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University of Lagos, Akoka
Department of Mathematics
MAT 122: Calculus
Second Semester Examination 2023 / 2024 Session

Time Allowed: 2 hrs

Instruction: Answer all questions

Shade option E if your Answer is not one of the options provided. Number and show all working in the answer sheets provided. Submit only the Answer Sheets and OMR. All integration assumes the constant of integration $+c$.

1. Find $\int(4x^3+3x-1)dx$ A. $12x^2+3$ B. $x^4+\frac{3}{2}x^2-x$ C. $x^4+\frac{3}{2}x^2$ D. $\frac{1}{4}(12x^2+3)$

2. Obtain $\int\frac{2dx}{2-3x}$ A. $-\frac{2}{3}\ln(2-3x)$ B. $-\frac{3}{2}\ln(2x+3)$ C. $\frac{2}{3}e^{2-3x}$ D. $-\frac{3}{2}\ln(2x-3)$

3. Integrate $\int\frac{\ln x}{x}dx$ A. $x\ln x$ B. $\frac{e^x}{x}$ C. $\frac{1}{2}(\ln x)^2$ D. $\frac{1}{x}$

4. Integrate $\int(e^{3x}+8x)dx$ A. $3e^{3x}+8$ B. $3e^{3x}+4x^2$ C. $e^{3x}+8$ D. $\frac{e^{3x}}{3}+4x^2$

5. Find $\int\sin^8 x\cos x dx$ A. $\frac{\cos^9 x}{9}$ B. $-\frac{\cos^7 x}{7}$ C. $\frac{\sin^8 x}{8}$ D. $\ln(\cos^8 x)$ (SIN9X)/9

6. $\lim_{x\to\frac{1}{2}}\frac{8x^3-4}{2x-5}$ equals... A. $\frac{3}{4}$ B. $-\frac{3}{4}$ C. 0 D. -2

7. $\frac{d}{dx}\left[\ln\left(\frac{2x^2}{x^3+1}\right)\right]$ equals A. $\frac{2}{x(x^3+1)}$ B. $\frac{2+x^3}{x(x^3+1)}$ C. $\frac{2x^3}{x(x^3+1)}$ D. $\frac{2-x^3}{x(x^3+1)}$

8. Evaluate $\frac{d}{dx}[ke^{f(x)}]$ where k is a constant. A. $kxe^{f(x)}$ B. $kf'(x)e^{f(x)}$ C. $\frac{ke^{f(x)}}{f'(x)}$ D. $kf(x)e^{f(x)}$

9. Which of the following option is incorrect? A. $\frac{d}{dx}[\ln(f'(x))]=\frac{f''(x)}{f'(x)}$
B. $\int e^{3x}dx=3e^{3x}$ C. $\frac{d}{dx}[\int f'(x)dx]=f'(x)$ D. $\frac{d}{dx}\left[\text{cosec}\frac{x}{2}\right]=-\frac{1}{2}\text{cosec}\frac{x}{2}\cot\frac{x}{2}$

10. $\frac{d}{dx}[Cot(5x^2+3)]$ equals ... A. $-10x\,cosec^2(5x^2+3)$
B. $10x\,cosec^2(5x^2+3)$ C. $-10x\,cosec(5x^2+3)\cot(5x^2+3)$ D. $cosec^2(5x^2+3)$

11. Which of the following option best represent the differentiation formula of a function $y=g(x)$?
A. $\frac{dy}{dx}=\lim_{h\to0}\frac{g(x)-g(x+h)}{\Delta x}$ B. $\frac{dy}{dx}=\lim_{h\to0}\frac{g(x)-g(x+h)}{x}$ C. $\frac{dy}{dx}=\lim_{h\to0}\frac{g(x+h)-g(x)}{\Delta x}$ D. $\frac{dy}{dx}=\lim_{h\to0}\frac{g(x+h)-g(x)}{x}$

12. The first derivative of $\sqrt[3]{7-2x^3}$ with respect to x is …

A. $\frac{1}{\sqrt[3]{7-2x^3}}$ B. $\frac{-2x^2}{\sqrt[3]{(7-2x^3)^2}}$ C. $\frac{-6x^2}{\sqrt[3]{(7-2x^3)^2}}$ D. $\frac{2x^3}{\sqrt[3]{(7-2x^3)^2}}$

13. Obtain the first derivative of $y = 7x^3 tan\ 3x$ with respect to x.

A. $21x^2(x\ sec^2 3x + tan\ 3x)$ B. $42x^2(x\ sec^2 3x + tan\ 3x)$ C. $21x^2(x\ tan\ 3x + sec^2 3x)$. D. $21x^2(x\ tan\ 3x - sec^2 3x)$

14. Find $\frac{dy}{dx}$ of $y = \frac{x^2+3}{2x-7}$, A. $\frac{2x^2+3}{(2x-7)^2}$ B. $\frac{2x^2-14x+3}{(2x-7)^2}$ C. $\frac{2x^2-14x-6}{(2x-7)^2}$ D. $\frac{2x^2-14x+6}{(2x-7)^2}$

15. Which of the following option is correct? A. $\frac{d}{dx}[x\ e^{f(x)}] = xf'(x)\ e^{f(x)}$ B. $\frac{d}{dx}[sin^2 3x] = -3\ cos^2 3x$

C. $\frac{d}{dx}[tan\ (2x+3)] = sec^2(2x+3)$ D. $\frac{d}{dx}[\text{cosec}\ (5x^2)] = -10x\ \text{cosec}\ (5x^2)\cot(5x^2)$

16. The Quotient rule of differentiation formula for the function $V = \frac{p(x)}{q(x)}$ is …

A. $\frac{dV}{dx} = \frac{q\ dp - p\ dq}{p^2}$ B. $\frac{dV}{dx} = \frac{q\ dp + p\ dq}{q^2}$ C. $\frac{dV}{dx} = \frac{p\ dp - q\ dp}{q^2}$ D. $\frac{dV}{dx} = \frac{q\ dp - p\ dq}{q^2}$

17. Obtain $\int \frac{dx}{4+9x^2}$ A. $\frac{1}{3}\tan^{-1}\left(\frac{3x}{2}\right)$ B. $\frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right)$ C. $\frac{2}{3}\ln\left(\frac{2+3x}{2}\right)$ D. $\ln(4+9x^2)$

18. By using long division rule, $\int \frac{x^2-1}{x+3}dx$ is A. $\frac{x^2}{2}+3x+8\ln(x-3)$ B. $x^2-\ln(x-3)$ C. $\frac{x^3}{2}-\ln(x-3)$

D. $e^{x+2}-\ln(x-3)$

19. By Using Partial fraction technique, $\int \frac{dx}{x-x^2}$ is, A. $-\ln(x^2-x)$ B. $\ln\left(\frac{x-1}{x}\right)$ C. $\ln\left(\frac{x}{x-1}\right)$

D. $\frac{x}{2}\ln(x^2-x)$

20. Obtain $\int xe^{x^2-4}dx$ A. e^{x^2-4} B. $2xe^{x^2-4}$ C. $\ln(x^2-4)$ D. $\frac{1}{2}e^{x^2-4}$

21. Integrate $\int \sec^2 x \tan x dx$ A. $2\sec^2 x$ B. $\tan^2 x$ C. $\frac{1}{2}\sec^2 x$ D. $\cos ecx \cot x$

22. $\lim_{x\to\infty} \frac{4x-2x^3}{7x^3-8}$ equals… A. $\frac{2}{7}$ B. $-\frac{2}{7}$ C. 0 D. $-\frac{1}{2}$

23. Given the function $f(x-2) = 2x^2 - 5x + 2$, evaluate $f(x)$

A. $2x^2+3x$ B. $2x^2+3x+1$ C. $2x^2+2x+71$ D. $2x^2-3x+1$

24. Find the inverse $f^{-1}(x)$ of the function $f(x) = \frac{3x+1}{x-5}$.

A. $\frac{3x+1}{x-3}$ B. $\frac{x-3}{5x+1}$ C. $\frac{3x-1}{x-5}$ D. $\frac{5x+1}{x-3}$

25. Given the functions $f(x) = 3x^2 - 2x + 1$, $g(x) = 2x + 5$ evaluate $g(f($ A. $5x^2 - 26$

B. $5x^2 - 30x - 2$. C. $6x^2 - 4x + 7$ D. $7x^2 + 3x + 1$.


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26. Given the function $f(u) = 5u^2 - 7u + 2$, find $f(f(3))$. A. 3382 X 3200 C. 3182 D. 423

27. Find $\int \ln\frac{x}{2}\,dx$ A. e^x B. $\frac{x}{2}(\ln x - 1)$ C. $\frac{1}{x}$ X $x\left(\ln\frac{x}{2} - 1\right)$

28. Find $\int \frac{x}{x-1}\,dx$ A. $\ln(x+1)$ X $x + \ln(x-1)$ C. $e^{\frac{x+1}{x}}$ D. $\ln\left(\frac{x-1}{x}\right)$

29. Obtain $\int \sin^2 x\,dx$ A. $\frac{1}{2}x - \frac{\sin 2x}{2}$ B. $\frac{1}{4}x + \frac{\sin 2x}{2}$ C. $\frac{1}{4}x - \frac{\sin x}{4}$ X $\frac{1}{2}x - \frac{\sin 2x}{4}$

30. $\lim_{x\to 0}\frac{x^5}{1-\cos 3x}$ equals... A. 5 B. 1 X 0 D. 9

31. Given the function $f(u-2) = 3u^2 - u + 1$, find $f(5)$. X 141 B. 139 C. 71 D. 70

32. Which of the following option best describes the reduction formula for $I_n = \int sec^n x\,dx,\ n \geq 2$. A. $\frac{1}{n-1}sec^{n-2}x\,tan\,x + \frac{n-2}{n-1}I_{n-2}$ B. $\frac{-1}{1-n}sec^{n-2}x\,tan\,x + \frac{n-2}{n-1}I_{n-2}$ C. $\frac{1}{n-1}sec^{n-2}x\,cot\,x + \frac{n-2}{n-1}V_{n-2}$ D.

33. Find $\frac{\partial f}{\partial x}$ if $f(x,y) = e^{-x}\sin(x+y)$

A. $e^{-x}[\cos(x+y) + \sin(x+y)]$ B. $e^{-x}[\cos(x+y) - \sin(x+y)]$

C. $e^{-x}[\cos(x-y) - \sin(x+y)]$ X. $-e^{-x}[\cos(x+y) - \sin(x+y)]$

34. If $u(x,y,z) = e^{xyz}$. Find $\frac{\partial^3 u}{\partial x\partial y\partial z}$.

A. $e^{xyz}\left[1 + xyz + 3x^2y^2z^2\right]$ B. $e^{xyz}\left[1 + 2xyz + 3x^2y^2z^2\right]$

C. $e^{xyz}\left[1 + 3xyz + 4x^2y^2z^2\right]$ X. $e^{xyz}\left[1 + 3xyz + x^2y^2z^2\right]$

35. Find $\frac{\partial f}{\partial x}$ if $f(x,y) = \frac{1}{\sqrt{y}}e^{-\frac{(x-a)^2}{4y}}$, where a is constant

A. $\frac{-(x-a)^2}{5y^{\frac{3}{2}}}e^{-\frac{(x-a)^2}{4y}}$ B. $\frac{-(x-a)^2}{4y^{\frac{3}{2}}}e^{-\frac{(x-a)^2}{4y}}$ C. $\frac{-(x-a)^2}{3y^{\frac{3}{2}}}e^{\frac{(x-a)^2}{4y}}$ X. $\frac{-(x-a)^2}{2y^{\frac{3}{2}}}e^{\frac{(x-a)^2}{4y}}$

36. If $u(x,y) = x^y$. Find $\frac{\partial^2 u}{\partial y\partial x}$

X. $\frac{u}{x} + \frac{uy\log x}{x}$ B. $\frac{u}{x} + \frac{ux\log x}{y}$ C. $\frac{u}{y} + \frac{uy\log x}{x}$ D. $\frac{yu}{x} + \frac{uy\log x}{x}$

37. Find $\frac{dy}{dx}$ if $\tan(x^2y^4) = 3x + y^2$ X $\frac{3 - 2xy^4\sec^2(x^2y^4)}{4x^2y^3\sec^2(x^2y^4) - 2y}$

B. $\frac{3 + 2xy^4\sec^2(x^2y^4)}{4x^2y^3\sec^2(x^2y^4) + 2y}$ C. $\frac{3 + 2xy^4\sec^2(x^2y^4)}{4x^2y^3\sec^2(x^2y^4) - 2y}$ D. $\frac{3 - 2xy^4\sec^2(x^2y^4)}{4x^2y^3\sec^2(x^2y^4) + 2y}$

38. Find $\frac{dy}{dx}$ at $(0,3)$ $y^2e^{2x} = 3y + x^2$ A. -4 B. -5 X. -6 D-7

39. Find $\frac{dy}{dx}$ if $\cos(x^2+2y)+xe^{y^2}=1$

A. $\frac{2x\sin(x^2+2y)+e^{y^2}}{2yxe^{y^2}+2\sin(x^2+2y)}$

X B. $\frac{2x\sin(x^2+2y)-e^{y^2}}{2yxe^{y^2}-2\sin(x^2+2y)}$

C. $\frac{2x\sin(x^2+2y)-e^{y^2}}{2yxe^{y^2}+2\sin(x^2+2y)}$

D. $\frac{2x\sin(x^2+2y)+e^{y^2}}{2yxe^{y^2}-2\sin(x^2+2y)}$

40. Find $\frac{dy}{dx}$ if $y=\cos(5x-3y)$

A. $\frac{-5\sin(5x-3y)}{1-3\sin(5x-3y)}$

B. $\frac{-5\sin(5x-3y)}{1+3\sin(5x-3y)}$

X C. $\frac{5\sin(5x-3y)}{1-3\sin(5x-3y)}$

D. $\frac{5\sin(5x-3y)}{1+3\sin(5x-3y)}$

41. Find $\frac{dy}{dx}$ if $e^{xy^2}=x-y$

A. $\frac{1+xy^2+y^3}{2x^2y-2xy^2+1}$

B. $\frac{1-xy^2+y^3}{2x^2y+2xy^2+1}$

C. $\frac{1-xy^2-y^3}{2x^2y-2xy^2-1}$

X D. $\frac{1-xy^2+y^3}{2x^2y-2xy^2+1}$

42. Find the minimum value of the function $y=2x^3-21x^2+36x-20$

A. -120 X -128 C. -130 D. -138

43. Using the reduction formula, evaluate $\int \cos^4 x\,dx$,

X A. $\frac{1}{4}\cos^3 x\sin x+\frac{3}{8}\cos x\sin x+\frac{3}{8}x$

B. $\frac{1}{4}\cos^3 x\sin x+\frac{3}{8}\cos x\sin x-\sin x$

C. $\frac{1}{4}\cos^3 x\sin x+\frac{1}{2}\cos x\sin x+\frac{3}{8}x$

D. $\frac{1}{4}\cos^3 x\sin x-\frac{1}{2}\cos x\sin x+\frac{3}{8}x$

44. $\int_{\frac{\pi}{2}}^{\frac{3\pi}{2}}(\cos x-2x)\,dx$ equals ... A. $-2(1-\pi^2)$ X $-2(1+\pi^2)$ C. $-2(1-2\pi^2)$ D. π^2

45. Using the Wallis formula the integral of $\int_0^{\pi}\cos^3 x\,dx$ is ... A. $\frac{3}{4}$ B. $\frac{\pi}{3}$ C. $\frac{4}{3}$ D. $\frac{2\pi}{3}$

46. Using the Wallis formula the integral of $\int_0^{\frac{\pi}{2}}\sin^6 x\,dx$ is ... X $\frac{5\pi}{32}$ B. $\frac{5\pi}{16}$ C. $\frac{5}{16}$ D. $\frac{5\pi}{8}$

47. The nth term of the Maclaurin series expansion of $\cos x$ is...

A. $\frac{(-1)^n(x)^{2n+1}}{(2n+1)}$ B. $\frac{(-1)^{2n}(x)^{2n}}{(2n)!}$ C. $\frac{(-1)^n(x)^{2n+1}}{(2n+1)!}$ X $\frac{(-1)^n(x)^{2n}}{(2n)!}$

48. The nth term of the Maclaurin series expansion of $\sin 2x$ is... X $\frac{(-1)^{n+1}(2x)^{2n+1}}{(2n+1)!}$ B. $\frac{(-1)^{2n}(2x)^{2n}}{(2n)!}$

C. $\frac{(-1)^n(2x)^{2n+1}}{(2n+1)!}$ D. $\frac{(-1)^n(2x)^{2n}}{(2n)!}$

49. What is the value of K for which the function $f(x)=p\sin x+\frac{\sin 3x}{3}$ has an extremum at $x=\frac{\pi}{3}$

A. 0 B. 1 X. 2 D. 3

50. The maximum value of the function $f(x)=x^3+2x^2-4x+6$

A. 2 B. -2 X $\frac{2}{3}$ D. $-\frac{2}{3}$

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1. Given the function $\varphi(x) = m\left(\frac{x-l}{m-l}\right) + l\left(\frac{x-m}{l-m}\right)$, one of the following is correct. A. $\varphi(l+m) = \varphi(l)/\varphi(m)$

   B. $\varphi(l+m) = \varphi(l) - \varphi(m)$ X $\varphi(l+m) = \varphi(l) + \varphi(m)$ D. $\varphi(l+m) = \varphi(l)\varphi(m)$

2. Given the function $y = \left(\frac{u}{v}\right)^n$, one of the following is correct.

   A. $n\left(\frac{u}{v}\right)^{n-1}$ B. $n\left(\frac{u}{v}\right)^n\left[\frac{u'}{u} - \frac{v'}{v}\right]$ C. $\left(\frac{vu' - uv'}{v^2}\right)^n$ X $n\left(\frac{u}{v}\right)^{n-1}\left[\frac{uv' - vu'}{v^2}\right]$

3. $\int\sqrt{3-x^2}\,dx$, the best substitution is A. $x = 3\sin^{-1} z$ B. $x = 3\sin z$ X $x = \sqrt{3}\sin z$ D. $x = 3\cos\sqrt{z}$

4. The derivative $\frac{dy}{dx}$ of a function $y = f(u)$ of another function $u = g(x)$ is given as.....

   A. $\frac{dy}{du}\left(\frac{dx}{du}\right)$ X $\frac{dy}{du}\left(\frac{du}{dx}\right)$ C. $\frac{dx}{du}\left(\frac{du}{dy}\right)$ D. $\frac{dy}{du} + \frac{du}{dx}$

5. Which of the following best suits the Taylors series expansion of a given function $f(x)$ about the point $x = b$? A. $\sum_{r=0}^{\infty}\frac{(x-b)^r}{r!}f^{(r)}(b)$ B. $\sum_{r=0}^{\infty}\frac{(x-b)^r}{r!}f^{(r)}(0)$ C. $\sum_{r=0}^{\infty}\frac{x^r}{r!}f^{(r)}(0)$ D. $\sum_{r=0}^{\infty}\frac{(x-b)^r}{r}f^{(r)}(b)$

6. The $\frac{d}{dx}\left(7^{5x-1} + \log_e|5x^2 - x|\right)$ equals ..... A. $5\left(7^{5x-1}\right) + \frac{10x-1}{5x^2-x}$

   B. $5\left(7^{5x-1}\right)In|7| + 10x - 1$ C. $5\left(7^{5x-1}\right) + \frac{10x}{5x^2-x}$ X $5\left(7^{5x-1}\right)In|7| + \frac{10x-1}{5x^2-x}$

7. The $\lim_{x\to -5}\frac{x^3+3x-1}{x^2-25}$ is ..... A. $\frac{72}{10}$ X $-\frac{78}{10}$ C. -4 D. $-\frac{82}{10}$

8. Given $y = \log_e 4x^2$, then $y'' - 3y'$ equals..... A. $\frac{-(2-6x)}{x^2}$ B. $\frac{2}{x}$ X $\frac{-(2+6x)}{x^2}$ D. $\frac{-2}{x^2}$

9. The nth term of the Maclaurin series expansion of the function e^{-3x} is .....

   A. $\frac{(3x)^n}{n!}$ X $\frac{(-3x)^n}{n!}$ C. $\frac{(-3x)^n}{n}$ D. $\frac{(-3x)^{n+1}}{n!}$

10. Evaluate the minimum value of y if $y = x^3 - 3x^2 + 1$. A. 2 -3 B. 3 3 D. 1

A. $\frac{2}{\sqrt{x+\Delta x}+\sqrt{x}}$ B. $\frac{2\Delta x}{\sqrt{x+\Delta x}+\sqrt{x}}$ C. $\frac{\Delta x}{\sqrt{x+\Delta x}+\sqrt{x}}$ D. $\frac{1}{\sqrt{x+\Delta x}+\sqrt{x}}$

25. Given that $x^2-2xy+3y^2=50$. Find $\frac{dy}{dx}$ at point $(-1,-1)$

A. $-\frac{1}{2}$ B. $\frac{1}{4}$ C. $\frac{1}{2}$ D. $-\frac{1}{4}$

26. Use Wallis's formula to evaluate the integral $\int_0^{\frac{\pi}{2}}(\cos^{10}x)dx$

A. $\frac{63}{512}\pi$ B. $\frac{53}{512}\pi$ C. $\frac{43}{512}\pi$ D. $\frac{33}{512}\pi$

27. Given that $\int_0^b (2x-6)^2=36$, Find the value of b

A. 4 B. 5 C. 6 D. 7

28. Evaluate $\int\frac{4x-8}{x^2-4x+5}dx$ A. $3\ln(x^2-6x+1)$ B.

$\ln(x^2-4x+5)$ C. $3\ln(x^2-4x+1)$ D. $3\ln(x^2-4x+5)$

29. Evaluate $\int\frac{1}{t^2+t}dt$ A. $\ln\left(\frac{t}{t+1}\right)$ B. $\ln\left(\frac{2t}{t+1}\right)$ C. $2\ln\left(\frac{t}{t+1}\right)$ D. $2\ln\left(\frac{2t}{t+1}\right)$

30. Evaluate $\int_2^{2\sqrt{3}}\frac{dx}{x^2+4}$ A. $\frac{\pi}{6}$ B. $\frac{\pi}{12}$ C. $\frac{\pi}{24}$ D. π

31. Find the domain of $\sqrt{x^2-16}$ A. $D=\{x:x=-4\}$

B. $D=\{x:x\le -4<4\}$ C. $\{x:x\ge 4\}$ D. $D=\{x:x\le -4\}\cup\{x:x\ge 4\}$

32. Use the substitution $u=\cos x$ to evaluate $\int_0^b \sin^3 x\cos^2 x dx$

A. $\frac{37}{517}$ B. $\frac{37}{480}$ C. $\frac{40}{517}$ D. $\frac{47}{480}$

33. Evaluate $\lim_{\theta\to\frac{\pi}{2}}\theta\tan\theta$. A. ½ B. ¼ C. -1 D. 1

34. Find $\frac{dy}{dx}$ if $y=(3+2x)(1-x)$ A. 4x-1 B. 1+4x C. 1-4x D. -1-4x

35. Evaluate $\int\frac{\log_e x}{x}dx$ A. $\frac{\log_e x}{2}$ B. $\frac{(\log_e x)^2}{2}$ C. $\frac{\log_e x^2}{2}$ D. $2\log_e x$

36. Integrate $5xe^{x^2}$ A. $\frac{2}{5}e^{x^2}+c$ B. $\frac{5}{2}e^{x^2}+c$ C. $2xe^{x^2}+c$ D. $\frac{2}{5}x^2e^{x^2}+c$

37. Integrate $\int x^2\ln x dx$ A. $\frac{x}{3}\left(\ln x+\frac{1}{3}\right)$ B. $\frac{x}{3}\left(\ln x-\frac{1}{3}\right)$ C. $\frac{x^3}{3}\left(\ln x+\frac{1}{3}\right)$ D. $\frac{x^3}{3}\left(\ln x-\frac{1}{3}\right)$

11. Obtain $\int \sec x dx$ A. $\sec x \tan x$ B. $\ln|\sec x \tan x|$ C. $\ln|\sec x + \tan x|$ D. $\sec^2 x \tan x$

12. Find $\int \frac{5x}{x^2+6x-7} dx$ A. $\frac{5}{8}\ln|x-1| + \frac{35}{8}\ln|x+7|$

B. $\frac{35}{8}\ln|x-1| + \frac{5}{8}\ln|x+7|$ C. $\frac{5}{8}\ln|x^2+6x-7|$ D. $\frac{5}{8}In|x+1| + \frac{35}{8}In|x-7|$

13. Obtain $\int x^2 \cos x dx$ A. $\frac{x^3}{3}\sin x$ B. $x^2 \sin x + 2x\cos x - 2\sin x$ C. $x^2 \cos x + 2x \sin x - 2\cos x$

14. Given that $\frac{dy}{dx} = \frac{\cos 3\sqrt{x}}{\sqrt{x}}$, then y is ... A. $-2\cos 3\sqrt{x}$ B. $\frac{2}{3}\cos 3\sqrt{x}$ C. $2\sin 3\sqrt{x}$ D. $\frac{2}{3}\sin 3\sqrt{x}$

15. Evaluate the integral $\int \frac{2x}{x-1} dx$ A. $2x + 2\ln|x-1|$ B. $2 + 2\ln|x-1|$ C. $2x + \frac{2}{x-1}$ D. $2x - 2\ln|x-1|$

16. Evaluate the integral $\int \cos ec^2 5x \sqrt{\cot 5x} dx$

A. $-\frac{2}{15}\sqrt{\cos ec^3 5x}$ B. $-\frac{2}{5}\sqrt{\cot^3 5x}$ C. $\frac{2}{15}\sqrt{\tan^3 5x}$ D. $-\frac{2}{15}\sqrt{\cot^3 5x}$

17. Evaluate $\lim_{x\to 0}\left(\frac{\tan 4x}{3x}\right)$. A. $\frac{1}{3}$ B. $\frac{3}{4}$ C. $\frac{4}{3}$ D. $\frac{1}{4}$

18. Find the values of a and b that make $f(x)$ continuous, $f(x) = \begin{cases} x+1 & x<1 \\ ax+b & 1 \le x < 2 \\ 3x & x \ge 2 \end{cases}$

A. $a=-2, b=4$ B. $a=4, b=-2$ C. $a=2, b=4$ D. $a=-2, b=-4$

19. Find $\frac{dy}{dx}$ if $y = \sqrt[4]{\tan 4x}$. A. $\frac{\sec^2 4x}{\sqrt[4]{\tan^3 4x}}$ B. $\frac{-\sec^2 4x}{\sqrt[4]{\tan^3 4x}}$ C. $\frac{\tan^2 4x}{\sqrt[4]{sce^3 4x}}$ D. $\frac{-\tan^2 4x}{\sqrt[4]{sce^3 4x}}$

20. Given that a is a positive constant and $\int_{\ln 1}^{\ln a} (e^x + e^{-x}) dx = \frac{48}{7}$, find the exact value of a

A. 5 B. 6 C. 7 D. 8

21. Integrate $\int \frac{\ln x}{x} dx$. A. $\left(\frac{2\ln x}{\sqrt{2}}\right)^2$ B. $\left(\frac{\ln x}{2\sqrt{2}}\right)^2$ C. $\left(\frac{\ln x}{2}\right)^2$ D. $\left(\frac{\ln x}{\sqrt{2}}\right)^2$

22. Find the minimum point of the function $y = x^2 - 2x - 24\sqrt{x}$, $x > 0$

A. $(-4, -40)$ B. $(4, -40)$ C. $(-4, 40)$ D. $(4, 40)$

23. Given that $y = \frac{3\sin\theta}{2\sin\theta + 2\cos\theta}$ and $\frac{dy}{d\theta} = \frac{K}{1+\sin 2\theta}$. What is the value of K?

A. 1 B. 1.5 C. 2 D. 2.5

24. If $y = \sqrt{x}$, from first principle find $\frac{\Delta y}{\Delta x}$