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Mock Paper	•							1	
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Mathematical Formulae	<u>immation</u>	Nil	inciuuc	u with	questi	<u>он рарстз</u>		6	
Candidates may use any o symbolic algebra, differer NOT use calculators such 9970G, Hewlett Packard	ntiation an as the Te	nd/or inte	gration	. Thus	candid	ates may		7	
In the boxes above, write your centre number signature. You must write your answer for ea question. If you need more space to complete answer sheets.	ch quest your an	tion in th	e spac any qu	e follo	owing i, use a	the additional			
When a calculator is used, the answer should	be given	n to an a	ppropi	riate d	egree (of accuracy.	-		
Information for Candidates A booklet 'Mathematical Formulae and Stati Full marks may be obtained for answers to A			provid	ed.					
This paper has seven questions.									
Advice to Candidates							-		

You must ensure that your answers to parts of questions are clearly labelled. You must show sufficient working to make your methods clear to the examiner.

Answers without working may gain no credit.

Turn over

Total



Use the substitution $u = 4 + 3x^2$ to find the exact value of	
$\int_0^2 \frac{2x}{(4+3x^2)^2} \mathrm{d}x .$	
	(6)

2. A curve has equation

and an equation of the normal to the curve at the point $(4, 3)$, givin $a + by + c = 0$, where a , b and c are integers.	ng your answer in the form (8)

. 1

$$f(x) = \frac{1+14x}{(1-x)(1+2x)}, \quad |x| < \frac{1}{2}.$$

(a) Express f(x) in partial fractions.

(3)

(b) Hence find the exact value of $\int_{\frac{1}{2}}^{\frac{1}{3}} f(x) dx$, giving your answer in the form $\ln p$, where *p* is rational.

(5)

(c) Use the binomial theorem to expand f(x) in ascending powers of x, up to and including the term in x^3 , simplifying each term.

, 1 3 2	
	(5)

5

4. The line l_1 has vector equation $\mathbf{r} = \begin{pmatrix} 11 \\ 5 \\ 6 \end{pmatrix} + \lambda \begin{pmatrix} 4 \\ 2 \\ 4 \end{pmatrix}$, where λ is a parameter.

The line l_2 has vector equation $\mathbf{r} = \begin{pmatrix} 24 \\ 4 \\ 13 \end{pmatrix} + \mu \begin{pmatrix} 7 \\ 1 \\ 5 \end{pmatrix}$, where μ is a parameter.

(a) Show that the lines l_1 and l_2 intersect.

(4)

(b) Find the coordinates of their point of intersection.

(2)

Given that θ is the acute angle between l_1 and l_2 ,

(c) find the value of $\cos \theta$. Give your answer in the form $k\sqrt{3}$, where k is a simplified fraction.

(4)

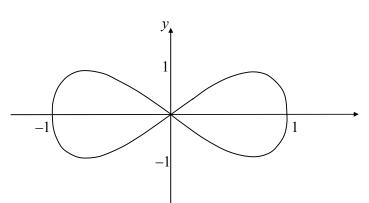
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5.

Figure 1



The curve shown in Fig. 1 has parametric equations

$$x = \cos t$$
, $y = \sin 2t$, $0 \le t < 2\pi$.

(a) Find an expression for $\frac{dy}{dx}$ in terms of the parameter t.

(3)

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(b) Find the values of the parameter t at the points where $\frac{dy}{dx} = 0$.

(3)

(c) Hence give the exact values of the coordinates of the points on the curve where the tangents are parallel to the *x*-axis.

(2)

(d) Show that a cartesian equation for the part of the curve where $0 \le t < \pi$ is

$$y = 2x\sqrt{(1 - x^2)}.$$
 (3)

(e) Write down a cartesian equation for the part of the curve where $\pi \le t < 2\pi$.

(1)

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6. Figure 2

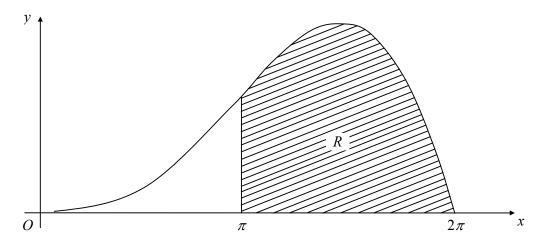


Figure 2 shows the curve with equation

$$y = x^2 \sin(\frac{1}{2}x), \quad 0 < x \le 2\pi.$$

The finite region R bounded by the line $x = \pi$, the x-axis, and the curve is shown shaded in Fig 2.

(a) Find the exact value of the area of R, by integration. Give your answer in terms of π . (7)

The table shows corresponding values of x and y.

х	π	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2π
y	9.8696	14.247	15.702	G	0

(b) Find the value of G.

(1)

- (c) Use the trapezium rule with values of $x^2 \sin(\frac{1}{2}x)$
 - (i) at $x = \pi$, $x = \frac{3\pi}{2}$ and $x = 2\pi$ to find an approximate value for the area R, giving your answer to 4 significant figures,
 - (ii) at $x = \pi$, $x = \frac{5\pi}{4}$, $x = \frac{3\pi}{2}$, $x = \frac{7\pi}{4}$ and $x = 2\pi$ to find an improved approximation for the area R, giving your answer to 4 significant figures.

(5)

11 Turn over

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	In an experiment a scientist considered the loss of mass of a collection of picked leaves. The mass M grams of a single leaf was measured at times t days after the leaf was picked.						
	The scientist attempted to find a relationship between M and t . In a preliminary model she assumed that the rate of loss of mass was proportional to the mass M grams of the leaf.						
((a) Write down a differential equation for the rate of change of mass of the leaf, using this model.						
	(2)						
((b) Show, by differentiation, that $M = 10(0.98)^t$ satisfies this differential equation. (2)						
	Further studies implied that the mass M grams of a certain leaf satisfied a modified differential equation						
	$10\frac{dM}{dt} = -k(10M - 1),$ (I)						
V	where k is a positive constant and $t \ge 0$.						
	Given that the mass of this leaf at time $t = 0$ is 10 grams, and that its mass at time $t = 10$ is 3.5 grams,						
((c) solve the modified differential equation (I) to find the mass of this leaf at time $t = 15$. (9)						
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