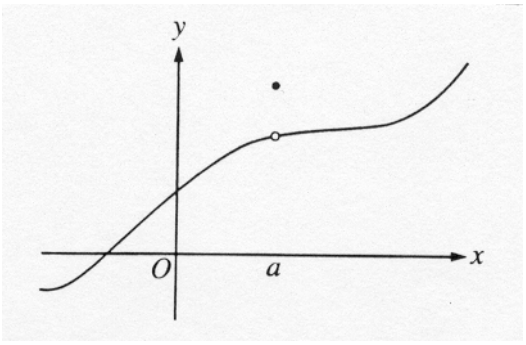
Sudoku Puzzle –A.P. Exam (Part B)
Questions are from the 1997 and 1998 A.P. Exams

Solve the 24 multiple-choice problems below.
A graphing calculator is required for some questions on this part.
The choices are integers from 1 to 9 inclusive.
Place the answer in the corresponding cell (labeled A, B, C, … W, X).
Then solve the resulting SUDOKU puzzle.

The rules of Sudoku are simple.
Enter digits from 1 to 9 into the blank spaces.
Every row must contain one of each digit.
So must every column, and so must every 3x3 square.
Each Sudoku has a unique solution that can be reached logically without guessing.



_____ A. The graph of a function f is shown above.
Which of the following statements about f is false?
(1) f has a relative maximum at x = a.
(2) x = a is in the domain of f.
(3) f is continuous at x = a.
(4) $\lim_{x \to a^+} f(x)$ is equal to $\lim_{x \to a^-} f(x)$.
(5) $\lim_{x \to a} f(x)$ exists.

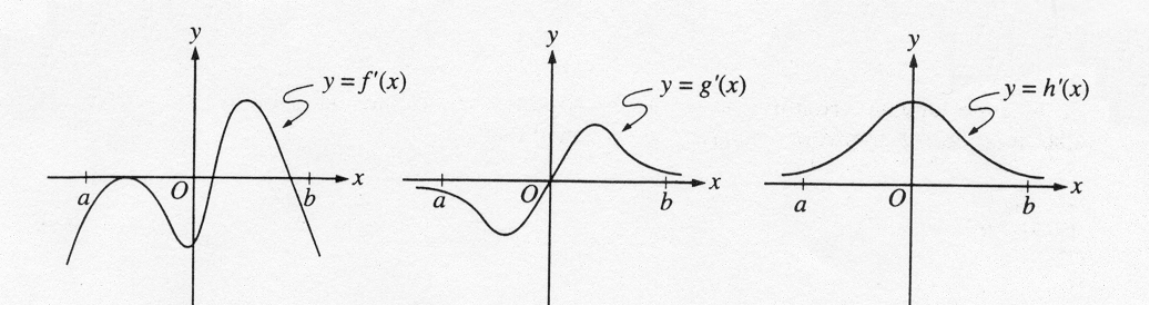
_____ B. Let f be the function given by $f(x) = 3e^{2x}$ and let g be the function given by $g(x) = 6x^3$. At what value of x do the graphs of f and g have parallel tangent lines?

(3) -0.701 (4) -0.567 (5) -0.391 (6) -0.302 (7) -0.258

_____ C. The radius of a circle is decreasing at a constant rate of 0.1 centimeter per second. In terms of the circumference C, what is the rate of change of the area of the circle, in square centimeters per second?

(1) $-(0.2)\pi C$ (2) $(0.1)^2 C$ (3) $-\dfrac{(0.1)C}{2\pi}$

(4) $-(0.1)C$ (3) $(0.1)^2 \pi C$



_____ D. The graphs of the derivatives of the functions, f, g, and h are shown above. Which of the functions f, g, or h have a relative minimum on the open interval $a < x < b$?

(1) h only (2) f only (3) g only (4) f and g only
(5) f, g, and h

_____ E. The first derivative of the function f is given by $f'(x) = \dfrac{\cos^2 x}{x} - \dfrac{1}{5}$.

How many critical values does f have on the open interval (0, 10)?

(5) Seven (6) Five (7) Four (8) Three (9) One

_____ F. Let f be the function given by $f(x) = |x|$.

Which of the following statements are true about f are true?

I. f is continuous at x = 0.
II. f is differentiable at x = 0.
III. f has an absolute minimum at x = 0.

(5) I only (6) II only (7) III only
(8) II and III only (9) I and III only

_____ G. If f is a continuous function and if $F'(x) = f(x)$ for all real numbers x, then $\int_1^3 f(2x)\,dx =$

(1) $2F(3) - 2F(1)$ (2) $\frac{1}{2}F(3) - \frac{1}{2}F(1)$ (3) $2F(6) - 2F(2)$

(4) $\frac{1}{2}F(6) - \frac{1}{2}F(2)$ (5) $F(6) - F(2)$

_____ H. If $a \neq 0$, then $\lim_{x \to a} \frac{x^2 - a^2}{x^4 - a^4}$ is

(5) 0 (6) $\frac{1}{6a^2}$ (7) $\frac{1}{a^2}$ (8) $\frac{1}{2a^2}$ (9) nonexistent

_____ I. Population y grows according to the equation $\frac{dy}{dt} = ky$, where k is a constant and t is measured in years. If the population doubles every 10 years, then the value of k is:

(2) 5.000 (3) 3.322 (4) 0.301 (5) 0.200 (6) 0.069

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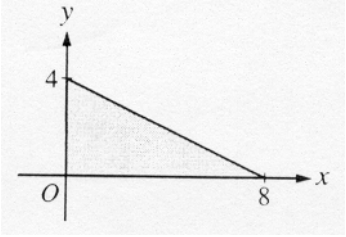
x	2	5	7	8
$f(x)$	10	30	40	20

_____ J. The function f is continuous on the closed interval [2, 8] and has values that are given in the table above. Using the subintervals [2, 5], [5, 7], and [7, 8], what is the trapezoidal approximation of $\int_2^8 f(x)\,dx$?

(1) 110 (2) 130 (3) 160 (4) 190 (5) 210



_____ K. The base of a solid is a region in the first quadrant bounded by the x-axis, the y-axis, and the line $x + 2y = 8$, as shown in the figure above. If cross sections of the solid perpendicular to the x-axis are semicircles, what is the volume of the solid?

(3) 12.566 (4) 14.661 (5) 16.755 (6) 67.021 (7) 134.041

_____ L. Which of the following is an equation of the line tangent to the graph of $f(x) = x^4 + 2x^2$ at the point where $f'(x) = 1$?

(5) $y = 8x - 5$ (6) $y = x + 7$ (7) $y = x + 0.763$
(8) $y = x - 2.146$ (9) $y = x - 0.122$

_____ M. Let $F(x)$ be an antiderivative of $\frac{(\ln x)^3}{x}$. If $F(1) = 0$, then $F(9) =$

(5) 0.048 (6) 0.144 (7) 5.827 (8) 23.308 (9) 1,640.250

_____ N. If g is a differentiable function such that $g(x) < 0$ for all real numbers x and if $f'(x) = (x^2 - 4)g(x)$, which of the following is true?

(1) f has a relative minimum at $x = -2$ and a relative maximum at $x = 2$.
(2) f has a relative maximum at $x = -2$ and a relative minimum at $x = 2$.
(3) f has a relative minima at $x = -2$ and at $x = 2$.
(4) f has a relative maxima at $x = -2$ and at $x = 2$.
(5) It cannot be determined if f has any relative extrema.

_____ O. If the base of b of a triangle is increasing at a rate of 3 inches per minute while its height h is decreasing at a rate of 3 inches per minute, which of the following must be true about the area A of the triangle?
(1) A remains constant.
(2) A is always increasing.
(3) A is always decreasing.
(4) A is decreasing only when $b < h$.
(5) A is decreasing only when $b > h$.

_____ P. Let f be a function that is differentiable on the open interval (1, 10). If $f(2) = -5$, $f(5) = 5$, and $f(9) = -5$, which of the following must be true?

I. f has at least two zeros.
II. The graph of f has at least one horizontal tangent.
III. For some c, $2 < c < 5$, $f(c) = 3$.

(2) I, II, and III (3) I and III only (4) I and II only
(5) I only (6) None

_____ Q. If $0 \le k < \frac{\pi}{2}$ and the area under the curve $y = \cos x$ from $x = k$ to $x = \frac{\pi}{2}$ is 0.1, then $k =$

(5) 1.471 (6) 1.414 (7) 1.277 (8) 1.120 (9) 0.436

_____ R. If $x^2 + xy = 10$, then when $x = 2$, $\frac{dy}{dx} =$

(5) -2 (6) $-\frac{7}{2}$ (7) $\frac{2}{7}$ (8) $\frac{3}{2}$ (9) $\frac{7}{2}$

_____ S. If f is continuous for $a \le x \le b$ and differentiable for $a < x < b$, which of the following could be false?

(5) $f'(c) = \frac{f(b) - f(a)}{b - a}$ for some c such that $a < c < b$.
(6) $\int_a^b f(x)\,dx$ exists.
(7) $f'(c) = 0$ for some c such that $a < c < b$.
(8) f has a minimum value on $a \le x \le b$.
(9) f has a maximum value on $a \le x \le b$.

_____ T. If $f(x) = \frac{e^{2x}}{2x}$, then $f'(x) =$

(5) 1 (6) $\frac{e^{2x}(1-2x)}{2x^2}$ (7) e^{2x}
(8) $\frac{e^{2x}(2x-1)}{x^2}$ (9) $\frac{e^{2x}(2x-1)}{2x^2}$

_____ U. The graph of the function $y = x^3 + 6x^2 + 7x - 2\cos x$ changes concavity at x =

(1) -1.58 (2) -1.63 (3) -1.67 (4) -2.33 (5) -1.89

_____ V. A railroad track and a road cross at right angles. An observer stands on the road 70 meters south of the crossing and watches an eastbound train traveling at 60 meters per second. At how many meters per second is the train moving away from the observer 4 seconds after it passes through the intersection?

(1) 57.60 (2) 57.88 (3) 59.20 (4) 60.00 (5) 67.40

_____ W. At time $t \geq 0$, the acceleration of a particle moving on the x-axis is $a(t) = t + \sin t$. At $t = 0$, the velocity of the particle is -2. For what value of t will the velocity of the particle be zero?

(1) 1.02 (2) 1.48 (3) 1.85 (4) 2.81 (5) 3.14

_____ X. Which of the following are antiderivatives of $f(x) = \sin x \cos x$?

I. $F(x) = \dfrac{\sin^2 x}{2}$

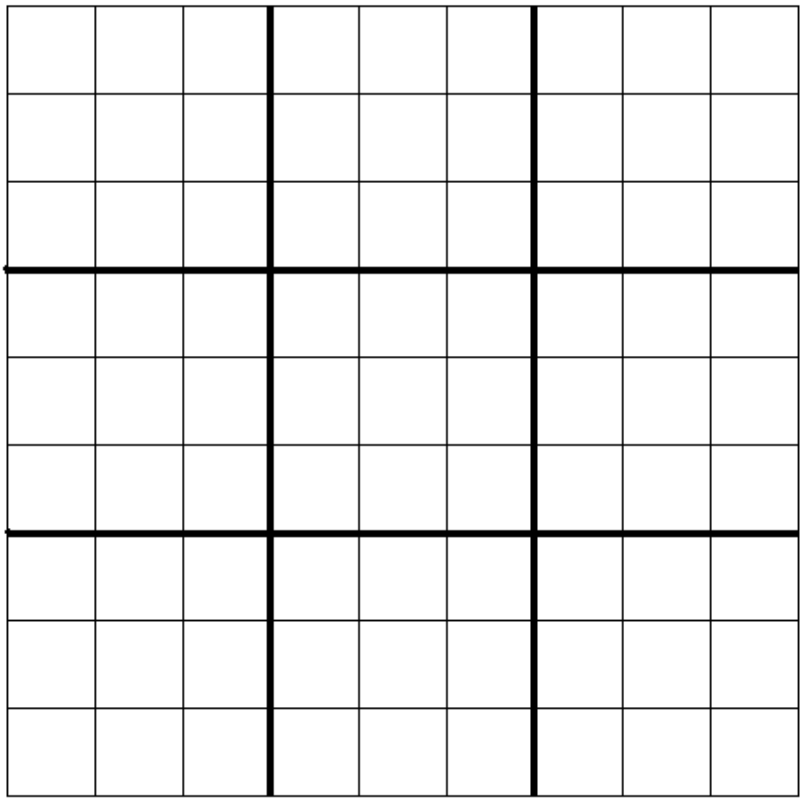
II. $F(x) = \dfrac{\cos^2 x}{2}$

III. $F(x) = \dfrac{-\cos(2x)}{4}$

(2) II and III only
(3) I and III only
(4) I only
(5) II only
(6) III only

	A	B					C	
			D	E				F
		G				H		
I		J					K	
L				M				
	N			O		P		Q
		R	S				T	
U				V				
		W						X

Here is a blank SUDOKU board for you to use:



Solution to the Sudoku (A.P. Exam Part B)

A = 3
B = 5
C = 4
D = 2

E = 8
F = 9
G = 4
H = 8

I = 6
J = 3
K = 5
L = 9

M = 7
N = 1
O = 5
P = 2

Q = 8
R = 6
S = 7
T = 9

U = 5
V = 1
W =2
X = 3

8	3	5	1	9	7	6	4	2
7	6	1	2	8	4	5	3	9
2	9	4	5	3	6	8	7	1
6	2	3	8	4	1	9	5	7
9	5	8	6	7	2	3	1	4
4	1	7	3	5	9	2	6	8
3	4	6	7	2	8	1	9	5
5	8	9	4	1	3	7	2	6
1	7	2	9	6	5	4	8	3