

- 1
- (a) 0.159 (B1)
 - (b) 0.149 (B1)
 - (c) 0.340 (B1)

(Total for question 1 is 3 marks)

- 2
- (a) 0.117 (B1)
 - (b) 0.117 (B1)
 - (c) 0.776 (B1)

(Total for question 2 is 3 marks)

- 3
- Use inverse normal with Area = 0.9, $\mu = 58$, $\sigma = 12$ (M1)
 - Final answer 73.4 minutes (A1)

(Total for question 3 is 2 marks)

- 4
- Use inverse normal for Area = 0.1 to find $Z = -1.28$ (M1)
 - Set up equation $-1.28 = \frac{150-164}{\sigma}$ (M1)
 - Rearrange to find σ (M1)
 - $\sigma = 10.9$ cm (A1)

(Total for question 4 is 4 marks)

- 5
- Find $Z = -0.524$ from inverse normal with Area = 0.3 (M1)
 - Use $Z = \frac{X-\mu}{\sigma} \Rightarrow -0.524 = \frac{26-\mu}{2.8}$ (M1)
 - $-1.47 = 26 - \mu$ (M1)
 - $\mu = 27.5$ (A1)

(Total for question 5 is 4 marks)

- 6
- For Area = 0.16, $Z = -0.994$ (B1)
 - For Area = 0.77, $Z = 0.739$ (B1)
 - Set up simultaneous equations: $-0.994 = \frac{10-\mu}{\sigma}$ and $0.739 = \frac{11-\mu}{\sigma}$ (M1)
 - Rearrange to $\mu = 10 + 0.994\sigma$ and $\mu = 11 - 0.739\sigma$ (M1)
 - Solve for σ : $1.73\sigma = 1 \Rightarrow \sigma = 0.577$ (A1)
 - Solve for μ : $\mu = 10.6$ (A1)
- (Total for question 6 is 6 marks)
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- 7
- For Area = 0.2, $z = -0.842$ (B1)
 - For Area = 0.7, $z = 0.524$ (B1)
 - Set up equations: $-0.842\sigma = 52 - \mu$ and $0.524\sigma = 60 - \mu$ (M1)
 - Subtract equations: $1.37\sigma = 8$ (M1)
 - $\sigma = 5.86$ (A1)
 - $\mu = 56.9$ (A1)
- (Total for question 7 is 6 marks)
-

- 8
- (a) 0.0388 (B2)
- (b) $H_0 : \mu = 415$ $H_1 : \mu < 415$ (B1)
- (c)
- State distribution of sample mean: $\bar{X} \sim N(415, \frac{3.4^2}{20})$ (M1)
 - Calculate $P(\bar{X} < 413) = 0.00426$ (A1)
 - Compare with significance level: $0.00426 < 0.01$, so reject H_0 . There is evidence to support the claim that the weight is lower than it should be. (B1)
- (Total for question 8 is 6 marks)
-

- 9
- (a) 0.0304 (B2)
- (b) $H_0 : \mu = 220$ $H_1 : \mu \neq 220$ (B1)
- (c)
- State distribution $\bar{X} \sim N(220, \frac{8^2}{10})$ (M1)
 - Calculate $P(\bar{X} > 230) = 0.0000386$ (A1)
 - Compare $0.0000386 < 0.005$ (half of 1% for two-tailed). There is evidence to suggest the mean time has changed. (B1)
- (Total for question 9 is 6 marks)
-

10

- (a)
- $\bar{x} = \frac{46313}{200} = 231.565$ (B1)
 - $\sigma = \sqrt{\frac{10861255}{200} - (231.565)^2}$ (M1)
 - $\sigma = 26.2$ (3sf) (A1)
- (b)
- $H_0 : \mu = 235, H_1 : \mu < 235$ (B1)
 - $\bar{X} \sim N(235, \frac{26.2^2}{200})$ (M1)
 - $P(\bar{X} < 231.565) = 0.0319$ (A1)
 - $0.0319 > 0.01$, so do not reject H_0 . (M1)
 - There is not enough evidence to support the manager's claim. (A1)

(Total for question 10 is 8 marks)

11

- (a) $P(X > 45) = 0.798$ (B1)
- (b)
- Find $P(X > 55) = 0.202$ (B1)
 - Use conditional probability: $P(X > 55 | X > 45) = \frac{P(X > 55)}{P(X > 45)}$ (M1)
 - $\frac{0.202}{0.798}$ (M1)
 - 0.254 (A1)
- (c)
- $H_0 : \mu = 50, H_1 : \mu > 50$ (B1)
 - $\bar{X} \sim N(50, \frac{6^2}{20})$ (M1)
 - $P(\bar{X} > 51.1) = 0.206$ (A1)
 - $0.206 > 0.05$, so do not reject H_0 (M1)
 - There is not enough evidence to support Hannah's belief. (A1)

(Total for question 11 is 10 marks)

12

- (a)
- Find $z = 0.524$ for 70th percentile (B1)
 - $0.524 = \frac{504-500}{\sigma} \Rightarrow \sigma = 7.63$ (M1)
 - Find $P(500 < W < 505) = 0.244$ (M1)
 - $P(k < W < 500) = 0.45 - 0.244 = 0.206$ (M1)
 - $P(W < k) = 0.5 - 0.206 = 0.294 \Rightarrow k = 495.9$ (A1)
- (b)
- $H_0 : \mu = 500, H_1 : \mu < 500$ (B1)
 - $\bar{X} \sim N(500, \frac{6^2}{20})$ (M1)
 - $P(\bar{X} < 498.1) = 0.0784$ (A1)
 - $0.0784 > 0.05$, so do not reject H_0 (M1)
 - There is not enough evidence to support the company manager's belief. (A1)

(Total for question 12 is 10 marks)

13

- (a) 0.0668 (B1)
- (b)
- $H_0 : \mu = 8, H_1 : \mu > 8$ (B1)
 - $\bar{X} \sim N(8, \frac{2^2}{20})$ (M1)
 - $P(\bar{X} > 8.8) = 0.0368$ (A1)
 - $0.0368 < 0.05$, so reject H_0 . There is evidence to support the manager's belief. (B1)

(Total for question 13 is 5 marks)