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WELSH JOINT EDUCATION COMMITTEE **CYD-BWYLLGOR ADDYSG CYMRU**

General Certificate of Education **Tystysgrif Addysg Gyffredinol**

Advanced Level/Advanced Subsidiary **Safon Uwch/Uwch Gyfrannol**

MATHEMATICS S2

Statistics

Specimen Mark Scheme

2005/2006

1. *(a)* (i) $z = \dfrac{200-195}{5} = 1$ M1A1

$\Rightarrow$ P(overflow) = 0.1587 A1

(ii) $\mu = 200 - 2.326 \times 5 = 188.4$ M1A1A1

(b) T is N(980,125) M1A1

$z = \dfrac{1000-980}{\sqrt{125}} = 1.79$ m1A1

Prob = 0.0367 A1

2. *(a)* Distribution of T is Poi(2.5). B1

Prob = $e^{-2.5}.\dfrac{2.5^2}{2} = 0.257$ M1A1

(b) T is now Poi(125) $\approx$ N(125,125) M1A1

$z = \dfrac{99.5-125}{\sqrt{125}} = -2.28$ M1A1A1

Prob = 0.0113 A1

3. *(a)* $\bar{x} = 73.5$ M1A1

95% confidence limits are

$73.5 \pm 1.96\sqrt{\dfrac{16}{10}}$ M1A1A1

giving [71.0, 76.0]. A1

(b) A 95% confidence interval is an interval determined by a method which would ensure that the parameter lies within the interval 95% of the time. B2 (Allow B1 if not completely convinced)

4. *(a)* P($\pi R^2 > 36\pi$) = P(R > 6) M1

$= \dfrac{(10-6)}{(10-4)}$ A1

$= \dfrac{2}{3}$ A1

(b) (i) The density of R is f(r) = 1/6 (si) B1

E(A) = $\pi\int_4^{10} r^2.\dfrac{1}{6}\mathrm{d}r$ M1A1

$= \dfrac{\pi}{18}\left[r^3\right]_4^{10}$ A1

$= 52\pi$ A1

(ii) $\mathrm{E}\left(A^2\right) = \pi^2 \int_4^{10} r^4 . \frac{1}{6} \mathrm{d}r$ M1A1

$= \frac{\pi^2}{30}\left[r^5\right]_4^{10}$ A1

$= 3299.2\,\pi^2$ A1

$\mathrm{Var}(A) = 3299.2\,\pi^2 - 52^2\,\pi^2$

$= 595.2\,\pi^2$ A1

5. The appropriate test statistic is

$$\mathrm{TS} = \frac{\bar{x} - \bar{y}}{\sigma\sqrt{\frac{1}{m} + \frac{1}{n}}}$$ M1

$$= \frac{52.6 - 49.8}{5\sqrt{\frac{1}{10} + \frac{1}{10}}}$$ A1A1

$= 1.25$ A1

EITHER

p-value $= 2 \times 0.1056$

$= 0.2112$ M1A1

This is greater than 0.01 so accept that concentrations are equal. A1

OR

Critical value = 2.576 M1A1

The calculated value is less than this so accept that concentrations are equal. A1

6. *(a)* (i) X is B(20,p) (si) B1

Sig level = $\mathrm{P}(X \geq 14 \,|\, p = 0.5)$ M1A1

$= 0.0577$ A1

(ii) We require

$\mathrm{P}(X \geq 14 \,|\, p = 0.7) = \mathrm{P}(Y \leq 6 \,|\, p = 0.3)$ M1A1

$= 0.608$ A1

(b) Under H_0, X is B(200,0.5) $\approx$ N(100,50) M1A1

$$z = \frac{119.5 - 100}{\sqrt{50}}$$ m1A1

$= 2.76$ A1

p-value = 0.00289 A1

Strong evidence to support Dafydd's theory. B1

7. *(a)* (i) $H_0: \mu = 3$ versus $H_1: \mu > 3$ B1

(ii) In 5 days, number sold Y is Poi(15) under H_0. B1
p-value = $P(Y \geq 20)$ M1
$= 0.1248$ A1
We cannot conclude that the mean has increased. B1

(b) Under H_0 the number sold in 100 days is Poi(300) ≈ N(300,300) B1B1

$$z = \frac{329.5 - 300}{\sqrt{300}}$$ M1A1

$= 1.70$ A1
p-value = 0.0446 A1
Significant at the 5% level because $0.0446 < 0.05$. B1B1