TEAM MATH QUEST SCORE SHEET ***2009 Senior Preliminary***
Senior High School *Category C: Calculus*

Team Information School:_____ Center:_____

Student Names: Grade Level: Current Math Class:

1 _____ _____ _____

2 _____ _____ _____

3 _____ _____ _____

Note: All answers must be in reduced form and include appropriate units of measurement.

#	Team Answer
1	
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#	Team Answer
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For Judge's Use Only

_____ **x 4 =** _____
 # correct answers

minus

_____ **x 1 =** _____
 # incorrect answers
(do not include non-responses)

SCORE

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1. $\lim_{x \to 0} \dfrac{\cos^2 x - 1}{3x \sin 2x}$ is:

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2. Given a function defined by $f(x) = \dfrac{2x+2}{x^2+5x+4}$, for what value(s) of x is the function discontinuous?

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3. What is the slope of the tangent line to the graph of the function $f(x) = \dfrac{1}{x^2}$ at the point $(3, \frac{1}{9})$?

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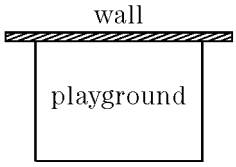
4. People planning a children's playground want to save on the cost of fencing it by positioning the playground against a wall of a building so that one side will not need to be fenced. The playground has to be a rectangle $400\,\mathrm{m}^2$ in area. What dimensions should they choose for the playground in order to use the least amount of fencing?



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5. The distance travelled by a car is given by $s(t) = 60t^2 - 20t$, where t is measured in hours and s in kilometres. After how many hours did the velocity reach 70 km/h?

6. Find $D_x^3 y$ given $y = \dfrac{3x-4}{4x+2}$.

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7. For the function $f(x) = \sqrt{x}$ determine the slope of the secant line through the points on the graph where $x = 4$ and $x = 1$.

8. $\lim_{x \to -4^+} \dfrac{7x^2}{16 - x^2}$ is

9. Given $3x = 5xy - y^2$, then $\frac{dy}{dx} =$

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10. Find all values of x for which the function $f(x) = -x^2 - 4x + 3$ is decreasing.

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11. A balloon rises vertically at the rate of 10 ft/s. A person on the ground 100 ft away from the spot below the rising balloon watches the balloon ascend; at what rate is the distance between balloon and observer changing when the balloon is 100 ft above ground?

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12. For any time $t \geq 0$, $x(t) = 2(t - \sin t)$ and $y(t) = 2(1 - \cos t)$. Find $\dfrac{dy}{dx}$ at $t = \frac{\pi}{4}$.

13. Evaluate $\dfrac{d}{dx}\displaystyle\int_0^x (t^3 - 4t + 3)\,dt$ for $x \geq 0$.

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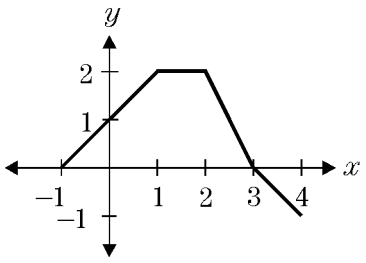
14. The graph of f is shown for $-1 \leq x \leq 4$. What is the value of $\int_{-1}^{4} f(x)\,dx$?



15. $\int x^2(x^3+5)^6\,dx =$

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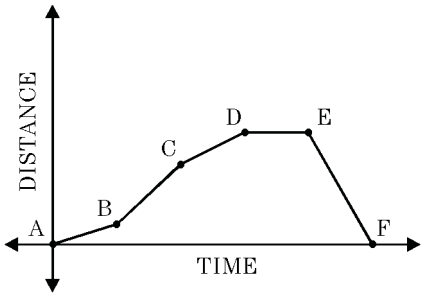
16. The graph shows the position function of a car. Between what two points is the car stopped?



17. Find the limit of the infinite sequence:

$$\frac{1}{4}, \frac{1}{10}, \frac{1}{18}, \ldots, \frac{1}{n(n+3)} \text{ as } n \to \infty$$

18. $\lim_{x \to 3^+} \dfrac{x^2 - x - 6}{|x - 3|}$ is

19. Determine whether the integral $\displaystyle\int_0^\infty \frac{2x}{1+x^2}\,dx$ converges or diverges and evaluate the integral if it converges.

20. Find the indefinite integral: $\int \frac{x}{16+x^4}\,dx$

21. $\int \sin^3(3x)\cos(3x)\,dx =$

22. Find $\frac{dy}{dx}$ for $y = x^3\sqrt{x+1}$.

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23. What is the product of two positive numbers satisfying the requirement that the sum of the first and twice the second is 120 and the product is a maximum?

24. An object has a constant acceleration of $42\,\text{ft/sec}^2$, an initial velocity of $-18\,\text{ft/sec}$, and an initial position of $3\,\text{ft}$. Find the position function describing the motion of this object.

25. Solve for x: $-x^2 + 5x + 6 < 0$

26. Find the volume of the solid of revolution obtained by rotating the region R bounded by $y = 2x$, $y = 0$, and $x = 1$ about the x-axis.

27. The functions f and g are differentiable and have the values shown in the table.

If $A = f \cdot g$ then $A'(6) =$

x	f	f'	g	g'
0	5	1	-7	$\frac{1}{4}$
2	8	3	-5	1
4	14	9	-3	4
6	26	27	-1	16

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28. Given the function $f(x) = \dfrac{(x^2+4)}{x}$ satisfies the hypothesis of the Mean Value Theorem on the interval $[1, 4]$, find a number C in the interval $(1, 4)$ which satisfies this theorem.

29. Set up a definite integral for the area of the region bounded by the graphs of $y = 9 - x^2$ and $y = 0$.

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30. A certain type of bacteria increases continuously at a rate proportional to the number present. If there are 500 present at a given time and 1,000 present 2 hours later, how many hours (from the initial given time) will it take for the numbers to be 2,500? Round your answer to 2 decimal places.