WJEC
CBAC

MS3
£3.00

GENERAL CERTIFICATE OF EDUCATION
TYSTYSGRIF ADDYSG GYFFREDINOL

MARKING SCHEME

MATHEMATICS - C1-C4 & FP1-FP3
AS/Advanced

SUMMER 2008

A/AS level Mathematics - S2 June 2008

Mark Scheme -

1 $\bar{x} = \frac{32.6}{5}$, $\bar{y} = \frac{36.78}{6}$ B1

SE of difference of means = $\sqrt{\frac{0.25^2}{5} + \frac{0.25^2}{6}}$ M1A1

The 95% confidence limits are

$6.52 - 6.13 \pm 1.96 \times 0.1514$ m1A1

giving [0.093, 0.687] A1

2 (a) E(X) = 4, Var(X) = 2.4 B1

Using Var(X) = $E(X^2) - [E(X)]^2$ M1

$E(X^2) = 2.4 + 16$ A1

$= 18.4$

E(Y) = 9, Var(Y) = 6.3 B1

Similarly,

$E(Y^2) = 6.3 + 81 = 87.3$ B1

(b) E(U)=E(X)E(Y) = 36 B1

$E(X^2Y^2) = E(X^2)E(Y^2) = 1606.32$ B1

Var(U) = $E(X^2Y^2) - [E(XY)]^2$ M1

$= 1606.32 - 36^2 = 310.32$ A1

3 (a) (i) $z = \frac{49 - 50}{2} = -0.5$ M1A1

Prob = 0.3085 A1

(ii) Number weighing less than 49 g is B(6,0.3085) si B1

Required prob = $\binom{6}{3} \times 0.3085^3 \times 0.6915^3 = 0.194$ M1A1

[Award M1A0 if combinatorial term omitted]

(b) X-3Y is N(50-3 $\times$18, $2^2 + 9 \times 1.2^2$), ie N(- 4, 16.96) M1B1B1

$z = \frac{4}{\sqrt{16.96}} = (\pm)0.97$ A1

Prob = 0.166 A1

4 (a) $\bar{x} = \dfrac{48.32}{8}$ (= 6.04) B1

SE of $\bar{X} = \dfrac{0.05}{\sqrt{8}}$ (= 0.01767…) M1

[Award M1 only if the 8 appears in the denominator]

99% conf limits are

$6.04 \pm 2.576 \times 0.01767..$ m1A1

[M1 correct form, A1 2.576]

giving [5.99,6.09] A1

(b) We solve

$\dfrac{2.576 \times 2 \times 0.05}{\sqrt{n}} = 0.04$ M1

$n = 41.467$ A1

giving $n = 42$ B1

[FT on their n]

5 (a) $H_0 : p = 0.6$ versus $H_1 : p < 0.6$ B1

(b) Under H_0, X is B(20,0.6) si B1

and Y (No not germ) is B(20,0.4) (si) B1

p-value = $P(X \leq 9 \mid H_0) = P(Y \geq 11 \mid H_0)$ M1

$= 0.1275$ A1

(c) X is now B(200,0.6) which is approx N(120,48) B1

$z = \dfrac{101.5 - 120}{\sqrt{48}}$ M1A1A1

[M1A1A0 if no continuity correction]

$= - 2.67$ A1

p-value = 0.00379 A1

Strong evidence to support Malcolm (or germination prob less than 0.6). B1

[No c/c gives z = - 2.74, p = 0.00307, wrong c/c gives z = - 2.81, p = 0.00248]

6 (a)(i) AC = $\sqrt{X^2 + X^2} = \sqrt{2}X$ (si) B1

We require P($\sqrt{2}X > 8$) = P($X > 8/\sqrt{2}$) M1A1

$= \dfrac{6 - 8/\sqrt{2}}{6-4} = 0.172$ (3 - 2v2) A1

(ii) Area = $\dfrac{X^2}{2}$ B1

We require P($\dfrac{X^2}{2} < 10$) = P($X < \sqrt{20}$) M1A1

$= \dfrac{\sqrt{20} - 4}{6-4} = 0.236$ (v5 – 2) A1

(b) EITHER

$f(x) = 0.5$ for $4 \le x \le 6$ B1

Expected area = $\int_4^6 0.5x^2 \times 0.5 \mathrm{d}x$ M1

$= 0.25\left[\dfrac{x^3}{3}\right]_4^6$ A1

$= \dfrac{38}{3}$ A1

OR

$E(X^2) = \mathrm{Var}(X) + (E(X))^2$ M1

$= \dfrac{2^2}{12} + 5^2 (= \dfrac{76}{3})$ A1A1

Expected area = $E\left(\dfrac{X^2}{2}\right) = \dfrac{38}{3}$ A1

7 (a) $H_0 : \mu = 2.5$ versus $H_1 : \mu \neq 2.5$ B1

(b)(i) Under H_0 S is Po(15) B1

P(S ≤ 8) = 0.0374 B1

P(S ≥ 23) = 0.0327 B1

Significance level = 0.0701 B1

(ii) If μ = 2, S is Po(12) B1

We require P($9 \le X \le 22$) = 0.9970 – 0.1550 M1A1

= 0.842 A1

(c) Under H_0, *S* is now Po(250) ≈ N(250,250) B1

$z = \dfrac{269.5 - 250}{\sqrt{250}}$ M1A1A1

= 1.23 A1

[Award M1A1A0 if the c/c is incorrect or omitted]

Prob from tables = 0.1093 A1

p-value = 0.2186 B1

Accept H_0 (context not required but accept if correct)). B1

[No c/c gives z = 1.26, prob = 0.1038, p-value = 0.2076;
incorrect c/c gives z = 1.30, prob = 0.0968, p-value = 01936]