PIMS EDUCATIONAL ACADEMY Regd. No. : 130/10

MODEL HIGHER SECONDARY EXAMINATION www.mathstimes.com

KEY FOR MATHEMATICS

A

Q No.	Option	Answer
1.	2	4
2.	4	inverse axiom
3.	3	ω^{n-k}
4.	4	taking finite number of elementary transformations
5.	2	$\frac{1}{50\pi} cm/\min$
6.	1	1.5 cm^2/sec
7.	1	$\frac{9}{4}$
8.	1	0
9.	3	$\pm 1, \pm i$
10.	4	(i) , (ii), and (iii)
11.	4	200m
12.	1	1
13.	4	k^{n-1} (adj I)
14.	1	1
15.	2	$\frac{1}{\sqrt{6}}$
16.	2	(−8, −6, −22)
17.	3	2
18.	2	$\sqrt{3}\lambda$
19.	1	(2 , −1, 4) and 5
20.	1	$\pi\int_c^d x^2 dy$
21.	1	(6, 6)
22.	3	$\frac{9}{4}$
23.	3	4
24.	1	$\left(-\frac{1}{2}, -8\right)$
25.	4	$\cos\frac{\pi}{2} - i\sin\frac{\pi}{2}$
26.	3	$\omega^n = 1$
27.	1	1, 1
28.	2	2π

B

Q No.	Option	Answer
1.	2	(−8, −6, −22)
2.	3	2
3.	2	$\sqrt{3}\lambda$
4.	1	(2 , −1, 4) and 5
5.	1	$\pi\int_c^d x^2 dy$
6.	4	200m
7.	1	1
8.	4	k^{n-1} (adj I)
9.	1	1
10.	2	$\frac{1}{\sqrt{6}}$
11.	3	$\omega^n = 1$
12.	1	1, 1
13.	2	2π
14.	4	9π
15.	1	20π
16.	1	1.5 cm^2/sec
17.	1	$\frac{9}{4}$
18.	1	0
19.	3	$\pm 1, \pm i$
20.	4	(i) , (ii), and (iii)
21.	4	$x^2 - y^2 - 2xy = c$
22.	1	$\frac{dy}{dx} = \lambda y$
23.	4	$\int_e Qdx$
24.	2	an asymptote parallel to y-axis
25.	1	0
26.	4	Q – {0}
27.	3	3
28.	3	$\frac{25}{51}$

29.	4	9π	29.	2	$\frac{24}{169}$
30.	1	20π	30.	2	all possible values between certain given limits
31.	4	$Q - \{0\}$	31.	2	4
32.	3	3	32.	4	inverse axiom
33.	3	$\frac{25}{51}$	33.	3	ω^{n-k}
34.	2	$\frac{24}{169}$	34.	4	taking finite number of elementary transformations
35.	2	all possible values between certain given limits	35.	2	$\frac{1}{50\pi} cm/\min$
36.	4	$x^2 - y^2 - 2xy = c$	36.	1	(6, 6)
37.	1	$\frac{dy}{dx} = \lambda y$	37.	3	$\frac{9}{4}$
38.	4	$\int_e Qdx$	38.	3	4
39.	2	an asymptote parallel to y-axis	39.	1	$\left(-\frac{1}{2}, -8\right)$
40.	1	0	40.	4	$\cos\frac{\pi}{2} - i\sin\frac{\pi}{2}$

SECTION – B

41. $AB = \begin{bmatrix} 2 & 3 \\ 1 & 1 \end{bmatrix}$ **- 1 mark**

$(AB)^{-1} = \begin{bmatrix} -1 & 3 \\ 1 & -2 \end{bmatrix}$ **- 1 mark**

$B^{-1} = \begin{bmatrix} 2 & 1 \\ -1 & 0 \end{bmatrix}$ **- 1 mark**

$A^{-1} = \begin{bmatrix} -1 & 2 \\ 1 & -1 \end{bmatrix}$ **- 1 mark**

$B^{-1}A^{-1} = \begin{bmatrix} -1 & 3 \\ 1 & -2 \end{bmatrix}$ **- 1 mark**

$(AB)^{-1} = B^{-1}A^{-1}$ **- 1 mark**

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42. $\Delta = 0$ **- 1 mark**

$\Delta x = 0$ **- 1 mark**

$\Delta y = 0$ **- 1 mark**

One of the coefficients aij of $\Delta \neq 0$ **- 1 mark**

$\therefore$ The solution set is (x , y) = $\left(\frac{9-5K}{4}, K\right)$, $K \in R$ **- 2 marks**

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43. i) $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ **- 1 mark**

$(2\vec{i} - \vec{j} + \vec{k}).(\vec{i} - 3\vec{j} - 5\vec{k}) = 0$ **- 1 mark**

$\therefore$ angle between two sides is 90^o **- 1 mark**

Note : For any other method, full marks may be given

ii) $\vec{r} = -\vec{i} - \vec{k}$ - 1 mark

$\vec{M} = \vec{r} \times \vec{F}$ - 1 mark

$\vec{M} = 2\vec{i} - 7\vec{j} - 2\vec{k}$ - 1 mark

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44. $\vec{a} = 2\vec{i} + 6\vec{j} - 7\vec{k}$ and $\vec{b} = -2\vec{i} + 4\vec{j} - 3\vec{k}$ - 1 mark

$\left[\vec{r} - \left(2\vec{i} + 6\vec{j} - 7\vec{k}\right)\right]\left[\vec{r} - \left(-2\vec{i} + 4\vec{j} - 3\vec{k}\right)\right] = 0$ - 2 marks

$x^2 + y^2 + z^2 - 10y + 10z + 41 = 0$ - 1 mark

Centre (0, 5, -5) - 1 mark

Radius = 3 - 1 mark

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45. $1 + i = \sqrt{2}\left(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}\right)$ - 3 marks

$(1 + i)^n = \left(\sqrt{2}\right)^n\left(\cos\frac{n\pi}{4} + i\sin\frac{n\pi}{4}\right)$ - 1 mark

$(1 + i)^n = \left(\sqrt{2}\right)^n\left(\cos\frac{n\pi}{4} - i\sin\frac{n\pi}{4}\right)$ - 1 mark

$(1 + i)^n + (1 - i)^n = 2^{\frac{n+2}{2}}\cos\frac{n\pi}{4}$ - 1 mark

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46. i) $\left|(a_1 + ib_1)\right|\left|(a_2 + ib_2)\right| \ldots\ldots \left|(a_n + ib_n)\right| = \left|A + iB\right|$ - 1 mark

$\sqrt{a_1^{\,2} + b_1^{\,2}}\sqrt{a_2^{\,2} + b_2^{\,2}} \ldots\ldots \sqrt{a_n^{\,2} + b_n^{\,2}} = \sqrt{A^2 + B^2}$ - 1 mark

On squaring

$\left(a_1^{\,2} + b_1^{\,2}\right)\left(a_2^{\,2} + b_2^{\,2}\right) \ldots\ldots \left(a_n^{\,2} + b_n^{\,2}\right) = A^2 + B^2$ - 1 mark

ii) $\arg(a_1 + ib_1) + \arg(a_2 + ib_2) + \ldots\ldots + \arg(a_n + ib_n) = \arg(A + iB)$ - 1 mark

$\tan^{-1}\left(\frac{b_1}{a_1}\right) + \tan^{-1}\left(\frac{b_2}{a_2}\right) + \ldots\ldots + \tan^{-1}\left(\frac{b_n}{a_n}\right) = \tan^{-1}\left(\frac{B}{A}\right)$ - 1 mark

By taking the general value

$\tan^{-1}\left(\frac{b_1}{a_1}\right) + \tan^{-1}\left(\frac{b_2}{a_2}\right) + \ldots\ldots + \tan^{-1}\left(\frac{b_n}{a_n}\right) = k\pi + \tan^{-1}\left(\frac{B}{A}\right)$ - 1 mark

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47. Rough diagram - 2 marks

Co – ordinate of A (2ct , o) - 1 mark

Co – ordinate of B (0 , $\frac{2c}{t}$) - 1 mark

The mid – point of AB (ct , $\frac{c}{t}$**)** - 2 marks

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48. f(0) = 1 - 1 mark

f'(0) = -1 - 1 mark

f''(0) = 2 - 1 mark

$\frac{1}{1+x} = 1 - x + x^2 - \ldots\ldots$ - 3 marks

Note : The sign of the 4th term may be put as '+' or '-'

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49. I = $\int_0^3 \frac{\sqrt{x}}{\sqrt{x} + \sqrt{3-x}}\,dx$ - 1 mark

I = $\int_0^3 \frac{\sqrt{3-x}}{\sqrt{3-x} + \sqrt{x}}\,dx$ - 2 marks

$2I = \int_0^3 dx$ (or) $[x]_0^3$ **- 2 marks**

I = $\frac{3}{2}$ **- 1 mark**

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50. IF = sinx . **- 2 marks**

Solution is ysinx = $\int \sin 2x dx$ **- 2 marks**

y sinx = $\frac{-\cos 2x}{2} + c$ (or) 2ysinx + cos2x=c **- 2 marks**

51.

p	q	r	p ∨ q	(p ∨ q) ∧ r
T	T	T	T	T
T	T	F	T	F
T	F	T	T	T
T	F	F	T	F
F	T	T	T	T
F	T	F	T	F
F	F	T	F	F
F	F	F	F	F

column 1 to 4 (each 1 mark) **- 4 marks**

column 5 **- 2 marks**

Note : (i) Instead of F and T one may use 0 and 1 or 1 and 0

(ii) The order of the rows need not be as in the scheme

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52. Stating:

$a*b = a*c \Rightarrow b = c$ **- 1 mark**

$b*a = c*a \Rightarrow b = c$ **- 1 mark**

Proving

$a*b = a*c \Rightarrow b = c$ **- 1 mark**

$b*a = c*a \Rightarrow b = c$ **- 1 mark**

Note :

(i) For L.C.L the left elements must be same.

(ii) For R.C.L the right elements must be same.

(iii) One may take any three different elements.

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53. (i) $\int_{-\infty}^{\infty} f(x)dx = \frac{2}{9}\int_0^3 xdx$ **- 1 mark**

= 1 **- 1 mark**

∴ f(x) is a p.d.f **- 1 mark**

(ii) np = 6, npq = 9 **- 1 mark**

In Binomial distribution mean > variance, Since np > npq ($\because q < 1$) **- 1 mark**

The given statement is false **- 1 mark**

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54. f(x) = $Ke^{-2(x^2+2x-1)}$ **- 1 mark**

$= Ke^{-2(x-1)^2}$ **- 1 mark**

$= Ke^{-\frac{1}{2}\left(\frac{x-1}{\frac{1}{2}}\right)^2}$ **- 1 mark**

M = 1 **- 1 mark**

σ = $\frac{1}{2}$ **- 1 mark**

K = $\sqrt{\frac{2}{\pi}}$ **- 1 mark**

55. (a) $m = \frac{dy}{dx} = 2x - 1$ **- 1 mark**

At (1 , -2) , m = 1 **- 1 mark**

The equations of the tangent y = x - 3 **- 2 marks**

The equations of the tangent y = - x - 1 **- 2 marks**

(OR)

(b) T = k $\sqrt{l}$

log T = log K + $\frac{1}{2}$ logl **- 1 mark**

$\frac{1}{T} dT = \frac{1}{2}\frac{1}{l} dl$ **- 1 mark**

$\frac{\Delta T}{T} \times 100 = \frac{1}{2} \times \frac{dl}{l} \times 100$ **- 1 mark**

$= \frac{1}{2} \times \frac{10.3}{32.1} \times 100$ **- 1 mark**

= - 0.156% **- 1 mark**

The percentage error in the time of swing is a decrease of 0.156 **- 1 mark**

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www.mathstimes.com **SECTION – C**

56. $[A,B] = \begin{bmatrix} 1 & 1 & 1 & 6 \\ 1 & 2 & 3 & 14 \\ 1 & 4 & 7 & 30 \end{bmatrix}$ **- 1 mark**

$\sim \begin{bmatrix} 1 & 1 & 1 & 6 \\ 0 & 1 & 2 & 8 \\ 0 & 3 & 6 & 24 \end{bmatrix}$ $R_2 \to R_2 - R_1$; $R_3 \to R_3 - R_1$ **- 2 marks**

$\sim \begin{bmatrix} 1 & 1 & 1 & 6 \\ 0 & 1 & 2 & 8 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ $R_3 \to R_3 - 3R_2$ **- 1 mark**

$\rho(A) = \rho(A, B) = 2 < 3$ (no of unknowns) **- 1 mark**

The given system is consistent and has an infinite number of solutions **- 1 mark**

Taking Z = K **- 1 mark**

X = K – 2 **- 1 mark**

y = 8 – 2K **- 1 mark**

$\therefore$ Solution set is (x,y,z) = {K-2, 8-2K, K}, K$\in$R **- 1 mark**

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57. Condition for intersecting is

$\left[(\vec{a}_2 - \vec{a}_1)\,\text{ü}\,\text{v}\right] = 0$ (OR) $\begin{vmatrix} x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ l_1 & m1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0$ **- 1 mark**

To prove $\left[(\vec{a}_2 - \vec{a}_1)\,\text{ü}\,\text{v}\right] = 0$ **- 2 marks**

Take $\frac{x-1}{1} = \frac{y+1}{-1} = \frac{z}{3} = \lambda$ **- 1 mark**

Point $(\lambda + 1, -\lambda - 1, 3\lambda)$ **- 1 mark**

Take $\frac{x-2}{1} = \frac{y-1}{2} = \frac{z+1}{-1} = \mu$ **- 1 mark**

Point $(\mu + 2, 2\mu + 1, -\mu - 1)$ **- 1 mark**

$(\lambda + 1, -\lambda - 1, 3\lambda) = (\mu + 2, 2\mu + 1, -\mu - 1)$ **- 1 mark**

$\mu = -1, \ \lambda = 0$ **- 1 mark**
The point of intersection is (1, -1 , 0) **- 1 mark**

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58. $\vec{a} = -\vec{i} + 3\vec{j} + 2\vec{k}$ **- 1 mark**

$\vec{u} = \vec{i} + 2\vec{j} + 2\vec{k}$ **- 1 mark**

$\vec{v} = 3\vec{i} + \vec{j} + 2\vec{k}$ **- 1 mark**

Vector Form

$\vec{r} = \left(-\vec{i} + 3\vec{j} + 2\vec{k}\right) + s\left(\vec{i} + 2\vec{j} + 2\vec{k}\right) + t\left(3\vec{i} + \vec{j} + 2\vec{k}\right)$ **- 2 marks**

Cartesian Form

$$\begin{vmatrix} x+1 & y-3 & z-2 \\ 1 & 2 & 2 \\ 3 & 1 & 2 \end{vmatrix} = 0$$ **- 3 marks**

2x + 4y -5z = 0 **- 2 marks**

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59. Z = x + iy **- 1 mark**

$$\frac{Z+1}{Z+i} = \frac{(x+1)+iy}{x+i(y+1)}$$ **- 2 marks**

$$\frac{(x+1)+iy}{x+i(y+1)} \times \frac{x-i(y+1)}{x-i(y+1)}$$ **- 2 marks**

$$\frac{x(x+1)+y(y+1)}{x^2+(y+1)^2} = 1$$ **- 3marks**

$\therefore$ Locus of P is x – y = 1 **- 2 marks**

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60. $(x - 3)^2 = 12 (y + 1)$ -2 marks

Axis : x-3 = 0 - 1mark
Vertex : (3,-1) - 1mark
Focus : (3 , 2) - 1mark
Directrix : y + 4 = 0 - 1mark
Latus rectum : 12 - 1mark
Equation of Latus rectum : y – 2 = 0 - 1mark
Rough Diagram - 2marks

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61. Rough diagram **- 2 marks**

A = 36, e = 0.206

(i) closest distance $F_1A = CA - CF_1$ **- 1 mark**
$= a - ae = a(1 - e)$ **- 1 mark**
$= 36 \times 0.794$ **- 1 mark**
= 28.584 million miles **- 1 mark**

(ii) Greatest distance $F_1A^1 = F_1C + CA^1$ **- 1 mark**
$= ae + a = a(e + 1)$ **- 1 mark**
$= 36 \times 1.206$ **- 1 mark**
= 43.416 million miles **- 1 mark**

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62. $\lim\limits_{x \to 0+} x^{\sin x}$ is of the form 0^o. **- 1 mark**

Let y = $x^{\sin x} \Rightarrow \log y = \sin x \log x$ **- 1 mark**

$$\log y = \frac{\log x}{\operatorname{cosec} x}$$ **- 1 mark**

$$\lim_{x \to 0+} \log y = \lim_{x \to 0+} \frac{\log x}{\operatorname{cosec} x}\left(\frac{-\alpha}{\alpha} \ form\right)$$ **- 1 mark**

$$= \lim_{x \to 0+} \frac{-\sin^2 x}{x \cos x}(\div \ form)$$ **- 2 marks**

$\lim_{x\to 0+} \log y = 0$ - 2 marks

$\lim_{x\to 0+} y = e^o = 1$ - 2 marks

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63. $f'(\theta) = 2\cos 2\theta$ - 1 mark

$f''(\theta) = -4\sin 2\theta$ - 1 mark

$f'''(\theta) = 0 \Rightarrow \theta = \frac{\pi}{2} \in (0, \pi)$ - 2 marks

$(0, \frac{\pi}{2}) \to$ concave downward (or) convex upward - 2 marks

$(\frac{\pi}{2}, \pi) \to$ concave upward (or) convex downward - 2 marks

Point of inflection $(\frac{\pi}{2}, 0)$ - 2 marks

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64. $\frac{\partial u}{\partial x} = 3\cos 3x \cos 4y$ - 2 marks

$\frac{\partial u}{\partial x} = -4\sin 3x \sin 4y$ - 2 marks

$\frac{\partial^2 u}{\partial x \partial y} = -12\cos 3x \sin 4y$ - 2 marks

$\frac{\partial^2 u}{\partial y \partial x} = -12\cos 3x \sin 4y$ - 2 marks

$\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$ - 2 marks

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65. Eqn of AB is y = $\frac{3}{2}(x+1)$ - 1 mark

Eqn of Bc is y = $\frac{7-x}{2}$ - 1 mark

Eqn of CB is y = $\frac{1}{2}(x+1)$ - 1 mark

Area = $\int_{-1}^{1} \frac{3}{2}(x+1)dx + \int_{1}^{3}\left(\frac{7-x}{2}\right)dx - \int_{-1}^{3}\left(\frac{x+1}{2}\right)dx$ - 2 marks

$= \frac{3}{2}\left[\frac{x^2}{2} + x\right]_{-1}^{1} + \left[7x - \frac{x^2}{2}\right]_{1}^{3} - \frac{1}{2}\left[\frac{x^2}{2} + x\right]_{-1}^{3}$ - 1 mark

= 4 sq units - 2 marks

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66. $p^2 - 6p + 9 = 0$ - 1 mark

The CF is (A + Bx) e^{3x} - 2 marks

PI$_1$ = $\left(\frac{x}{9} + \frac{2}{27}\right)$ - 3marks

PI$_2$ = e^{2x} - 2 marks

Y = $y = (A + Bx)e^{3x} + \left(\frac{x}{9} + \frac{2}{27}\right) + e^{2x}$ - 2 marks

Note : (1) Instead of A+ Bx one may use Ax + N

(2) Instead of A , B one may use any other different symbols

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67. $\frac{dt}{dt} \alpha (T - 15)$ - 1 mark

$\frac{dt}{dt} = K(T-15)$ **- 1 mark**

$T - 15 = ce^{Kt}$ **- 2 marks**

C = 85 **- 1 mark**

$e^{5k} = \frac{45}{85}$ **- 2 marks**

When t = 10, T = 15 + $85e^{10K}$ **- 2 marks**

T = 38.82C° **- 1 mark**

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68. Closure axiom — Heading **- 1 mark**

Explanation **- 1 mark**

Associative axiom — Heading **- 1 mark**

Explanation **- 1 mark**

Identity axiom — Heading **- 1 mark**

[0] is the identity element **- 1 mark**

Inverse axiom — Heading **- 1 mark**

Inverse of a + b $\sqrt{2}$ is –a-b $\sqrt{2}$ **- 1 mark**

Explanation **- 1 mark**

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69. (i) λ = 4.5 **- 1 mark**

P(x = 9) = $\frac{e^{-4.5} \times (4.5)^9}{\angle 9}$ **- 2 marks**

(ii) λ = 7.2 **- 1 mark**

P(x < 10) = $\sum_{x=0}^{9} \frac{e^{-7.2} \times (7.2)^x}{\angle x}$ **- 2 marks**

(iii) λ = 9.9 **- 1 mark**

P (x ≥ 14) = 1 – p (X < 14) **- 1 mark**

$1 - \sum_{0}^{13} \frac{e^{-9.9} \times (9.9)^x}{\angle x}$ **- 2 marks**

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70. a) The condition for y = mx + c to be a tangent of ellipse is $c^2 = a^2m^2 + b^2$ **- 2 marks**

m = 1 **- 1 mark**

c = 4 **- 1 mark**

$a^2 = 9$, $a^2m^2 + b^2 = 16$ **- 2 marks**

It touches to the ellipse

The point of contact is $\left(\frac{-a^2m}{c}, \frac{b^2}{c}\right)$ **- 1 mark**

i.e (-3 , 1) **- 2 marks**

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b) Rough Diagram **- 1 mark**

$\frac{dx}{dt} = -3a\cos^2 t \sin t$ **- 2 marks**

$\frac{dy}{dt} = 3a\sin^2 t \cos t$ **- 2 marks**

$\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2} = 3a\sin t \cos t$ **- 2 marks**

Length = $4 \int_0^{\pi/2} 3a\sin t \cos t dt$ **- 2 marks**

= 6a www.mathstimes.com - 1mark