Formulas for AP Calculus BC key Update 2023

1. slope of a parametrized curve $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$

2. $\int$ tanu du -ln$|$ cos(u) $|$ +c

3. $\int$ cotu du=: ln$|$ sin(u) $|$ +c

4. $\int$ secu du=: ln$|$ secu + tanu$|$ +c

5. $\int$cscu du=: -ln$|$ csc(u) + cot(u) $|$ +*c*

6. Integration by parts $\int u dv = uv - \int v\, du$

7. order for choosing u in integration by parts: LIPET: Logs, Inv.trig, polynomial, exponential, trig

8. logistics differential equation $\frac{dP}{dt} = \frac{K}{M}P(M-P)$

9 logistic growth model $P = \frac{M}{1+Ae^{-kt}}$

10 length of curve (Cartesian): $\int_a^b \sqrt{1 + (\frac{dy}{dx})^2}dx$

11. partial sum of a geometric series $S_n = \frac{a(1-r^n)}{1-r}$

12a) What is the formula for the sum of an infinite geometric series $S = \frac{a_1}{1-r}$

12b) For what values of r does a geometric series converge? $|r|<1$

13. Maclaurin Series $f(0) + f'(0)x + f"(0)\frac{x^2}{2!} + \cdots f^n(0)\frac{x^n}{n!} + \cdots$

14. Taylor Series: $f(a) + f'(a)(x-a) + \frac{f"(a)(x-a)^2}{2!} + \ldots + f^n(a)\frac{(x-a)^n}{n!} + \ldots$

15. Maclaurin Series for $\frac{1}{1-x}$ $1+x+x^2+x^3+x^4+\ldots$

16 Maclaurin Series for $\frac{1}{1+x}$ $1 - x + x^2 - x^3 + x^4 + \ldots$

17 Maclaurin Series for e^x $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \cdots$

18 Maclaurin Series for sinx $x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} \ldots$

19 Maclaurin Series for cosx $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots$

20 Maclaurin Series for ln(1+x) $x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots$

21 Maclaurin Series for $\tan^{-1}(x)$ $x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \cdots$

22 LaGrange form of Remainder $R_n(x)=\frac{f^{(n+1)}(c)}{(n+1)!}(x-a)^{n+1}$

23 Remainder Estimation Theorem $|R_n(x)|\le\frac{M}{(n+1)!}|x-a|^{n+1}$

24 $\int\frac{du}{\sqrt{a^2-u^2}}$ arcsin (u/a) + c

25 $\int\frac{du}{a^2+u^2}$ 1/a arctan (u/a) +c

26 $\int\frac{du}{u\sqrt{u^2-a^2}}$ 1/a arcsec(|u|/a) +c

27 What does this series converge to $\sum_{n=0}^{\infty}\frac{1}{n!}$ converges to e

28 What does this series converge to $\sum_{n=1}^{\infty}b_n-b_{n+1}$ converges to b_1

29 For what values of p does the series converge $\sum_{n=1}^{\infty}\frac{1}{n^p}$ converges for p > 1

30 Does the series converge? $\sum_{n=1}^{\infty}\frac{1}{n}$ Diverges: Harmonic Series

31 Does the series converge? $\sum_{n=1}^{\infty}(-1)^n\frac{1}{n}$ Converges: Alternating Harmonic Series

32 2nd derivative of a parameterized curve $\frac{d^2y}{dx^2}=\frac{\frac{dy'}{dt}}{\frac{dx}{dt}}$

33 length of a parameterized curve $L=\int_a^b\sqrt{\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2}\,dt$

34 position vector (standard form) $r(t) = f(t)\mathbf{i} + g(t)\mathbf{j} + h(t)\mathbf{k}$

35 speed from velocity vector $\text{speed} = |v(t)|$

36 direction from velocity vector $$\text{direction} = \frac{\text{velocity vector}}{\text{speed}} = \frac{v(t)}{|v(t)|}$$

37 polar to Cartesian formula $x = r\cos\theta$ $y = r\sin\theta$ $r^2 = x^2 + y^2$

38 trajectory equations $$x = x_o + (v_o\cos\alpha)t$$ $$y = y_o + (v_o\sin\alpha)t - \frac{1}{2}gt^2$$

39 slope of polar graph: $$(r,\theta) = \frac{r'\sin\theta + r\cos\theta}{r'\cos\theta - r\sin\theta}$$

40 slope of polar graph at origin $\text{slope} = \tan\theta$

41 area inside polar curve $$A = \int_\alpha^\beta \frac{1}{2}r^2 d\theta$$

42 length of curve (polar) $$L = \int_a^b \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\, d\theta$$

43 Parameterization of ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ becomes $x = a\cos t$, $y = b\sin t$