MEMORANDUM

QUESTION 1

1.1 $P(X \geq 2)\checkmark = 1 - P(x = 0) - P(X = 1)\checkmark$

$= 1\checkmark - \binom{6}{0} 0{,}8^0 . 0{,}2^6\checkmark - \binom{6}{1} 0{,}8^1 . 0{,}2^5\checkmark$

$= \frac{624}{625} = 0{,}9984\checkmark$ (6)

1.2 $\mu = 48\checkmark$

$\sigma = \sqrt{60 \times 0{,}8 \times 0{,}2} = \frac{4\sqrt{15}}{5}\checkmark$

$P(X \geq 45)\checkmark \rightarrow P(X > 44{,}5)\checkmark$

$= P\left(z > \frac{44{,}5-48}{\frac{4\sqrt{15}}{5}}\right)\checkmark$

$= P(z > -1{,}13)\checkmark$

$= 0{,}5 + 0{,}3708\checkmark$

$= 0{,}8708\checkmark$ (8)

1.3 $np = 60 \times 0{,}8 = 48 > 5\checkmark$

$nq = 60 \times 0{,}2 = 12 > 5\checkmark$ (2)

1.4 There must be symmetry to use a normal approximation.✓✓ (2)

QUESTION 2

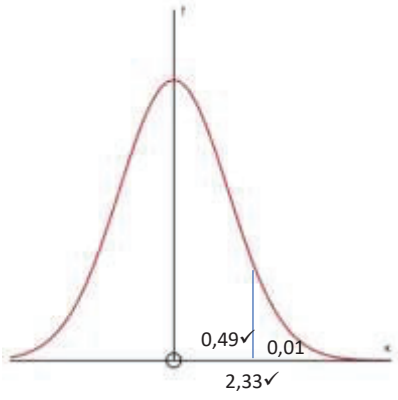
Let l be lower reaches and u upper

$\bar{u} = 80{,}5\checkmark;\ \bar{l} = 99\checkmark$

$H_0: \mu_l = \mu_u\checkmark$

$H_1: \mu_l > \mu_u\checkmark$

$z = \frac{99 - 80{,}5\checkmark}{\sqrt{\frac{25^2}{15}\checkmark + \frac{10^2}{10}\checkmark}} = 2{,}57 \ldots\checkmark$



Lies in the rejection region. Enough evidence to reject the null hypothesis at a 1% level. The alkalinity in the lower reaches is higher than the alkalinity in the higher reaches.✓✓ (12)

QUESTION 3

3.1 $0{,}15 - 0{,}05 < 0{,}15 \pm 2{,}33\sqrt{\frac{0{,}15\times0{,}85}{n}} < 0{,}15 + 0{,}05$

$2{,}33\checkmark\checkmark\sqrt{\frac{0{,}15\checkmark\times0{,}85\checkmark}{n\checkmark}} < 0{,}05\checkmark$

$n > 276{,}8\checkmark$

Sample of 277 people✓ (8)

3.2 (a) $\bar{x} = \frac{59+63}{2}\checkmark$

$= 61\ kg\checkmark$ (2)

(b) $59 < 61 \pm z\frac{9}{\sqrt{64}} < 63\checkmark$

$61\checkmark + z\frac{9}{\sqrt{64}}\checkmark < 63\checkmark$

$z = 1{,}78\checkmark$

$P = 0{,}4625\checkmark$

$\% = 2 \times 0{,}4625 \times 100\checkmark = 92{,}5\%\checkmark$ (8)

QUESTION 4

4.1 $0{,}12 + 0{,}22 + p + q = 1\checkmark\checkmark$

$p + q = 0{,}66\checkmark$

$0 \times 0{,}12 + 1 \times 0{,}22 + 2p + 3q = 1{,}9\checkmark\checkmark$

$2p + 3q = 1{,}68\checkmark$

$p = 0{,}3\checkmark$

$q = 0{,}36\checkmark$ (8)

4.2 $E[X^2] = 0^2 \times 0{,}12 + 1^2 \times 0{,}22\checkmark + 2^2 \times 0{,}3\checkmark + 3^2 \times 0{,}36\checkmark$

$= 4{,}66\checkmark$

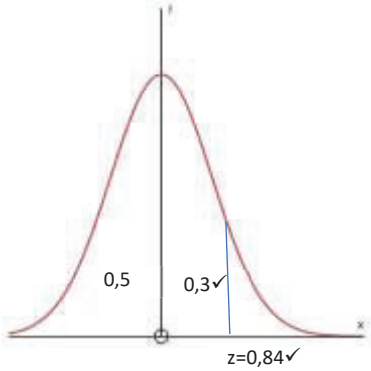
$\sigma = \sqrt{4{,}66 - 1{,}9^2}\checkmark$

$= 1{,}0247\checkmark$ (6)

QUESTION 5

5.1 $0{,}84 = \frac{180-150}{\sigma}\checkmark\checkmark$

$\sigma = 36\ min\checkmark\checkmark$ (6)



5.2 $P(X < 120)$

$= P(z < \frac{120-150}{36})\checkmark\checkmark$

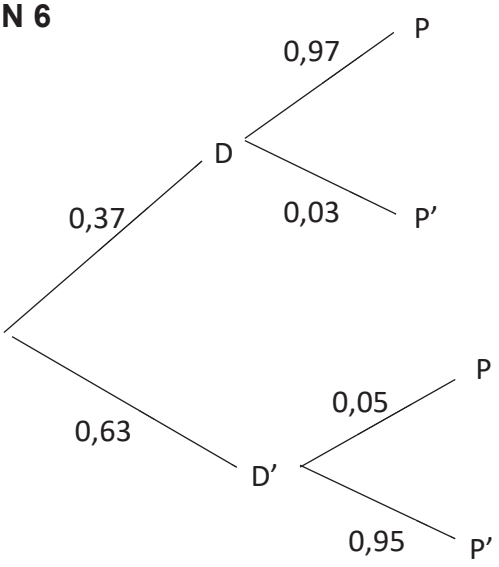
$= P(z < -0{,}83)\checkmark$

$= 0{,}5 - 0{,}2967\checkmark\checkmark$

$= 0{,}2033\checkmark$ (6)

QUESTION 6

6.1



(a) $P(P) = 0{,}37\checkmark \times 0{,}97\checkmark + \checkmark 0{,}63\checkmark \times 0{,}05\checkmark = 0{,}3904\checkmark$ (6)

(b) $P(D/P)\checkmark = \frac{P(D \cap P)}{P(P)}\checkmark = \frac{0{,}37 \times 0{,}97}{0{,}3904}\checkmark = 0{,}9193\checkmark$ (4)

6.2 (a) $11!$ ✓$= 39\,916\,800$ ✓ (2)

(b) $6!$ ✓$\times 7P5$ ✓✓$= 1\,814\,400$ ✓ (4)

(c) (i) 11^3 ✓✓$= 1331$ ✓✓ (4)

(ii) $P(X \leq 2)$ ✓$= 1 - P(X = 3)$ ✓

$$= 1 - \frac{\binom{5}{3}\checkmark\binom{6}{0}\checkmark}{\binom{11}{3}\checkmark}$$

$$= \frac{31}{33}\checkmark$$ (6)