

SAINT IGNATIUS' COLLEGE

Trial Higher School Certificate

2005

MATHEMATICS

8:50am – 11:55am Monday 22nd August 2005

Directions to Students

Reading Time : 5 minutes	Total Marks 120
Working Time : 3 hours	
 Write using blue or black pen. (sketches in pencil). 	Attempt Question 1 – 10
 Board approved calculators may be used 	All questions are of equal value
 A table of standard integrals is provided at the back of this paper. 	
 All necessary working should be shown in every question. 	
 Answer each question in the booklets provided and clearly label your name and teacher's name. 	

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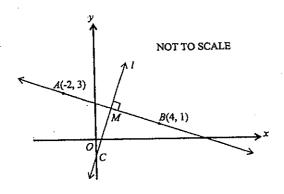
Total marks (120) Attempt Questions I – 10 All questions are of equal value

Answer each	question in a	i SEPARATE	writing booklet.

QUE	STION 1 (12 MARKS) Use a SEPARATE writing Booklet M	arks
(a)	The circumference of a circle is 9.29 metres. Find the radius of the circle to 3 significant figures, using the formula $C = 2\pi r$.	. 2
(b)	Differentiate $3x^2 - 4\sqrt{x}$.	2
(c)	Expand and simplify $(\sqrt{6} + \sqrt{2})^2$.	2
(d)	Solve the equation $a - \frac{a-2}{4} = 4$.	2
(e)	Find the values of c for which $ 2c+3 > 1$.	2
(f)	The roots of an equation are $\frac{2}{3}$ and 4. Write down its equation in the form $ax^2 + bx + c = 0$ where a, b and c are integers.	2

QUESTION 2 (12 MARKS) Use a SEPARATE writing Booklet

Marks



The diagram shows the points A(-2, 3) and B(4, 1). M is the midpoint of the interval AB. l is the line through M perpendicular to AB.

(i)	Find the gradient of the line AB.	i
(ii)	Find the coordinates of M .	1
(iii)	Show that the equation of AB is $x+3y-7=0$.	1
(iv)	Show that the equation of l is $3x - y - 1 = 0$.	1
(v)	Find the coordinates of C , the point of intersection of I and the y-axis.	1
(vi)	Show that C is equidistant from A and B	2
(vii)	Find the perpendicular distance from C to the line AB .	2
(viii)	Hence find the area of the triangle ABC.	2
(ix)	State the inequality that defines the region of the half-plane under the line AB.	1

QUE	STION	3 (12 MARKS) Use a SEPARATE writing Booklet	Marks
(a)	Differ	entiate with respect to x:	
•	(i)	x ³ cos x	2
	(ii)	$\left(3+e^{2x}\right)^4$	2
(b)		· -	2
	(ii)	Find $\int_0^{\pi} \sec^2 2x dx$.	2
(c)	The	oradient function of a curve is given by $\frac{dy}{dx} = 6x^2 - 4x + 1$.	
(6)			
			2
	(1)		_
	(ii) Find $\int \frac{6x}{x^2 + 2} dx$. (ii) Find $\int_0^{\frac{\pi}{6}} \sec^2 2x dx$.	2	

QUESTION 4

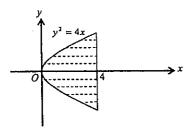
(12 MARKS) Use a SEPARATE writing Booklet

Marks

2

- (a) Consider the function $f(x) = x^3 6x^2 + 9x$.
 - (i) Find the coordinates of the stationary points and determine their nature. 3
 - (ii) Find the x-coordinate of the point of inflexion.
 - (iii) Find where the curve meets the x-axis.
 - (iv) Sketch the graph of y = f(x).
 - (v) Find the values of x for which the gradient is decreasing.

(b)



The diagram shows the region bounded by the curve $y^2 = 4x$ and the line x = 4.

- (i) Find the exact area of the shaded region.
- (ii) The region is rotated about the x-axis.
 - Calculate the exact volume of the solid formed.

OUESTION 5 (1

(12 MARKS) Use a SEPARATE writing Booklet

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2

(a) Jim decides to start a daily exercise program, in which he increases the time spent on exercise each day by 2 minutes from the previous day. On the first day he does 10 minutes of exercise.

- i) For how long will Jim exercise on the 30th day?
- (ii) What will be the total length of time spent on exercise in the first 30 days? 2
- iii) On which day would Jim have achieved 40 hours of exercise in total? 3
- (b) Jill commences her working career, earning \$30 000 per year in her first year.

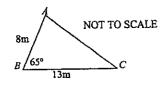
 If she stays with the same company, her annual salary will increase by 5% each
 - (i) What will be Jill's annual salary in her 20th year (to nearest dollar)?
 - (ii) In what year would her annual salary first exceed \$50 000?
 - (iii) What will be her total earnings in the first 20 years of employment?

OUESTION 6

(12 MARKS) Use a SEPARATE writing Booklet

Marks

(a)



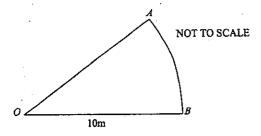
The diagram shows the triangular cross-section of the roofline of a modern building. AB = 8m, BC = 13m, and $\angle ABC = 65^{\circ}$. BC is horizontal.

Find the length of the beam AC.

Find the angle of elevation of the beam AC.

Building regulations require a cross-sectional area of at least 48m² for adequate ventilation. Does this design satisfy this regulation?

(b)



AOB is the sector of a circle, centre O and radius 10m.

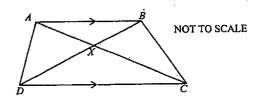
3

The area of the sector is 60m². Calculate the exact perimeter of the sector AOB.

Question 6 continues on page 7

Question 6 (continued)

(c)



ABCD is a trapezium, and AB is parallel to DC. The diagonals AC and BD intersect at X. AX = 4cm, CX = 10cm, BD = 12cm.

Copy the diagram neatly into your answer booklet.

Prove $\triangle AXB$ is similar to $\triangle CXD$.

Find the length of BX.

End of Question 6

QUESTION 7 (12 MARKS) Use a SEPARATE writing Booklet Marks

- (a) Find the coordinates of the points of intersection of the line 2x y 2 = 0 and the hyperbola xy = 4.
- (b) Solve the equation for x: $3\times 3^{2x} + 26\times 3^{x} - 9 = 0.$
- (c) For what values of c does the equation $x^2 + 5x + c = 0$ have two real and different roots?
- (d) α, β are the roots of the quadratic equation $2x^2 5x 8 = 0$. Without finding the roots, find the value of:

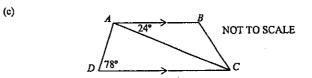
(i)
$$\alpha^2 + \beta^2$$
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(ii)
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QUESTION 8 (12 MARKS) Use a SEPARATE writing Booklet Marks

(a) Evaluate
$$\sum_{r=1}^{4} \frac{1}{r(r-1)}$$
.

- (b) The equation of a parabola is $8y = x^2 4x 4$. By expressing the equation in the form $(x - h)^2 = 4a(y - k)$, find:
 - (i) the coordinates of the vertex.
 - (ii) the coordinates of the focus.
 - (iii) the equation of the directrix.



ABCD is a trapezium and AB is parallel to DC. $\angle BAC = 24^{\circ}, \angle ADC = 78^{\circ}$.

Explain why $\triangle ACD$ is isosceles.

(d) Consider the function $f(x) = \begin{bmatrix} 3 + 2^{-x} & \text{for } x \ge 0 \\ x + 4 & \text{for } x < 0 \end{bmatrix}$

- (i) Evaluate f(-1)+f(1).
- (ii) Find $\lim_{x\to\infty} f(x)$.
- (iii) Is the function continuous at x = 0? Give reasons.

QUESTION 9 (12 MARKS) Use a SEPARATE writing Booklet

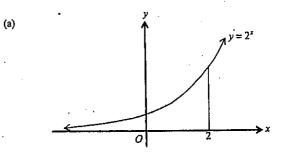
- (a) The value of a car depreciates exponentially according to the formula $V = Ae^{-b}$ where V dollars is the value of the car after t years. A car's new price is \$32 000, and after 6 years its value is \$14 000.
 - (i) Show that $V = Ae^{-kt}$ satisfies the equation $\frac{dV}{dt} = -kV$.

Marks

1

- (ii) What is the value of A?
- (iii) Find the value of k correct to 3 significant figures.
- (iv) What will be the value of the car after 10 years?
- (v) At what rate will the value of the car be decreasing when it is 10 years old?
- (b) A particle moves along a straight line. Its position x metres from O, t seconds after starting, is given by $x = 3 + \cos 2t$.
 - (i) Find the position of the particle after $\frac{3\pi}{4}$ seconds.
 - (ii) In what direction does the particle start to move?
 - (iii) Sketch the graph of ν as a function of t for $0 \le t \le 2\pi$.
 - (iv) What is the maximum acceleration of the particle?

QUESTION 10 (12 MARKS) Use a SEPARATE writing Booklet Marks



The area between the curve $y=2^x$ and the x-axis for $0 \le x \le 2$, is rotated about the x-axis to form a solid.

- (i) Write down the definite integral which represents the volume of the solid. 1
- (ii) Use Simpson's Rule with three function values to find the approximate volume of the solid giving your answer to 2 decimal places.
- (iii) Using integration and the result $\int a^{a} dx = \frac{1}{\ln a} a^{a}$, 2 evaluate the volume of the solid, giving your answer to 2 decimal places.
- (b) Consider the function $f(x) = xe^{-x}$.
 - (i) Show that the graph of y = f(x) has one stationary point at x = 1.
 - (ii) Show that the stationary point is a maximum.
 - (iii) Show that there is one point of inflexion and it occurs at x = 2.
 - (iv) By considering the signs of x and e^{-x} for large positive and large negative values of x, sketch the graph of y = f(x).

End of paper

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· · · · · · · · · · · · · · · · · · ·	so from below				1 4 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Asa	o trom above	f(x) = 3+2	*	7	
A de la Maria	x) is continuou	s at x =0.	\mathcal{O}		

Mathematics: Question 9	V. A. W.	A A A A A A A A A A A A A A A A A A A
Sale seried Solutions	Marks Awarded	Marker's Community
(a) V= Ae Ht		
(1) 数 kAe-M		
=-kV	Section 2	i. Distriction of the second
(ii) When t=0, V=32000		
32 000 = A e.		
A = \$2.000		
(iii t=6, Y=14000: 14000=33000.c.		
- Lk - Agi(t) (2)		
k.o.io.lose)	in the second	ing the state of t
Gul When t = 10, V = 32 000 x c	A A Y	
Value = \$ 1051		
(1) when t = 10, 2 = 0 111 2 405		
Value decreasing at \$ 1111 per year		
\mathbf{O}		
(b) x = 3 + 105 =t		
(1) When t= # 1 sc = 3 + cos (4 4)		
= 3		1.00
(ii) v = -2 \$ in \$1.		
It starts to move in regotive direction		
(%) 31		
1 1 0 0		
(r) a = -4 cos et		
Maximum acceleration is 4 m/s	The state of	

Mathematics:	stion 10	And the state of	out it see see	
	inguised Solutions		Marks Awarded	Marker's Comments
(a) (i) V • 1	10 (2x) dr.	0		
(i) ×	0 1 2			
1. (22)24	# ± [1+ 4* 4 ± 11	+4)		
Volume	# N x T = 34.	-6 uni P(24)		
(11) V= #	J. 4 x de + [th+ 4x]2.			, v
= 7	= [16-1] 3 99 units (1	d D) 🦟		
	* X C "*			en e
(0) 1(2) + 6	** (-x (-c-*))		
	ne stationary			
	(-c*) + c* e*-1e** = e	*(-) *61)_		
: 5701)	Deint is movin			
(All Fort (se	· · · · · ·	\mathcal{O}		
(ir) For xxx,	the only po	int of the transfer		
	>0:, f(x) <0			
	1 1 2	(2)		