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D) G) 5 E) All this 39. $\lim x^3 + x + = A$) B) C) D) E) 3 29 CHAPTER. LIMITS 5 x^3 3. $\lim x / x + A$) C) C) D) 3 E) 5 $x \lim = x + A$) B) C) D) E) there is no $3x + x \lim x^4 + 7x^3 = A$) B) C) 3 7 D) E) 33. $\lim x x + 4 x = A$) B) C) 4 D) E) { 34. Function $G(x) = x + \>$; is not continuous in $x =$ because $4 x + \>$; A) $G()$ does not exist B) $\lim x G(x)$ there is no C) $\lim x G(x) = G()$ D) The three statements A, B and C E) None of the above 35 exist. The function domain $f(x) = 4 x$ is A) $x \&$; or $x \&$; B) x or $x C) \&$; $x \&$; D) $x E) x 36. \lim x 5 x 5 = A$) B) C) D) 5 E) there is no $x 6 x$ Find k so that $f(x) = x^4$ is continuous for all x . $k x = 4 A$) any value B) C) 8 D) 6 E) no Madness value means that we keep trying the same thing and hopefully it comes out differently. Albert Einstein 30 6 CALCULUS PROBLEM BOOK.9 Mostra a.P. a.P. limits 38. For function $f(x) = x$, find the following: a) $\lim x f(x)$; b) $\lim x f(x)$; c) $\lim x + f(x)$; d) $\lim x f(x)$; e) All horizontal asymptotes; f) All vertical asymptotes. 39. Consider function $h(x) = a$) What is the domain of h ? b) Find all zeros of h . /x.c) Find all vertical and horizontal asymptotes of h . d) Find $\lim x + h(x)$. e) Find $\lim x h(x)$. f) Find $\lim x h(x)$. 33. Consider the function $g(x) = \sin x$ defined for all real numbers. a) Is $g(x)$ a uniform function, a strange function, or neither? Justify your answer. b) Find the zeros and the domain of g .c) Find $\lim g(x)$. $x x \&$; 33. Let $f(x) = x \&$; $x = a$) Draw the f.b chart) At which points c in the f domain there is $\lim x c f(x)? c$) At what points only the left boundary exists? d) At what points only the right boundary exists? 31 CHAPTER. LIMITS 7 A.P. Calculation Test a section A multiple option Without calculators Time 3 minutes Number of questions 5 The score in this section is determined by the formula $[C (.5)]$.8 where C is the number of correct answers and I am the number of incorrect answers. An unanswered question earns zero points. The maximum possible points obtained in this section is 7, which represents 5% of the total score of the test. Directions: Solve each of the following problems, using the space available for zero work. After examining the options form, decide which is the best of the given options and fill in the corresponding choice on your answer sheet. Don't spend too much time on any problem. Good luck! NAME: 32 8 THE CALCULATION PROBLEM BOOK AP. Which of the following is continuous in $x=?$ I. $f(x) = x$ II. $f(x) = e x$ III. $f(x) = \ln(e x)$ A) And only B) II only C) I and II only D) II and III only E) none of these. The graph of an f-function is reflected across the x-axis and then scrolls up the units. Which of the following describes this transformation in f? A) $f(x) B f(x) + C f(x +) D) f(x) E) f(x) + 3$. Which of the following functions is not continuous for all actual numbers x ? A) $f(x) = x / 3 B) f(x) = (x +) 4 C) f(x) = x + D) f(x) = + e x E) f(x) = x 3 x + 9 33 CHAPTER. LIMITS 9 $\ln x$ 4. $\lim x x$ is A) B) C) e D) e E) nonexistent (5. $\lim x x +) x = A$) B) C) D) E) $x 3 4x + 6. \lim x x 3 = 5 A) 5 B) C) 3 D) E) There is no 34 3 THE CALCULATION PROBLEM BOOK AP 7. For what value of k does $\lim x 4 x x + k x 4 A) B) 4 C) 3 D) 7 E) This value does not exist. Exist? so $x 8. \lim = x A) B) C) D) E) 9. Let's say f is defined as $x x f(x) = x k x =$. Then the value of k for which $f(x)$ is continuous for all real values of x is $k = A) B) C) D) E) 35 CHAPTER. LIMITS 3. The average exchange rate of $f(x) = x^3$ over the range $[a, b]$ is A) $3b + 3a B) b + ab + a C) b + a D) b^3 to 3 E) b^4 to 4$ (b Function is not continuous in $x =$ because A) $G()$ is not defined. B) $\lim x G(x)$ does not exist. C) $\lim x G(x) G()$. D) $G()$ 5. E) None of the above $x 5 x \&$; $\&$; $= 5 x = 5x 3 x \&$; $\lim x x + 5 x + = A) B) C) D) E) there is no 36 3 THE CALCULATION PROBLEM BOOK AP 3. The intermediate value theorem states that given a continuous function f defined in the closed interval $[a, b]$ for which it is between $f(a)$ and $f(b)$, there is a point c between a and b such as A) $c = a$ b) $f(a) = f(b)$ C) $f(c) = D) f() = c E) c = 4$. The function $f(x) = x 3 x 3$ has A) a removable discontinuity in $x = 3$. B) infinite discontinuity in $x = 3$. C) a discontinuity of jump to $x = 3$. D) without discontinuities. E) removable discontinuity in $x =$ and infinite discontinuity in $x =$ Find the values of c so that the function $f(x) = x \&$; $x + c x$ is continuous everywhere. A) 3, B), 3 C), 3 D) 3, E) There are no such values. 37 CHAPTER. LIMITS 33 A.P. Calculus Test One Section Two Free Answer Calculators allowed Time 45 minutes Number of questions 3 Each of the three questions is worth 9 points. The maximum possible points obtained in this section is 7, which represents 5% of the total score of the test. There is no penalty for guessing. SHOW ALL YOUR WORK. You will be graded on the methods you use, as well as the accuracy of your answers. The correct answers without supporting the job cannot receive full credit. Type all jobs for each problem in the space provided. Be sure to write clearly and readably. The deleted or crossed work will not be graded. Justifications require you to give math (non-calculator) reasons and clearly identify functions, charts, tables, or other objects that you use. You are allowed to use your calculator to solve an equation or chart of a function without showing work. However, you must clearly identify your problem settings. Your work should be expressed in mathematical notation instead of calculator syntax. For example, $y = x$ cannot be written as $Y=X^k$. Unless otherwise specified, the answers (numerical or algebraic) should not be simplified. If your answer is given as a decimal approximation, it should be correct in three places after the decimal point. Good luck! NAME: 38 34 THE CALCULATION PROBLEM BOOK AP. Think about function $f(x) = (x 3) 9 x$ a) What is the domain of f ? What are the zeros of f ? b) Evaluate $\lim x 3 f(x)$. c) Determine all vertical and horizontal asymptotes of f . d) Find all non-mobile discontinuities of f . Think about the function $g(x) = x$ with domain $(,)$. a) Fill in the following table. $x x$ b) What is $\lim g(x)$? What is $\lim g(x)? x + c$) What do you think the smallest value of $g(x)$ is for range values $(,)$? Justify your answer. d) Find the average change rate of $g(x)$ of $x = a$ $x =$ Consider the function $F(x) = (a x)$ where a is a positive real number. a) What is the domain of F ? What are the F ? b) Find all F -asymptotes and discuss any F .c discontinuity) Evaluate $\lim F(x)$, $\lim F(x)$ and $\lim F(x)$. $x x a$ d) What value of a will $F(6) = ?$ CHAPTER 39 39 35 40 36 THE BOOK OF CALCULATION PROBLEMS AP. Negative and fractional exponents Rewrite each expression with fractional exponents and simplifies $x 5$ and $x 3 x + 4 (x +) (x + 6) 4 3 x + 6$ Rewrite each expression with radicals and simplifies $x 5 / (x +) 5 / 4 34. (64x) 3 / 338. y / 3$ Rewrite and simplify each of the following in two ways: a) only with positive exponents; and b) without denominators. 34. x and $3 x 4$ and 343. $(x + 5) (x + 7) 3 (x + 7) 4 (x + 5) x / 5$ and $3 / 4 x 3 / 5 y / (x / 3 + x 7 / 3)$ Completely factor in each of the following expressions $x 3 / 5 4x / x / 3 + 6x 5 / x 6 / 5 49x 8 / x 7 / 3 6x 5 / 3 + x 349. x 3 + x x (4 3 x 4 / 3 + x) (x / 3 + 4x / 3)$ 35. $(x 3 + 3x) / (x + 4)$ 35. $(x + 6x + 9) / (x + 3) 3 / 353. (x / 3 + x / 3) (x / 3 + (x / 3 + 3x / 3 +) (x / 3 x 4 / 3 4 3 (x) / 3 x 8 / 3 (x + 7) / x / x + 7 x (x 7) / (x 3) x 7 (x 3) x 7 (x 3) 41 CHAPTER. DERIVATIVES 37. Logically thinking about logic in each of the following problems, you are given a true statement. From the tax return, determine which of the three options is logically equivalent. (You don't need to know what the words mean in order to determine the correct answer.) 357. If it's raining, then I'll go to the mall. A) If I go to the mall, then it's raining. B) If it's not raining, then I won't go to the mall. C) If I don't go to the mall, then it's not raining If a snark is a grunk, then a quango is a trone. A) If a quango is a throne, then a snark is a grunk. B) If a quango is not a throne, then a snark is not a grunk. C) If a snark is not a grunk, then a quango is not a trone If a function is linear, then the graph is not a parabola. A) If the graph is a parabola, the function is not linear. B) If the graph is a parabola, then the function is linear. C) If the function is not linear, then the graph is a parabola. 36. If a function has a vertical asymptote, then it is rational, logarithmic or trigonometric. A) If a function is rational, logarithmic or trigonometric, then the function has a vertical asymptote. B) If a function is not rational, logarithmic and trigonometric, then the function has no vertical asymptote. C) If a function is not rational, logarithmic and trigonometric, then the function has no vertical asymptote. 36. If $f(x)$ is continuous and $f(a) = f(b)$, then there is a number c between a and b so that $f(c)$ is the maximum of $f(x)$. A) If $f(x)$ is not continuous or $f(a) = f(b)$, then there is no number c between a and b so that $f(c)$ is the maximum of $f(x)$. B) If there is a number c between a and b so that $f(c)$ is the maximum of $f(x)$, then $f(x)$ is not continuous or $f(a) = f(b)$. C) If there is no number c between a and b so that $f(c)$ is the maximum of $f(x)$, then $f(x)$ is not continuous or $f(a) = f(b)$. 42 38 THE CALCULATION PROBLEM BOOK AP. 3 The derivative by definition For each of the following, use the derivative a) find an expression expression $f(x)$ and b) find the value of $f(a)$ for the given value of a . 36. $f(x) = x 3$; $a = 363$. $f(x) = x x$; $a = 364$. $f(x) = + x$; $a = f(x) = x$; $a =$ Differentiate each function. You do not need to use definition $g(x) = 3x x p(x) = (x) w(x) = (3x + 4) 369. j(x) = 3x 4 x 3 + 6x x 37. t(x) = 5 x 3 3 5x 4 Reply to each of the following. 37. $k(x) = (x / 3) (x / 3 + x / 3 + 4) 37. y(x) = x 3x 5x + 7x 373. G(x) = (3x (x + 5) 374. S(x) = x 375. V(x) = 3 \pi x 3 + \pi x 376. What is the derivative of any function of the form $and = a$, where one is constant? 377. What is the derivative of any function of the form $y = mx + b$, where m and b are constant? 378. What is the derivative of any function of the form $and = x n$, where n is constant? 379. If $3x + 6x$ is derived from a function, then what could be the original function? 38. Let $y = 7x 3$. Find and $y ()$. Find $dy dy$ and $dx dx$. $x =$ Determine if each of the following functions is different than $x =$; that is, does the derivative exist in $x = ?$ (38. $f(x) = x x 384. f(x) = x \&$; 38. $f(x) = x \{ x 385. f(x) = 4x x \&$; $\{ (x) 3 \{ x 383. f(x) = (x) x \&$; 386. $f(x) = x x \&$; $x A$ habit of basing convictions on the evidence, and of giving them only that degree of certainty that the evidence guarantees, if it became general, to cure most of the evils of which the world suffers. Bertrand Russell 43 CHAPTER. DERIVATIVES 39.4 Exit in a Tangent For the following five problems, find an equation for the tangent line on the curve in the x -coordinate $y = 4 x$; $X = 388. y = x$; $X = 389. y = x$; $X = 39. y = x 3$; $X = 39. y = x 3 + 3x$; $X = 39$. At what points does the graph of $y = x + 4x$ have a horizontal tangent? 393. Find an equation for the tangent in the curve $y = x$ that has slope What is the instantaneous speed of changing the area of a circle when the radius is 3 cm ? 395. What is the instantaneous rate of change in the volume of a ball when the radius is cm ? $(x \sin () 396. Does the (x) = x x$ graphic have a tangent at the source? Justify your $x =$ answer Consider curve $y = x 3 4x + a$) Find an equation for the tangent in the curve at the point $(,)$. b) What is the range of values on the curve slope? c) Find equations for tangents in the curve at points where the curve slope is 8. Determine which of the following functions are differential to $x = y = x / y = x / 3 4. y = x 4 / 3 4. y = x 5 / 3 4. y = x / 4 43. x = x 5 / 4 4. y = x / 5 45. y = x / 5 46. Based on the answers of the above problems, find a pattern for differential functions with exponents of the following forms: x even / strange, x strange / strange, x strange / even. Error is human, but when the eraser wears off ahead of the pencil, you're exaggerating it. Josh Jenkins 44 4 CALCULUS AP PROBLEM BOOK.5 Six problems arising 47. The water is flowing into a large spherical tank at a steady pace. That $V (t)$ is the volume of water in the at the time t , and $h(t)$ be the height of the water level at the time t . a) Give a physical interpretation of $dv dt$ b) Which of $dv dt$ c) It is $Fri dt$ d) It is $dh dt$ 48. Let $f(x) = x$. and $dh dt$ and $dh dt$. is it constant? Explain your answer. positive, negative or zero when the tank is a full quarter? positive, negative or zero when the tank is a full quarter? a) Find the average change rate of f from $x = to x =$. b) Find the average change rate of f from $x = to x =$. c) Use the calculator to estimate $f()$, instant rate change from $f a$. d) Sketch the f graph and use it to explain why the response to the part (b) is a better estimate of $f()$ than the response to the part (a). Can you suggest a generalization of your ideas? 49. The $p(t)$ position of an object at the time t is given by $p(t) = 3t + a$. a) Find the instantaneous speed of the object at an arbitrary time . b) Find the instantaneous speed of the object at the moment $t =$. 4. Let $f(x) = x + x$. a) Use the derivative definition to find $f(x)$. b) Find an equation of the tangent line in the f -chart at point $(,)$. c) Sketch the f graph along with the tangent line which is party (b) on the same axes. 4. Find a function $f(x)$ and a point such that $f(a)$ does not exist even though $f(a)$ does. There's dust on my guitar! The total amount of dust after t days is given by $g(t)$. I know $g(3) = 7$ milligrams and $g'(3) = 5$. a) Estimate $g(3)$. b) What are the units of $g'(t)$? Many very learned men lack intelligence. Democritus Nothing is more terrible than seeing ignorance in action. Derivative Trigonometry 4.6: An updater Evaluates each of the following expressions. Do not use a calculator. 43. as $\pi (\sin 3\pi 4)(\text{body } 5\pi 4) 45. \text{dry } 4\pi \text{ body}(\pi 4) 47. \sin(\pi \pi 6) 48. \sin 5\pi 6 + \text{as } \pi \arcsin 4. \text{Arctan } 3 4. \sin (3) 4. \text{so } (3) 43. \sin(\arctan) 44. \tan(\sec) 45. \sin(\arcsin) 3) 46. \arcsin(\sin \pi) 47. \arccos (\text{body}(\pi 4)) 48. Which of the following are indefinite? a) $\arccos.5 b) \arcsin.5 c) \arctan.5 d) \text{secc } 3 e) \arcsin$ 4. Evaluate the following limits. Graphize the functions of the calculator if necessary. 49. $\lim x + \sin x 43. \lim x \sec x 43. \lim x \csc x 43. \lim x \arctan x 433. \lim x \arctan x 434. \lim x \arcsin x 435. We know that $\sin x$ is a strange function and because x is a uniform function, but what about these? a) $\arccos x b) \arcsin x c) \arctan x d) \text{secc } e) \csc x$ Find exact solutions to each of the following equations over the range $[, \pi)$ $\text{body } 3\pi = 439. \sin \theta 3\sin \theta + = 437. \text{as } x = 438. \sin 3\theta + = 44. \text{body } \theta + \text{body } \theta = 44. \text{body } x + \sec x = \text{Water is draining from a tank. The water volume of the tank is given by } V(t) = + (t) 3$, where V is in gallons and t is the number of hours since the water began to drain. Answer the following questions using correct drives. a) How much water is initially in the tank? b) A speed is draining after hours? c) Will Will tank have been completely drained after two days? What? Any fool can know. The point is to understand. Albert Einstein Einstein$$$$$$$$$$$$

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