [2 marks]

Markscheme

valid approach

eg Venn diagram, $P(A) - P(A \cap B)$, $0.62 - 0.18$ **(M1)**

$P(A \cap B') = 0.44$ **A1 N2**

[2 marks]

3b. [4 marks]

Markscheme

valid approach to find either $P(B')$ or $P(B)$ (M1)



eg (seen anywhere), $1 - P(A \cap B') - P((A \cup B)')$

correct calculation for $P(B')$ or $P(B)$ (A1)

eg $0.44 + 0.19$, $0.81 - 0.62 + 0.18$

correct substitution into $\frac{P(A \cap B')}{P(B')}$ (A1)

eg $\frac{0.44}{0.19+0.44}$, $\frac{0.44}{1-0.37}$

0.698412

$P(A | B') = \frac{44}{63}$ (exact), 0.698 A1 N3

[4 marks]

4a. [2 marks]

Markscheme

correct approach indicating subtraction (A1)

eg $0.79 - 0.095$, appropriate shading in diagram

$P(289 < w < 310) = 0.695$ (exact), 69.5 % A1 N2

[2 marks]

4b. [2 marks]

Markscheme

METHOD 1

valid approach (M1)

eg $1 - p, 21$

-0.806421

$z = -0.806$ A1 N2

METHOD 2

(i) & (ii)

correct expression for z (seen anywhere) (A1)

eg $\frac{289-u}{\sigma}$

valid approach (M1)

eg $1 - p, 21$

-0.806421

$z = -0.806$ (seen anywhere) A1 N2

[2 marks]

4c. [3 marks]

Markscheme

METHOD 1

attempt to standardize (M1)

eg $\sigma = \frac{289-297}{z}, \frac{289-297}{\sigma}$

correct substitution with their z (do not accept a probability) A1

eg $-0.806 = \frac{289-297}{\sigma}, \frac{289-297}{-0.806}$

9.92037

$\sigma = 9.92$ **A1 N2**

METHOD 2

(i) & (ii)

correct expression for z (seen anywhere) **(A1)**

eg $\frac{289-u}{\sigma}$

valid approach **(M1)**

eg $1 - p, 21$

-0.806421

$z = -0.806$ (seen anywhere) **A1 N2**

valid attempt to set up an equation with **their** z (do not accept a probability) **(M1)**

eg $-0.806 = \frac{289-297}{\sigma}, \frac{289-297}{-0.806}$

9.92037

$\sigma = 9.92$ **A1 N2**

[3 marks]

4d. [3 marks]

Markscheme

valid approach **(M1)**

eg $P(W < w) = 0.35, -0.338520$ (accept 0.385320), diagram showing values in a standard normal distribution

correct score at the 35th percentile **(A1)**

eg 293.177

294 (g) **A1 N2**

Note: If working shown, award **(M1)(A1)A0** for 293.

If no working shown, award **N1** for 293.177, **N1** for 293.

Exception to the **FT** rule: If the score is incorrect, and working shown, award **A1FT** for correctly finding their minimum weight (by rounding up)

[3 marks]

4e. [5 marks]

Markscheme

evidence of recognizing binomial (seen anywhere) **(M1)**

eg $X \sim B(36, p), {}_n C_a \times p^a \times q^{n-a}$

correct probability (seen anywhere) **(A1)**

eg 0.65

EITHER

finding $P(X \leq 18)$ from GDC **(A1)**

eg 0.045720

evidence of using complement **(M1)**

eg $1 - P(X \leq 18)$

0.954279

$P(X > 18) = 0.954$ **A1 N2**

OR

recognizing $P(X > 18) = P(X \geq 19)$ **(M1)**

summing terms from 19 to 36 **(A1)**

eg $P(X = 19) + P(X = 20) + \dots + P(X = 36)$

0.954279

$P(X > 18) = 0.954$ **A1 N2**

[5 marks]

4f. [2 marks]

Markscheme

correct calculation (A1)

$$0.954^2, \binom{2}{2} 0.954^2 (1 - 0.954)^0$$

0.910650

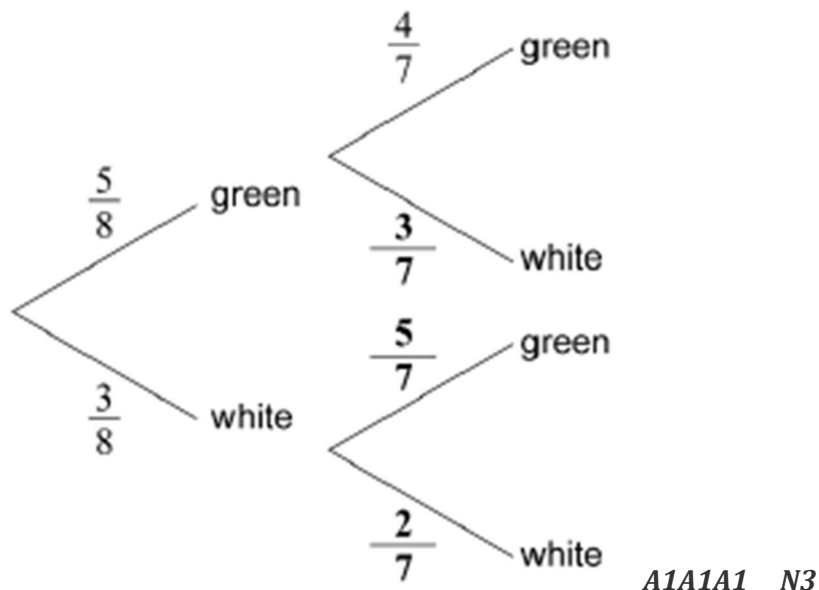
0.911 A1 N2

[2 marks]

5a. [3 marks]

Markscheme

correct probabilities



Note: Award A1 for each correct **bold** answer.

[3 marks]

5b. [3 marks]

Markscheme

multiplying along branches (M1)

$$\text{eg } \frac{5}{8} \times \frac{3}{7}, \frac{3}{8} \times \frac{5}{7}, \frac{15}{56}$$

adding probabilities of correct mutually exclusive paths (A1)

$$\text{eg } \frac{5}{8} \times \frac{3}{7} + \frac{3}{8} \times \frac{5}{7}, \frac{15}{56} + \frac{15}{56}$$

$$\frac{30}{56} \left(= \frac{15}{28} \right) \quad \text{A1} \quad \text{N2}$$

[3 marks]

6a. [4 marks]

Markscheme

valid approach (M1)

eg total probability = 1

correct equation (A1)

$$\text{eg } 0.475 + 2k^2 + \frac{k}{10} + 6k^2 = 1, 8k^2 + 0.1k - 0.525 = 0$$

$$k = 0.25 \quad \text{A2} \quad \text{N3}$$

[4 marks]

6b. [1 mark]

Markscheme

$$P(X = 2) = 0.025 \quad \text{A1} \quad \text{N1}$$

[1 mark]

6c. [3 marks]

Markscheme

valid approach for finding $P(X > 0)$ (M1)

eg $1 - 0.475, 2(0.25^2) + 0.025 + 6(0.25^2), 1 - P(X = 0), 2k^2 + \frac{k}{10} + 6k^2$

correct substitution into formula for conditional probability (A1)

eg $\frac{0.025}{1-0.475}, \frac{0.025}{0.525}$

0.0476190

$P(X = 2 | X > 0) = \frac{1}{21}$ (exact), 0.0476 A1 N2

[3 marks]

7. [7 marks]

Markscheme

finding the z-value for 0.17 (A1)

eg $z = -0.95416$

setting up equation to find σ , (M1)

eg $z = \frac{168-180}{\sigma}, -0.954 = \frac{-12}{\sigma}$

$\sigma = 12.5765$ (A1)

EITHER (Properties of the Normal curve)

correct value (seen anywhere) (A1)

eg $P(X < 192) = 0.83, P(X > 192) = 0.17$

correct working (A1)

eg $P(X < 192 - h) = 0.83 - 0.8, P(X < 192 - h) = 1 - 0.8 - 0.17,$

$P(X > 192 - h) = 0.8 + 0.17$

correct equation in h

eg $\frac{(192-h)-180}{12.576} = -1.88079, 192 - h = 156.346$ (A1)

35.6536

$$h = 35.7 \quad A1 \quad N3$$

OR (Trial and error using different values of h)

two correct probabilities whose 2 sf will round up **and** down, respectively, to 0.8 **A2**

$$\text{eg } P(192 - 35.6 < X < 192) = 0.799706, P(157 < X < 192) = 0.796284,$$

$$P(192 - 36 < X < 192) = 0.801824$$

$$h = 35.7 \quad A2$$

[7 marks]

8a. [2 marks]

Markscheme

valid approach **(M1)**

$$\text{eg } p + 3 = 13, 13 - 3$$

$$p = 10 \quad A1 \quad N2$$

[2 marks]

8b. [2 marks]

Markscheme

valid approach **(M1)**

$$\text{eg } p + 3 + 5 + q = 20, 10 - 10 - 8$$

$$q = 2 \quad A1 \quad N2$$

[2 marks]

8c. [2 marks]

Markscheme

valid approach **(M1)**

$$\text{eg } 20 - p - q - 3, 1 - \frac{15}{20}, n(E \cap H') = 5$$

$$\frac{5}{20} \left(\frac{1}{4} \right) \quad A1 \quad N2$$

[2 marks]

9a. [1 mark]

Markscheme

$$P(X > 107) = 0.24 \quad \left(= \frac{6}{25}, 24\% \right) \quad A1 \quad N1$$

[1 mark]

9b. [3 marks]

Markscheme

valid approach **(M1)**

$$\text{eg } P(X > 100) = 0.5, P(X > 100) - P(X > 107)$$

correct working **(A1)**

$$\text{eg } 0.5 - 0.24, 0.76 - 0.5$$

$$P(100 < X < 107) = 0.26 \quad \left(= \frac{13}{50}, 26\% \right) \quad A1 \quad N2$$

[3 marks]

9c. [2 marks]

Markscheme

valid approach **(M1)**

$$\text{eg } 2 \times 0.26, 1 - 2(0.24), P(93 < X < 100) = P(100 < X < 107)$$

$$P(93 < X < 107) = 0.52 \quad \left(= \frac{13}{25}, 52\% \right) \quad A1 \quad N2$$

[2 marks]

10a. [2 marks]

Markscheme

evidence of binomial distribution (may be seen in part (b)) **(M1)**

eg np , 150×0.08

$k = 12$ **A1 N2**

[2 marks]

10b. [2 marks]

Markscheme

$$P(X = 12) = \binom{150}{12} (0.08)^{12} (0.92)^{138} \quad \text{(A1)}$$

0.119231

probability = 0.119 **A1 N2**

[2 marks]

10c. [2 marks]

Markscheme

recognition that $X \leq 11$ **(M1)**

0.456800

$P(X < 12) = 0.457$ **A1 N2**

[2 marks]

11a. [2 marks]

Markscheme

correct substitution into $E(X)$ formula **(A1)**

eg $0(p) + 1(0.5) + 2(0.3) + 3(q) = 1.2$

$q = \frac{1}{30}$, 0.0333 **A1 N2**

[2 marks]

11b. [2 marks]

Markscheme

evidence of summing probabilities to 1 **(M1)**

eg $p + 0.5 + 0.3 + q = 1$

$p = \frac{1}{6}, 0.167$ **A1 N2**

[2 marks]

11c. [1 mark]

Markscheme

$P(3 \text{ blue}) = \frac{1}{30}, 0.0333$ **A1 N1**

[1 mark]

11d. [1 mark]

Markscheme

valid reasoning **R1**

eg $P(3 \text{ white}) = P(0 \text{ blue})$

$P(3 \text{ white}) = \frac{1}{6}$ **AG N0**

[1 mark]

11e. [3 marks]

Markscheme

valid method **(M1)**

eg $P(3 \text{ white}) = \frac{w}{10} \times \frac{w-1}{9} \times \frac{w-2}{8}, \frac{{}^w C_3}{{}^{10} C_3}$

correct equation **A1**

$$\text{eg } \frac{w}{10} \times \frac{w-1}{9} \times \frac{w-2}{8} = \frac{1}{6}, \frac{{}^w C_3}{{}_{10} C_3} = 0.167$$

$$w = 6 \quad \mathbf{A1} \quad \mathbf{N2}$$

[3 marks]

11f. [4 marks]

Markscheme

recognizing one prize in first seven attempts **(M1)**

$$\text{eg } \binom{7}{1}, \left(\frac{1}{6}\right)^1 \left(\frac{5}{6}\right)^6$$

correct working **(A1)**

$$\text{eg } \binom{7}{1} \left(\frac{1}{6}\right)^1 \left(\frac{5}{6}\right)^6, 0.390714$$

correct approach **(A1)**

$$\text{eg } \binom{7}{1} \left(\frac{1}{6}\right)^1 \left(\frac{5}{6}\right)^6 \times \frac{1}{6}$$

0.065119

0.0651 **A1 N2**

[4 marks]

12. [2 marks]

Markscheme

valid approach **(M1)**

$$\text{eg } B(n, p), \binom{n}{r} p^r q^{n-r}, (0.167)^2 (0.833)^7, \binom{9}{2}$$

0.279081

0.279 **A1 N2**

[2 marks]

13a. [2 marks]

Markscheme

valid interpretation (may be seen on a Venn diagram) **(M1)**

eg $P(A \cap B) + P(A' \cap B)$, $0.2 + 0.6$

$P(B) = 0.8$ **A1 N2**

[2 marks]

13b. [4 marks]

Markscheme

valid attempt to find $P(A)$ **(M1)**

eg $P(A \cap B) = P(A) \times P(B)$, $0.8 \times A = 0.2$

correct working for $P(A)$ **(A1)**

eg 0.25 , $\frac{0.2}{0.8}$

correct working for $P(A \cup B)$ **(A1)**

eg $0.25 + 0.8 - 0.2$, $0.6 + 0.2 + 0.05$

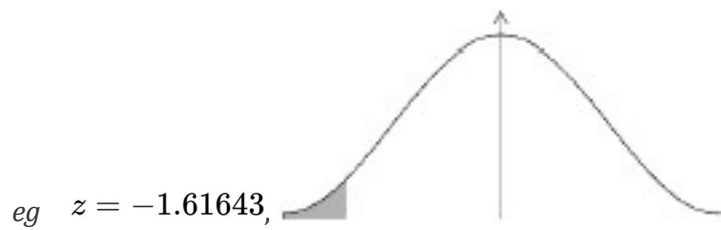
$P(A \cup B) = 0.85$ **A1 N3**

[4 marks]

14a. [3 marks]

Markscheme

valid approach **(M1)**



2.48863

$w = 2.49$ (kg) A2 N3

[3 marks]

14b. [3 marks]

Markscheme

correct value or expression (seen anywhere)

eg $0.053 - P(X \leq 2.15)$, 0.039465 (A1)

evidence of conditional probability (M1)

eg $\frac{P(2.15 \leq X \leq w)}{P(X \leq w)}$, $\frac{0.039465}{0.053}$

0.744631

0.745 A1 N2

[3 marks]

15a. [1 mark]

Markscheme

$P(\text{red}) = \frac{5}{15+m}$ A1 N1

[1 mark]

15b. [5 marks]

Markscheme

recognizing binomial distribution (M1)

eg $X \sim B(n, p)$

correct value for the complement of **their** P (seen anywhere) **A1**

eg $1 - \frac{5}{15+m}, \frac{10+m}{15+m}$

correct substitution into $\text{Var}(X) = np(1 - p)$ **(A1)**

eg $4 \left(\frac{5}{15+m} \right) \left(\frac{10+m}{15+m} \right), \frac{20(10+m)}{(15+m)^2} < 0.6$

$m > 12.2075$ **(A1)**

$m = 13$ **A1 N3**

[5 marks]

16a. [3 marks]

Markscheme

(i) $q = 0.1$ **A1 N1**

(ii) appropriate approach **(M1)**

eg $P(A) - q, 0.4 - 0.1$

$p = 0.3$ **A1 N2**

[3 marks]

16b. [3 marks]

Markscheme

valid approach **(M1)**

eg $P(A \cup B) = P(A) + P(B) - P(A \cap B), P(A \cap B) + P(B \cap A')$

correct values **(A1)**

eg $0.8 = 0.4 + P(B) - 0.1, 0.1 + 0.4$

$$P(B) = 0.5 \quad A1 \quad N2$$

[3 marks]

17a. [5 marks]

Markscheme

(i) $p = 3 \quad A1 \quad N1$

(ii) valid approach **(M1)**

eg $(12 + 10 + 3) - 21, 22 - 18$

$$q = 4 \quad A1 \quad N2$$

(iii) $r = 8, s = 6 \quad A1A1 \quad N2$

17b. [4 marks]

Markscheme

(i) $\frac{12}{21} \left(= \frac{4}{7} \right) \quad A2 \quad N2$

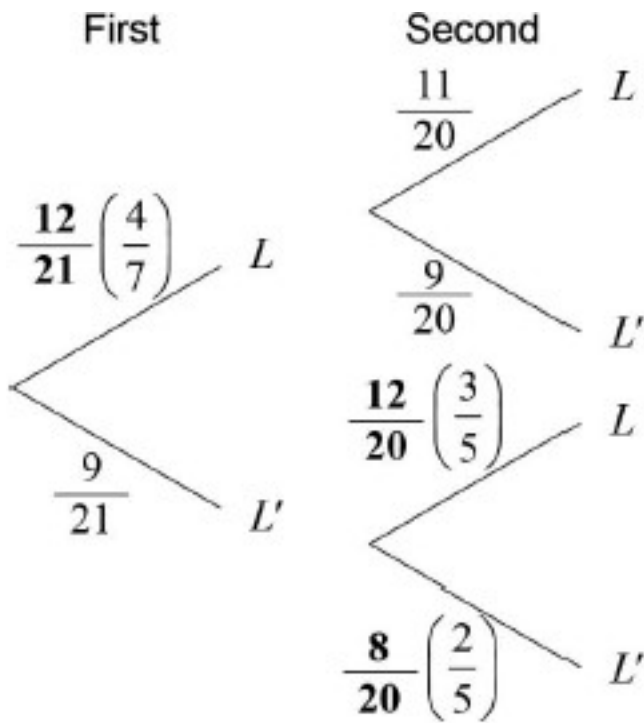
(ii) valid approach **(M1)**

eg $8 + 6, r + s$

$$\frac{14}{21} \left(= \frac{2}{3} \right) \quad A1 \quad N2$$

17c. [4 marks]

Markscheme



A1A1A1 N3

(i)

(ii) $\frac{11}{20}$ *A1 N1*

[4 marks]

18a. *[2 marks]*

Markscheme



A1A1 N2

Note: Award **A1** for vertical line clearly to right of mean,

A1 for shading to left of their vertical line.

18b. *[2 marks]*

Markscheme

$$P(X \leq 25) = 0.894350 \quad (A1)$$

$$P(X \leq 25) = 0.89 \quad (\text{must be 2 d.p.}) \quad A1 \quad N2$$

[2 marks]

18c. [2 marks]

Markscheme

$$c = 22.0976$$

$$c = 22.1 \quad A2 \quad N2$$

[2 marks]

19a. [3 marks]

Markscheme

evidence of using $\sum p_i = 1 \quad (M1)$

correct substitution $A1$

eg $0.15 + k + 0.1 + 2k = 1, 3k + 0.25 = 1$

$$k = 0.25 \quad A1 \quad N2$$

[3 marks]

19b. [2 marks]

Markscheme

correct substitution $(A1)$

eg $0 \times 0.15 + 1 \times 0.25 + 2 \times 0.1 + 3 \times 0.5$

$$E(X) = 1.95 \quad A1 \quad N2$$

[2 marks]

Total [5 marks]

20a. [2 marks]

correct substitution (A1)

eg 0.3×0.6

$P(A \cap B) = 0.18$ A1 N2

[2 marks]

20b. [2 marks]

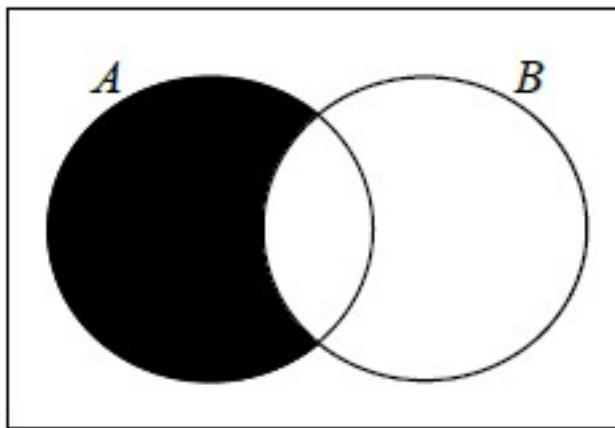
correct substitution (A1)

eg $P(A \cup B) = 0.3 + 0.6 - 0.18$

$P(A \cup B) = 0.72$ A1 N2

[2 marks]

20c. [1 mark]



A1 N1

20d. [2 marks]

Markscheme

appropriate approach (M1)

eg $0.3 - 0.18$, $P(A) \times P(B')$

$P(A \cap B') = 0.12$ (may be seen in Venn diagram) A1 N2

[2 marks]