**AP Calculus – Final Review Sheet**

| When you see the words …. | This is what you think of doing |
|---|---|
| 1. Find the zeros | |
| 2. Find equation of the line tangent to $f(x)$ at $(a,b)$ | |
| 3. Find equation of the line normal to $f(x)$ at $(a,b)$ | |
| 4. Show that $f(x)$ is even | |
| 5. Show that $f(x)$ is odd | |
| 6. Find the interval where $f(x)$ is increasing | |
| 7. Find interval where the slope of $f(x)$ is increasing | |
| 8. Find the minimum value of a function | |
| 9. Find the minimum slope of a function | |
| 10. Find critical values | |
| 11. Find inflection points | |
| 12. Show that $\lim_{x \to a} f(x)$ exists | |
| 13. Show that $f(x)$ is continuous | |
| 14. Find vertical asymptotes of $f(x)$ | |
| 15. Find horizontal asymptotes of $f(x)$ | |

| | |
|---|---|
| 16. Find the average rate of change of $f(x)$ on $[a,b]$ | |
| 17. Find instantaneous rate of change of $f(x)$ at $a$ | |
| 18. Find the average value of $f(x)$ on $[a,b]$ | |
| 19. Find the absolute maximum of $f(x)$ on $[a,b]$ | |
| 20. Show that a piecewise function is differentiable at the point $a$ where the function rule splits | |
| 21. Given $s(t)$ (position function), find $v(t)$ | |
| 22. Given $v(t)$, find how far a particle travels on $[a,b]$ | |
| 23. Find the average velocity of a particle on $[a,b]$ | |
| 24. Given $v(t)$, determine if a particle is speeding up at $t = k$ | |
| 25. Given $v(t)$ and $s(0)$, find $s(t)$ | |
| 26. Show that Rolle's Theorem holds on $[a,b]$ | |
| 27. Show that Mean Value Theorem holds on $[a,b]$ | |
| 28. Find domain of $f(x)$ | |
| 29. Find range of $f(x)$ on $[a,b]$ | |
| 30. Find range of $f(x)$ on $(-\infty, \infty)$ | |
| 31. Find $f'(x)$ by definition | |
| 32. Find derivative of inverse to $f(x)$ at $x = a$ | |

| | |
|---|---|
| 33. $y$ is increasing proportionally to $y$ | |
| 34. Find the line $x = c$ that divides the area under $f(x)$ on $[a,b]$ to two equal areas | |
| 35. $\dfrac{d}{dx}\displaystyle\int_a^x f(t)\,dt =$ | |
| 36. $\dfrac{d}{dx}\displaystyle\int_a^u f(t)\,dt$ | |
| 37. The rate of change of population is ... | |
| 38. The line $y = mx + b$ is tangent to $f(x)$ at $(a,b)$ | |
| 39. Find area using left Riemann sums | |
| 40. Find area using right Riemann sums | |
| 41. Find area using midpoint rectangles | |
| 42. Find area using trapezoids | |
| 43. Solve the differential equation ... | |
| 44. Meaning of $\displaystyle\int_a^x f(t)\,dt$ | |
| 45. Given a base, cross sections perpendicular to the $x$-axis are squares | |
| 46. Find where the tangent line to $f(x)$ is horizontal | |
| 47. Find where the tangent line to $f(x)$ is vertical | |
| 48. Find the minimum acceleration given $v(t)$ | |
| 49. Approximate the value of $f(0.1)$ by using the tangent line to $f$ at $x = 0$ | |

| | |
|---|---|
| 50. Given the value of $f(a)$ and the fact that the anti-derivative of $f$ is $F$, find $F(b)$ | |
| 51. Find the derivative of $f(g(x))$ | |
| 52. Given $\int_a^b f(x)\,dx$, find $\int_a^b [f(x)+k]\,dx$ | |
| 53. Given a picture of $f'(x)$, find where $f(x)$ is increasing | |
| 54. Given $v(t)$ and $s(0)$, find the greatest distance from the origin of a particle on $[a,b]$ | |
| 55. Given a water tank with $g$ gallons initially being filled at the rate of $F(t)$ gallons/min and emptied at the rate of $E(t)$ gallons/min on $[t_1,t_2]$, find a) the amount of water in the tank at $m$ minutes | |
| 56. b) the rate the water amount is changing at $m$ | |
| 57. c) the time when the water is at a minimum | |
| 58. Given a chart of $x$ and $f(x)$ on selected values between $a$ and $b$, estimate $f'(c)$ where $c$ is between $a$ and b. | |
| 59. Given $\dfrac{dy}{dx}$, draw a slope field | |
| 60. Find the area between curves $f(x), g(x)$ on $[a,b]$ | |
| 61. Find the volume if the area between $f(x), g(x)$ is rotated about the $x$-axis | |

**BC Problems**

| | |
|---|---|
| 62. Find $\lim\limits_{x \to \infty} \dfrac{f(x)}{g(x)}$ if $\lim\limits_{x \to \infty} f(x) = \lim\limits_{x \to \infty} g(x) = 0$ | |
| 63. Find $\displaystyle\int_0^\infty f(x)\ dx$ | |
| 64. $\dfrac{dP}{dt} = \dfrac{k}{M} P(M - P)$ or $\dfrac{dP}{dt} = kP\left(1 - \dfrac{P}{M}\right)$ | |
| 65. Find $\displaystyle\int \dfrac{dx}{x^2 + ax + b}$ where $x^2 + ax + b$ factors | |
| 66. The position vector of a particle moving in the plane is $r(t) = \langle x(t), y(t) \rangle$ <br> a) Find the velocity. | |
| 67. b) Find the acceleration. | |
| 68. c) Find the speed. | |
| 69. a) Given the velocity vector $v(t) = \langle x(t), y(t) \rangle$ and position at time 0, find the position vector. | |
| 70. b) When does the particle stop? | |
| 71. c) Find the slope of the tangent line to the vector at $t_1$. | |
| 72. Find the area inside the polar curve $r = f(\theta)$. | |
| 73. Find the slope of the tangent line to the polar curve $r = f(\theta)$. | |
| 74. Use Euler's method to approximate $f(1.2)$ given $\dfrac{dy}{dx}$, $(x_0, y_0) = (1,1)$, and $\Delta x = 0.1$ | |
| 75. Is the Euler's approximation an underestimate or an overestimate? | |
| 76. Find $\displaystyle\int x^n e^{ax} dx$ where $a, n$ are integers | |
| 77. Write a series for $x^n \cos x$ where $n$ is an integer | |

| | |
|---|---|
| 78. Write a series for $\ln(1+x)$ centered at $x=0$. | |
| 79. $\displaystyle\sum_{n=1}^{\infty}\frac{1}{n^p}$ converges if..... | |
| 80. If $f(x)=2+6x+18x^2+54x^3+...$, find $f\left(-\dfrac{1}{2}\right)$ | |
| 81. Find the interval of convergence of a series. | |
| 82. Let $S_4$ be the sum of the first 4 terms of an alternating series for $f(x)$. Approximate $\left\|f(x)-S_4\right\|$ | |
| 83. Suppose $f^{(n)}(x)=\dfrac{(n+1)\ n!}{2^n}$. Write the first four terms and the general term of a series for $f(x)$ centered at $x=c$ | |
| 84. Given a Taylor series, find the Lagrange form of the remainder for the 4$^{th}$ term. | |
| 85. $f(x)=1+x+\dfrac{x^2}{2!}+\dfrac{x^3}{3!}+...$ | |
| 86. $f(x)=x-\dfrac{x^3}{3!}+\dfrac{x^5}{5!}-\dfrac{x^7}{7!}+...+\dfrac{(-1)^n x^{2n+1}}{(2n+1)!}+...$ | |
| 87. $f(x)=1-\dfrac{x^2}{2!}+\dfrac{x^4}{4!}-\dfrac{x^6}{6!}+...+\dfrac{(-1)^n x^{2n}}{(2n)!}+...$ | |
| 88. Find $\displaystyle\int (\sin x)^m (\cos x)^n\,dx$ where $m$ and $n$ are integers | |
| 89. Given $x=f(t),\ y=g(t)$, find $\dfrac{dy}{dx}$ | |
| 90. Given $x=f(t),\ y=g(t)$, find $\dfrac{d^2y}{dx^2}$ | |
| 91. Given $f(x)$, find arc length on $[a,b]$ | |
| 92. $x=f(t),\ y=g(t)$, find arc length on $[t_1,t_2]$ | |
| 93. Find horizontal tangents to a polar curve $r=f(\theta)$ | |

| | |
|---|---|
| 94. Find vertical tangents to a polar curve $r = f(\theta)$ | |
| 95. Find the volume when the area between $y = f(x), x = 0, y = 0$ is rotated about the y-axis. | |
| 96. Given a set of points, estimate the volume under the curve using Simpson's rule. | |