**A2 Assignment Nu Cover Sheet** **Name:**

| Question | | Done | BP | Ready | Topic | Comment |
|---|---|---|---|---|---|---|
| Drill | Aa | | | | C4 Integration – Repeated linear factors | $-\frac{3}{(x-2)}-\frac{3}{(x-2)^2}+c$ |
| | Ab | | | | C4 Integration – cos^2 conversion | $x+sinx+c$ |
| | Ac | | | | C4 Integration – sin^2 conversion | $\frac{3}{2}x-\frac{3}{16}sin8x+c$ |
| | Ba | | | | C4 Integration – R method x solve | $1.17^c$, $3.26^c$ |
| | Bb | | | | C4 Integration – R method 2x solve | $1.13^c$ , $3.18^c$, $4.28^c$, 0.04 |
| | Bc | | | | C4 Integration – R method x/2 solve | $0^c$, $\pi^c$ |
| | Ca | | | | C3 Num Meth – confirm root in interval | Use a change of sign argument. Remember to say that $f(x)$ is continuous on the interval! |
| | Cb | | | | C3 Num Meth – confirm root in interval | Use a change of sign argument. Remember to say that $f(x)$ is continuous on the interval! |
| | Cc | | | | C3 Num Meth – confirm root in interval | Use a change of sign argument. Remember to say that $f(x)$ is continuous on the interval! |
| | Da | | | | C3 MOD – sketch & define range | $f(x)\geq 0$ |
| | Db | | | | C3 MOD – sketch & define range | $f(x)\geq -2$ |
| | Dc | | | | C3 MOD – sketch & define range | $f(x)\neq 2$ |
| Current work | 1a | | | | C4 Integration – sin(3x+1) | $\frac{1}{3}\cos(3x+1)+c$ |
| | 1b | | | | C4 Integration – cos(x/2) | $8\sin\left(\frac{x}{2}\right)+c$ |
| | 1c | | | | C4 Integration – tanx | $-\ln(cosx)+c$ |
| | 1d | | | | C4 Integration – cot4x | $\frac{1}{4}\ln(sin4x)+c$ |
| | 1e | | | | C4 Integration – trig reverse chain | $\frac{1}{10}\sec^5 2x+c$ |
| | 1f | | | | C4 Integration – tan5x | $-\frac{1}{5}\ln(cos5x)+c$ |
| | 1g | | | | C4 Integration – sin^2 conversion | $\frac{1}{2}x-\frac{1}{24}sin12x+c$ |
| | 1h | | | | C4 Integration – cos^2 conversion | $\frac{3}{2}x+\frac{3}{8}sin4x+c$ |
| | 1i | | | | C4 Integration – tan^2 conversion | $\frac{3}{4}tan4x-3x+c$ |
| | 1j | | | | C4 Integration – trig reverse chain | $\frac{1}{6}\tan^6 y+c$ |
| | 1k | | | | C4 Integration – cosec3u cot3u | $-\frac{1}{3}cosec3u+c$ |
| | 1l | | | | C4 Integration – reverse chain | $\frac{2}{21}(3x^2+1)^7+c$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1m | | | | C4 Integration – trig fraction | $\frac{1}{3}ln(2+tan3x)+c$ |
| | 1n | | | | C4 Integration – partial fractions | $\ln\lvert x-3\rvert-2\ln\lvert x-2\rvert+c$ |
| | 2 | | | | C4 Integration – definite case 3 partial fract | Proof |
| | 3a | | | | C3 Trig Proof | Proof |
| | 3b | | | | Hence C4 Integral | $\frac{\pi}{3}+\frac{1}{4}$ |
| | 4a | | | | C3 Trig Proof | Proof |
| | 4b | | | | Hence C4 Integral | 0 |
| | 5 | | | | C4 Integral – definite trig | $\frac{\sqrt{3}}{4}+\frac{1}{3}$ |
| | 6a | | | | C4 integral – definite sin^2 conversion | $\frac{\pi}{2}-1$ |
| | 6b | | | | C4 Integral – definite cos^2 conversion | $\frac{3\pi}{2}+\frac{9\sqrt{3}}{4}$ |
| | 7a | | | | C4 Binomial – expand 2/root(2-3x) | $\sqrt{2}+\left(\frac{3\sqrt{2}x}{4}\right)+\left(\frac{27\sqrt{2}x^2}{32}\right)+\left(\frac{135\sqrt{2}x^3}{128}\right)+\cdots$ |
| | 7b | | | | C4 Binomial – state validity | Valid \|x\| < 2/3 |
| | 7c | | | | C4 Binomial – estimate 2/root170 | 0.1534 |
| Consolidation | 8a | | | | M2 Kinematics – find velocity given displace | 56ms$^{-1}$ |
| | 8b | | | | M2 Kinematics –find acc given displacement | 28 ms$^{-2}$ |
| | 9a | | | | M2 Kinematics – find position given velocity | 29m |
| | 9b | | | | M2 Kinematics – find accel given velocity | -6 ms$^{-2}$ |
| | 9c | | | | M2 Kinematics – find max velocity | 13.5 ms$^{-1}$ |
| | 9d | | | | M2 Kinematics – find distance @ max velocity | 15.5 m |
| | 10a | | | | M2 Kinematics – acc vector find velocity | 0.5**i** – 2**j** ms$^{-1}$ |
| | 10b | | | | M2 Kinematics – acc vector find speed | 1.3 ms$^{-1}$ |
| | 10c | | | | M2 Kinematics – find position given acc vect | **i** – 0.4**j** m |
| | 10d | | | | M2 Kinematics – find displace @ t = 4 | 2.56m |
| | 11a | | | | M2 Projectiles – find speed & direction | 13 m s$^{-1}$, 39° above horizontal |
| | 11b | | | | M2 Projectiles – find speed & direction | 11 m s$^{-1}$, 7.7° below horizontal |
| | 12a | | | | C3 Identities – which is true? | D |
| | 12b | | | | C3 Identities – which is true? | A |
| Extra questi | TT3Ai | | | | R, α transformations | $R = 25$ |
| | TT3Aii | | | | R, α transformations | -25 |
| | TT3Aiii | | | | R, α transformations | 1.85 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | TT3Aiv | | | | R, α transformations | 3.84, 6.16 |
| | TT3B | | | | Implicit differentiation | $9y+7x=23$ |

| $\alpha$ | $\beta$ | $\gamma$ | $\delta$ | $\varepsilon$ | $\zeta$ | $\eta$ | $\theta$ | $\iota$ | $\kappa$ | $\lambda$ | $\mu$ | $\nu$ | $\xi$ | $o$ | $\pi$ | $\rho$ | $\sigma$ | $\tau$ | $\upsilon$ | $\varphi$ | $\chi$ | $\psi$ | $\omega$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*"One of the most endearing things about mathematicians is the extent to which they will go to avoid doing any work."* M Pardage

# A2 Maths with Mechanics Assignment $\nu$ (nu)
# Due in w/b 08/01/18

## Drill

**Part A** Integrate the following functions

$a)\ \int \frac{3x}{(x-2)^3}\,dx$

(b) $\int 2\cos^2\frac{x}{2}\,dx$

(c) $\int 3\sin^2 4x\,dx$

**Part B** Write in form indicated and hence solve for *x* (in radians to 2dp) in the interval [0, 2π]:

(a) $4\sin x - 3\cos x = 2.5$ $R\sin(x-\alpha)$ (b) $5cos2x + 12sin2x = 6$ $Rcos(2x-\alpha)$ (c) $\cos\left(\frac{x}{2}\right) + sin\left(\frac{x}{2}\right) = 1$ $Rcos\left(\frac{x}{2}-\alpha\right)$

**Part C** By first defining *f(x)* show that each of the following functions has a root on the interval given:

(a) $x^3 + 6x^2 = 9x - 2$ on (0, 0.5) (b) $1 + x^2 = x^3$ on (1, 2) (c) $x^2 = \sin x$ on (0.5, 1)

**Part D** For each of the following functions, with domain $x \in$ R, sketch its graph and state its range: mark any asymptotes

(a) $f(x) = |3x-2|$ (b) $f(x) = |x| - 2$ (c) $f(x) = 2 + \frac{3}{x}$

Learning formulae * you will need these in C4 integration
Complete the following:

| | |
|---|---|
| **sin(A+B)** | **≡** |
| **sin(A–B)** | **≡** |
| **cos (A+B)** | **≡** |
| **cos (A–B)** | **≡** |
| **tan(A+B)** | **≡** |
| **tan(A–B)** | **≡** |
| **sin2A** | **≡** |
| **cos2A** | **≡** |

| |
|---|
| **or ≡** |
| **or ≡** |
| **tan2A ≡** |
| **$\sin^2x+\cos^2x=$** |
| **$1+\cot^2x$ ≡** |
| **$\tan^2x+1$ ≡** |
| ***2sinAcosB ≡** |
| ***2cosAsinB ≡** |
| ***2cosAcosB ≡** |
| ***2sinAsinB ≡** |

*factor formulae express as sum or difference of sines and cosines

Complete the table: you will feel more confident about integration if you learn these

| f(x) | ∫f(x) | f(x) | ∫f(x) |
|---|---|---|---|
| $x^n$ | | cosecx | |
| $e^x$ | | secx | |
| 1/x | | cotx | |
| sinx | | $\sec^2 x$ | |
| cosx | | –cosecxcotx | |
| tanx | | secxtanx | |
| | | $-\text{cosec}^2x$ | |

1. Integrate the following functions using an appropriate method when required

(a) ∫ -sin(3x +1) dx (b) ∫ $4\cos\left(\frac{x}{2}\right)$ dx (c) ∫ tanx dx

(d) ∫ cot4x dx (e) ∫ $\sec^5 2x\, tan2x$ dx (f) ∫ tan5x dx

(g) ∫ $\sin^2 6x$ dx (h) ∫ $3\cos^2 2x$ dx (i) ∫ $3\tan^2 4x$ dx

(j) ∫ $\sec^2 y\tan^5 y$ dy (k) ∫ cosec3ucot3u du (l) ∫ $4x(3x^2+1)^6$ dt

(m) ∫ $\frac{\sec^2 3x}{2+tan3x}$ dy (n) ∫ $\frac{4-x}{(x-2)(x-3)}$ dx

2. Show that $\int_0^2 \frac{x^2+6x+7}{(x+2)(x+3)}dx = 2+\ln\left(\frac{25}{18}\right)$

**For the following definite integrations with limits give an exact answer in terms of π.**

3. a) Show that $\sin^2 x +3\cos^2 x \equiv 2+\cos 2x$.

b) Hence evaluate * check using your calculator to see if you're right !!! *

$$\int_{\pi/12}^{\pi/4} (\sin^2 x + 3\cos^2 x)dx$$

4. a) Show that $\frac{4\cos 2x}{\sin^2 2x} \equiv \cos ec^2 x - \sec^2 x$.

b) Hence evaluate $\int_{\pi/6}^{\pi/3} \frac{4\cos 2x}{\sin^2 2x} dx$ * check using your calculator to see if you're right !!! *

5. Evaluate $\int_0^{\pi/6} (\sin 3x + \cos 2x)dx$ * check using your calculator to see if you're right !!! *

6. Evaluate and check using your calculator to see if you're right !!!

(a) $\int_0^{\pi} \sin^2 \frac{1}{4} x dx$ (b) $\int_0^{\pi} 3\cos^2\left(\frac{x}{6}\right) dx$

7. a) Expand, in ascending powers of x up to $x^3$, $\frac{2}{\sqrt{2-3x}}$

b) State the validity of your expansion

c) Use your expansion to estimate $\frac{2}{\sqrt{170}}$ correct to 4.d.p (check this on your calculator !!)

**Mechanics**

**Use differentiation and integration for questions where the acceleration is not constant**

8 A particle P moves in a straight line such that at time t its displacement from a fixed point O is given by $x = 4t^3 + 2t^2$.

(a) Find the velocity when t = 2
(b) Find the acceleration when t = 1

9 A particle P is moving along the x-axis with velocity $v = (18t - 6t^2)$ $ms^{-1}$.
When t = 0, P is at x = 2m.

(a) Find the position of P when t = 3.
(b) Find the acceleration when t = 2.
(c) Find the maximum velocity.
(d) Find the distance OP when the velocity is a maximum.

10 Given that the acceleration vector of an object is $\mathbf{a} = -0.2\mathbf{j}$ $ms^{-2}$ ,with initial velocity $0.5\mathbf{i}$ $ms^{-1}$, and that the object starts at the origin, find:

(a) The velocity at time t = 10

(b) The speed when t = 6
(c) The position vector at t = 2
(d) The displacement from the origin at t = 4

11 A particle is projected with a speed of 21 m $s^{-1}$ at an angle of elevation 60°. Find its
i) speed
ii) and direction of motion after

a) 1 second b) 2 seconds

12. ***For these questions decide which of the responses given is (are) correct then choose***
***A if 1, 2 and 3 are correct***
***B if only 1 and 2 are correct***
***C if only 2 and 3 are correct***
***D if only 1 is correct***
***E if only 3 is correct***

***a)***

$x = 1 + \cos^2\theta - \cos^4\theta$

$y = 1 + \sin^2\theta - \sin^4\theta$

$1. x - y = 0$

$2. x + y = 2\cos^2\theta \sin^2\theta$

$3. x = 1 + \frac{1}{2}\sin^2 2\theta$

b)

$f(x) = e^{\sin x}$

$1. f(0) = 1$

$2. f'(0) = 1$

$3. f''(0) = 1$

## Optional extra questions for you if you are catching up on work from the C3 mock exam

**A** $\mathrm{f}(x) \equiv 7\cos x - 24\sin x$

Given that $\mathrm{f}(x) \equiv R\cos(x+\alpha)$, where $R \geq 0, 0 \leq \alpha \leq \frac{\pi}{2}$, and $x$ and $\alpha$ are measured in radians,

i) find $R$ and show that $\alpha = 1.29$ to 2 decimal places.
Hence write down
ii) the minimum value of f ($x$),
iii) the value of $x$ in the interval $0 \le x \le 2\pi$ which gives this minimum value.
iv) Find the smallest two positive values of $x$ for which $7\cos x - 24\sin x = 10$

**B** Find the equation of the tangent to the curve with implicit equation $x^2 + 3xy^2 - y^3 = 9$ at the point (2, 1).