

Question 8**(45 marks)**

- (a) A motoring magazine collected data on cars on a particular stretch of road. Certain details on 800 cars were recorded.
- (i) The ages of the 800 cars were recorded. 174 of them were new (less than 1 year old). Find the 95% confidence interval for the proportion of new cars on this road. Give your answer correct to 4 significant figures.
 - (ii) The data on the speeds of these 800 vehicles is normally distributed with an average speed of 87.3 km per hour and a standard deviation of 12 km per hour. What proportion of cars on this stretch of road would you expect to find travelling at over 95 km per hour?
 - (iii) The driver of a car was told that 70% of all the speeds recorded were higher than his speed. Find the speed at which this driver was recorded. Give your answer correct to the nearest whole number.
- (b) (i) A road safety programme was carried out in the area using posters, signs and radio slots. After the programme the motoring magazine recorded the speeds of 100 passing cars. The magazine carried out a hypothesis test, at the 5% level of significance, to determine whether the average speed had changed. The p -value of the test was 0.024. What can the magazine conclude based on this p -value? Give a reason for your answer.
- (ii) The magazine found that the average speed of **this sample** was lower than the previously established average speed of 87.3 km per hour. Find the average speed of the cars in this sample, correct to 1 decimal place.

Q8	Model Solution – 45 Marks	Marking Notes
(a) (i)	<p>Confidence interval</p> $0.2175 \pm 1.96 \sqrt{\frac{\left(\frac{174}{800}\right)\left(\frac{626}{800}\right)}{800}}$ $0.2175 - 1.96 \sqrt{\frac{(0.2175)(0.7825)}{800}} < p$ $< 0.2175 + 1.96 \sqrt{\frac{(0.2175)(0.7825)}{800}}$ $0.2175 - 1.96\sqrt{0.00021274} < p$ $< 0.2175 + 1.96\sqrt{0.00021274}$ $0.188913 < p < 0.246087$ $0.1889 < p < 0.2461$ <p>or</p> $18.89\% < p < 24.61\%$	<p>Scale 10C(0, 4, 7,10)</p> <p><i>Low Partial Credit:</i> 0.2175 or $\frac{174}{800}$ CI formulated with some substitution</p> <p><i>High Partial Credit:</i> CI fully substituted</p>
(a) (ii)	$\frac{x - \bar{x}}{\sigma}$ $\frac{95-87.3}{12} = 0.64167 \text{ (z score)}$ $\Rightarrow p(Z \leq 0.64167) = 0.7389$ $P(z \geq 0.64) = 1 - 0.7389$ $= 0.2611 \text{ or } 26.11\%$	<p>Scale 15D(0, 5, 7, 11, 15)</p> <p><i>Low Partial Credit:</i> μ or σ identified</p> <p><i>Mid Partial Credit:</i> z found</p> <p><i>High Partial Credit:</i> $P(z < 0.64)$ and stops or continues incorrectly</p>
(a) (iii)	$z = -0.52 = \frac{x - 87.3}{12}$ $\Rightarrow x = 81.06 \text{ km/h}$ $x = 81 \text{ km/h}$	<p>Scale 10C (0, 4, 7, 10)</p> <p><i>Low Partial Credit:</i> $\frac{x - 87.3}{12}$ $z \in [0.52, 0.53]$ or $z \in [-0.52, -0.53]$ and stops</p> <p><i>High Partial Credit:</i> Formula for x fully substituted</p>

(b) (i)	Average speed has changed p-value < 0.05	Scale 5B (0, 2, 5) <i>Mid Partial Credit:</i> Answer or reason correct
(b) (ii)	$0.024 = 2(1 - P(z \leq T))$ $\Rightarrow P(z \leq T) = 0.988$ <p>Therefore $z = 2.26$ or -2.26.</p> <p>Because the mean has reduced $z = -2.26$</p> $-2.26 = \frac{x - 87.3}{\frac{12}{\sqrt{100}}}$ $\Rightarrow x = 84.588 \text{ km/h}$ $\Rightarrow x = 84.6$	Scale 5C (0, 2, 3, 5) <i>Low Partial Credit:</i> $0.024 = 2(0.012)$ Value(s) of z found <i>High Partial Credit:</i> Formula for x fully substituted