SYDNEY GRAMMAR SCHOOL



2009 Half-Yearly Examination

FORM V MATHEMATICS EXTENSION 1

Wednesday 13th May 2009

General Instructions

- Writing time 2 hours
- Write using black or blue pen.
- Board-approved calculators may be used.
- All necessary working should be shown in every question.
- Start each question in a new book.

Structure of the paper

- Total marks 84
- All seven questions may be attempted.
- All seven questions are of equal value.

Collection

- Write your name, class and master clearly on each leaflet.
- Hand in the seven questions in a single well-ordered pile.
- Hand in a leaflet for each question, even if it has not been attempted.
- If you use a second leaflet for a question, place it inside the first.
- The question papers will be collected separately.

Checklist

• Writing leaflets: 7 per boy.

Examiner MLS

• Candidature -- 150 boys

	The state of the s	,
QUI	ESTION ONE (12 marks) Use a separate writing booklet.	Marks
(a)	Factorise $9x^2 - 16$.	1
(b)	Write down the value of $\log_2 8$.	1
(c)	Write down the exact value of cos 225°.	2
(d)	Solve $5 - 3x < 7$.	2
(e)	Solve $ x-1 = 4$.	2
(f)	The line $6x - ky = 4$ passes through the point (3, 2). Find the value of k .	2
(g)	Find the equation of a line that has an angle of inclination of 60° and an x intercept of 3.	2
	ESTION TWO (12 marks) Use a separate writing booklet.	Marks
(a)	The first term of an AP is 6. The fifth term is 22.	
	(i) Show that the common difference is 4.	1
	(ii) Find the tenth term.	1
	(iii) Find the sum of the first twenty terms.	1
	(iv) If the last term is 202, how many terms are there in this AP?	1

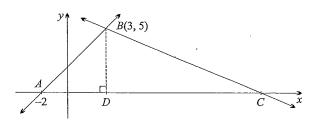
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Question 2 Continues on the Next Page

Exam continues next page ...

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(b)



The diagram shows the points A(-2,0), B(3,5) and the point C which lies on the x-axis. The point D also lies on the x-axis such that BD is perpendicular to AC.

- (i) Show that the gradient of AB is 1.
- (ii) Find the equation of the line AB.
- (iii) What is the size of $\angle BAC$?
- (iv) The length of BC is 13 units. Show that the length of DC is 12 units.
- (v) Calculate the area of $\triangle ABC$.
- (vi) Calculate the size of $\angle ABC$, to the nearest degree.

QUESTION THREE (12 marks) Use a separate writing booklet.

Marks

- (a) Differentiate the following functions:
 - (i) $x^3 + 4$
 - (ii) $2\sqrt{x}$
 - (iii) $\frac{2}{x^4}$
 - (iv) $\frac{6x-5}{x}$
- (b) Use the product rule to differentiate $(3x-1)(6x^2+5)$.
- (c) Differentiate $\frac{3x^2}{7x-1}$.
- (d) The equation of a parabola is $y = x^2 4x + 1$.
 - (i) Find the gradient of the tangent to this parabola at the point P(5,6).
 - (ii) Find the equation of the tangent to the parabola at the point P.
 - (iii) This tangent cuts the x-axis at A and the y-axis at B. Find the coordinates of M, the midpoint of AB.

Exam continues overleaf ...

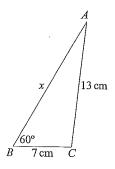
SGS Half-Yearly 2009 Form V Mathematics Extension 1 Page 4

QUESTION FOUR (12 marks) Use a separate writing booklet.

Marks

1

- (a) (i) Sketch the parabola $y = 6 + x 2x^2$, showing the x and y intercepts.
 - (ii) Solve $6 + x 2x^2 > 0$.
- (b) Find the values of k for which the roots of $3x^2 + 2kx + 4k = 0$ are real and distinct.
- (c) Show algebraically that the line y=2-x does not cut the curve $(x-2)^2+(y-2)^2=1$.
- (d)



The diagram shows a triangle with sides 7 cm, 13 cm and x cm, and an angle of 60° as marked.

- (i) Show that $x^2 7x = 120$.
- (ii) Find the value of x.
- (iii) Find the exact value of $\sin \angle ACB$.

QUESTION FIVE (12 marks) Use a separate writing booklet.

Marks

2

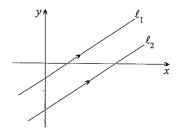
- (a) Determine whether $f(x) = \frac{2x}{x^2 + 2}$ is odd, even or neither.
- (b) The line y = mx + b is the tangent to the curve $y = x^3 3x + 1$ at the point (-2, -1). [2] Find m and b.
- (c) (i) Write down the gradient of the line ax + by + c = 0.
 - (ii) Without finding the point of intersection, find the equation of the line that passes through the intersection of the lines 3x y + 4 = 0 and x + 2y + 3 = 0 and is parallel to 2x 3y 7 = 0.
- (d) (i) If $x = \sec \theta \tan \theta$, show that $x + \frac{1}{x} = 2 \sec \theta$.
 - (ii) Hence, or otherwise, solve the equation $x + \frac{1}{x} = \frac{4}{\sqrt{3}}$.

Exam continues next page ...

QUESTION SIX (12 marks) Use a separate writing booklet. Marks (a) Solve $\sin 3\theta = \frac{1}{2}$, for $0^{\circ} \le \theta \le 180^{\circ}$. [3]
(b) Solve $2\sin^2\theta + \cos\theta = 2$, for $0^{\circ} \le \theta \le 360^{\circ}$.

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(c)



In the diagram:

 ℓ_1 is the line $(r\sin\theta)x-(r\cos\theta)y=c_1,$ and ℓ_2 is the line $(r\sin\theta)x-(r\cos\theta)y=c_2,$ where $c_2>c_1>0, r>0$ and θ is acute.

- (i) Copy this diagram onto your answer sheet.
 - (α) Find the x-intercept of ℓ_1 and ℓ_2 .
 - (β) Mark on the diagram an angle that is θ .
- (ii) Show that the distance between ℓ_1 and ℓ_2 is $\frac{c_2-c_1}{r}$.
- (iii) Hence, or otherwise, find the distance between the lines

$$x + \sqrt{3} y = \frac{3}{2}$$
 and $x + \sqrt{3} y = 1$.

The Examination Continues on the Next Page

Exam continues overleaf ...

2

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QUESTION SEVEN (12 marks) Use a separate writing booklet.

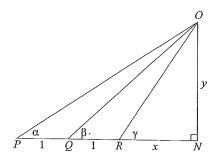
(a) Show that $1^3 + 3^3 + 5^3 + \dots + 25^3 = \sum_{j=1}^{25} j^3 - 8 \sum_{k=1}^{12} k^3$.

Marks

2

(b) Find the derivative of $y = (1 + (x^2 - 1)^3)^{\frac{1}{3}}$.

(c)



In the figure above, PQ = QR = 1 and $ON \perp PN$. The acute angles α, β and γ are marked in the diagram. Let RN = x and ON = y.

(i) Prove that
$$\cot \beta = \frac{1}{2}(\cot \alpha + \cot \gamma)$$
.

(ii) It is given that $\gamma = 2\alpha$ and that $\cot \alpha + \cot 2\alpha = \frac{2}{\sqrt{3}}$.

(
$$\alpha$$
) Show that $\triangle POR$ is isosceles.

(
$$\beta$$
) Show that $\beta = 60^{\circ}$.

$$(\gamma)$$
 Find an exact value for x .

(
$$\delta$$
) Find an exact value for tan α . Simplify your answer.

END OF EXAMINATION

Solutions and Morloung Scheme, H1 2009. <u>Q2</u> (a) (1) a=6, T5=22=6+4d . 4d = 16. $9x^{2}-16=(3x-4)(3x+4)$ 10928= 109,23=3 (2250) = -cos 450 / (for regolitie) $T_0 = 6 + 9 \times 4$ = 6 + 36S20 = 39(12 + 19x4) (d) 5-3x<7 $\frac{-3x < 2}{2 > -\frac{1}{3}} \qquad \qquad (one \ ef \ a < -\frac{1}{3})$ In = 200 = 6+ (n-1)4 200 = 6+44-4 (e) |x-1| = 4202 = 2+41 101=1+24 2=5 0 2= -3 (1) (3,2) salifies (62-kg) = 4. goes through (3,0) y-0=1(x+2) y-0= 1/3(21-3) 4=13x-313 ox 15x-y-3/13=0 Using Pythogenes 52+x2=132 JC1 = 131-52 x = 12

0) AC 10 2+3+12=17 cenits Cense = 5 x17 x5 = 42 5 0 ~ UI) es 2 CBD = 5

ZCB0= 67° ZABC = 45° +67° = 112°

(b) y = (3)(-1)(6)(+5)

36x-12x +15 +15 54x-1xx +15

= 3×(2×-2)

04. (d) $6 + 2x - 2x^{2} = 0$ (3 + 2x)(2 - x) = 0at 21=5 M= 10-4 $2 = 2 \text{ or } -\frac{3}{2}$ (1) $i_3-6 = 6(x-5)$ $i_3-6 = 6x-30$ $i_3-6 = 6x-30$ $i_3-6 = 6x-30$ 621-4-24=0 for word of (b) $3x^2 + 2hx + 4h = 0$ $A = 4h^2 - 4x3 \times 4h$ $= 4h^2 - 48h > 0$ for real & destruct either on diam or solve 462-48B >0 ceretten M = (2,-12) B(B-12)>0 down B>12 or B<0 (x-D) + (G-20-2) - (x-2) + x2 = /, (C) Solve 2x -4x +3 =0 1 = 16-4x2x3

Perp dest of line to Q21 to d; $\sqrt{\frac{1}{2}} = \sqrt{\frac{2+2-2}{\sqrt{2}}}$ 50 leve does not cut will 1) Closing come, rule

13 = 22+22-2××× >× Ce0600 31

169 = 22+49 . 140××2 x -7x -120 =0 x = 2 = 149 + 480 factoring! 5c -15) (sc +8) =0 Loven 270. But som a leight so x =15 SING = 51460 17 .. 1. 15 = 15/13 -

 $f(x) = \frac{2x}{x^2 + 2}$ P(-x) = 2(-x) = - (Ca)s, odd $\frac{1}{6}$ $\frac{1}$ at = 2, m of were = 12-3 = 9. so graduent of line is 9 and m=9 (-2-1) lies on y = 9x + b -1 = -18 + b $50 \ b = 17$ (c) (1) $m = -\frac{\alpha}{4}$ new line has the form (2x+2y+3)=0 & ER. (3+b)x + (2b-1)y + 4 + 3b=0 $M = \frac{-(3+b)}{2b-1}$ gradient of 34=2x-2 to 3

$$3 + b = \frac{1}{3} \quad (or equivalent)$$

$$9 + 3b = 7 + 4b = 7$$

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Alternature (111) Take a pt on li, x + 13 y - 3/2 = 0. e_{-q} $(\frac{3}{2}, 0)$ O few its destauce to x+15y-1=0 hole suce o a cente (ii) was most to be x-13 y = 3/2 and 20-13 y = 1

but, it made no difference to the auxus

(a) $1^3 + 2^3 + 3^3 + 4^3 + \cdots + 25^3 = (1^3 + 3^3 + 5^3 + \cdots + 25^3)$ +(23+2+3+62+ -- 243) $(e^{\frac{35}{2}} + e^{3} = \frac{3}{2} (27-1)^{3} + \frac{3}{2} (27)^{3}$ $50 \quad = \frac{3}{5}(27-1)^3 = \frac{3}{5}(27)^3 - \frac{5}{5}(27)^3 + \frac{2^3-8}{5}$ le 13+3+53+-- 253= 2+3-8 2 12 $y = \int_{1}^{2} + (x^{2} - 1)^{3}$ = 34.3×301×22 = (1+(x-13)=3 (x-1)= zx 2x (x=1)2 (1+(x-13) M3

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