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	GCE AS LEVEL – October/November 2013	9709	22

1 **(i)** State indefinite integral of the form $k \ln (4x - 1)$, where $k = 2$, 4, or ½ M1
State correct integral ½ ln $(4x - 1)$ A1 [2]

(ii) Substitute limits correctly M1
Use law for the logarithm of a power or a quotient M1
Obtain ln 3 correctly A1 [3]

2 Use quotient or product rule M1
Obtain correct derivative in any form A1
Equate (numerator) of derivative to zero and solve for x DM1
Obtain $x = \frac{1}{3}$ A1
Obtain $y = \frac{3}{2}$ A1 [5]

3 Use trig identity correctly to obtain a quadratic in cosec θ or sin θ M1
Solve the quadratic correctly M1
Obtain sin θ = ¼ or $-\frac{2}{3}$ A1
Obtain one correct answer A1
Carry out correct method for second answer from either root DM1
Obtain remaining 3 answers from 14.5, 165.5, 221.8, 318.2 and no others in the range A1
[Ignore answers outside the given range] [6]

4 **(i)** Substitute $x = 3$ or $x = -2$ and equate to zero M1
Obtain a correct equation in any form A1
Obtain a second correct equation in any form A1
Solve a relevant pair of equations for a or for b M1
Obtain $a = 4$ and $b = -3$ A1 [5]

(ii) Attempt division by $x + 2$ (or $x - 3$) and obtain partial quotient of $ax^2 + kx$ M1
Obtain linear factors $4x + 1$, $x + 2$ and $x - 3$ A1
[If linear factor $4x + 1$ obtained by remainder theorem or inspection, award B2]
[If linear factor $4x + 1$ obtained by division by $x^2 - x - 6$, award M1 A1] [2]

Alternative Method:
Attempt to form identity $(x^2 - x - 6)(rx + s) \equiv ax^3 + bx^3 - 25x - 6$ M1
Attempt to equate like terms M1
Leads to $s = 1$ B1, $r = 4$ A1, $b = -3$ A1, $a = 4$ A1
Obtain linear factors $4x + 1$, $x + 2$ and $x - 3$ A1

5 **(i)** State $\frac{dx}{dt} = \frac{1}{2}t^{-\frac{1}{2}}$ or $\frac{dy}{dt} = \frac{3}{t}$ B1

Use $\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$ M1

Use $y = 6$ to find t M1

Obtain $t = e^2$ A1

Obtaind $\frac{dy}{dx} = \frac{6}{e}$ A1 [5]

(ii) Obtain x and form equation of the tangent at their point M1

Obtain correct equation for tangent $\left(y - 6 = \frac{6}{e}(x - (1 + e))\right)$ A1

Show that tangent passes through (1, 0) by substitution A1 [3]

6 **(a)** Expand brackets and use $\sin^2 x + \cos^2 x = 1$ M1

Obtain $1 - \sin 2x$ A1

Integrate and obtain term of form $\pm k \cos 2x$, where $k = ½$, 1 or 2 M1

State correct integral $x + \frac{\cos 2x}{2}(+c)$ A1 [4]

(b) **(i)** State or imply correct ordinates 1.4142…, 1.0823…, 1 B1

Use correct formula, or equivalent, correctly with $h = \frac{\pi}{8}$ and three ordinates M1

Obtain answer 0.899 with no errors seen A1 [3]

(ii) Make a recognisable sketch of $y = \text{cosec } x$ for $0 < x \leqslant \frac{1}{2}\pi$ B1

Justify statement that the trapezium rule gives an over-estimate B1 [2]

7 **(i)** Integrate to obtain terms $4x^2$ and $\frac{1}{2}e^x$ B1 + B1

Substitute limits correctly M1

Obtain correct equation in any form $4a^2 + \frac{1}{2}e^a - \frac{1}{2} = \frac{1}{2}$ A1

Rearrange to given answer correctly A1 [5]

(ii) Consider sign of $\sqrt{\frac{2-e^a}{8}} - a$, or equivalent M1

Complete the argument correctly with appropriate calculations A1 [2]
$(f(0.2) = 0.112,\ f(0.3) = -0.015)$

(iii) Use the iterative formula correctly at least once M1

Obtain final answer 0.29 A1

Show sufficient iterations to justify its accuracy to 2 d.p. B1

$x_0 = 0.2$	$x_0 = 0.25$	$x_0 = 0.3$
0.3120	0.2992	0.2851
0.2815	0.2853	0.2894
0.2905	0.2894	
0.2879		

or show there is a sign change in the interval (0.285, 0.295) [3]