Nishant Jindal

LIMIT

Largest value of -ve Non Integer a for which

Q. $\lim_{x\to 1}\left\{\dfrac{-ax+\sin(x-1)+a}{x+\sin(x-1)-1}\right\}^{\frac{1-x}{1-\sqrt{x}}}=\dfrac{1}{4}$

then $a=?$

$$\lim_{x\to 1}\left(\frac{a(1-x)+\sin(x-1)}{(x-1)+\sin(x-1)}\right)^{1+\sqrt{x}}=\frac{1}{4}$$

$$\lim_{\substack{x\to 1\\ x\neq 1}}\left(\frac{\cancel{(x-1)}\left(\frac{\sin(x-1)}{(x-1)}-a\right)}{\cancel{(x-1)}\left(1+\frac{\sin(x-1)}{(x-1)}\right)}\right)^{1+\sqrt{x}}=\frac{1}{4}$$

$$\lim_{x\to 1}\left(\frac{1-a}{1+1}\right)^{1+\sqrt{x}}=\frac{1}{4}\Rightarrow\left(\frac{1-a}{2}\right)^{2}=\frac{1}{4}\Rightarrow\frac{1-a}{\cancel{2}}=\frac{1}{\cancel{2}}\text{ or }\frac{1-a}{\cancel{2}}=-\frac{1}{\cancel{2}}$$

$\left(\frac{1}{2}\right)^2=\frac{1}{4}$

$\boxed{a=0}$ $\boxed{a=2}$ ✗

Learning
Crosscheck

$a=2$ $\lim_{\boxed{x\to 1}}\left(-\frac{1}{2}\right)^{1+\sqrt{x}}=$

$x=.9999\ldots$

$x=1.00000000 1$

$(-ve)^{1.9999\ldots 9}=\left(-\frac{1}{2}\right)^{\frac{199999\ldots 9}{10000000\ldots}}=U.D$

$\left(-\frac{1}{2}\right)^{2000\ldots 1}$

$=\left(-\frac{1}{2}\right)^{\frac{2000000\ldots 1}{1000000\ldots}}=U.D.$

odd

Even

$(-ve)^{\frac{\text{odd}}{\text{Even}}}=U.D$

LIMIT

$(1)^\infty$ type

2 Method.

① Using $\lim_{x\to 0}(1+x)^{\frac{1}{x}} = e$

② Using formula.

$$\lim_{x\to a}(f(x))^{g(x)} = e^{g(x)(f(x)-1)}$$

$f(x) \to 1^\infty$

Q $\lim_{x\to 0}\left(\tan\left(\frac{\pi}{4}+x\right)\right)^{\frac{1}{x}\to g}$

f $\to 1^\infty$ form

$$e^{\lim_{x\to 0}\frac{1}{x}\left[\tan\left(\frac{\pi}{4}+x\right)-1\right]}$$

$\tan x \to \sec^2 x$

$$e^{\lim_{x\to 0}\frac{\tan\left(\frac{\pi}{4}+x\right)-1}{x}} \quad \left(\frac{0}{0}\right) \text{ DL}$$

$\tan\left(\frac{\pi}{4}+x\right) \to \sec^2\left(\frac{\pi}{4}+x\right) \times (0+1)$

$$e^{\lim_{x\to 0}\frac{\sec^2\left(\frac{\pi}{4}+x\right)-0}{1}}$$

$$e^{\sec^2\frac{\pi}{4}} = e^2$$

Q $\lim_{x\to 0}\left(\frac{\ln(1+x)}{x}\right)^{\frac{1}{x}} = e^{\frac{1}{x}\left[\frac{\ln(1+x)}{x}-1\right]}$

$\to 1^\infty$

$$e^{\lim_{x\to 0}\frac{\ln(1+x)-x}{x^2}} \left(\frac{0}{0}\right) = e^{\lim_{x\to 0}\frac{\frac{1}{1+x}-1}{2x}}$$

$$e^{\lim_{x\to 0}\frac{1-(1+x)}{2x(1+x)}} = e^{\frac{-1}{2}} = \frac{1}{\sqrt{e}}$$

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Q $\lim_{x\to\infty}\left(\frac{2x^2+3}{2x^2+5}\right)^{8x^2+3}$

$\frac{\infty}{\infty}$

$\frac{2}{2}=1^{\infty}$ form.

$e^{(8x^2+3)\left(\frac{2x^2+3}{2x^2+5}-1\right)}$

$e^{(8x^2+3)\left(\frac{\cancel{2x^2}+3-\cancel{2x^2}-5}{2x^2+5}\right)}$

$e^{(8x^2+3)\left(\frac{-2}{2x^2+5}\right)}$

$=e^{\lim_{x\to\infty}\frac{-16x^2-6}{2x^2+5}}\ \frac{\infty}{\infty}$

$=e^{-\frac{16}{2}}=e^{-8}$

Q $\lim_{x\to 0}\left(\frac{a^x+b^x}{2}\right)^{\frac{1}{x}}$ $a>0, b>0$

$\to 1^{\infty}$

$e^{\frac{1}{x}\left(\frac{a^x+b^x}{2}-1\right)}=e^{\frac{1}{2}\left(\frac{a^x+b^x-2}{x}\right)}$

$e^{\frac{1}{2}\lim_{x\to 0}\left(\frac{a^x-1}{x}+\frac{b^x-1}{x}\right)}$

$e^{\frac{1}{2}(\ln a+\ln b)}=e^{\frac{1}{2}\ln(ab)}$

$=e^{\ln(ab)^{1/2}}=(ab)^{1/2}=\sqrt{ab}$

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Results Chain

1) $\lim_{x\to 0}\left(\frac{a^x+b^x}{2}\right)^{\frac{1}{x}} = (a\cdot b)^{1/2}$

2) $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x}{3}\right)^{\frac{1}{x}} = (a\cdot b\cdot c)^{\frac{1}{3}}$

3) $\lim_{x\to 0}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{\frac{1}{x}} = (a\cdot b\cdot c\cdot d)^{\frac{1}{4}}$

4) $\lim_{x\to 0}\left(\frac{a_1^x+a_2^x+\cdots+a_n^x}{n}\right)^{\frac{1}{x}} = (a_1\cdot a_2\cdot a_3\cdots a_n)^{1/n}$

5) $\lim_{x\to \infty}\left(\frac{a_1^{\frac{1}{x}}+a_2^{\frac{1}{x}}+\cdots a_n^{\frac{1}{x}}}{n}\right)^{x} = (a_1\cdot a_2\cdot a_3\cdots a_n)^{1/n}$

Q $\lim_{x\to\infty}\left(\frac{1^{\frac{1}{x}}+2^{\frac{1}{x}}+3^{1/x}+\cdots+n^{\frac{1}{x}}}{n}\right)^{x} = ?$

$= (1\cdot 2\cdot 3\cdots n)^{\frac{1}{n}} = (\lfloor n)^{\frac{1}{n}}$

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LIMIT

good

Q $\lim_{n\to\infty}\left(\left(\frac{n}{n+1}\right)^{\alpha}+\sin\left(\frac{1}{n}\right)\right)^{n}$ $n\in Q.$

$(1+0)^{\infty}$ form $\lim_{n\to\infty}\left(\frac{n}{n+1}\right)^{\alpha}\to\frac{E}{E}=(1)^{\alpha}=1$ $\lim_{n\to\infty}\sin\left(\frac{1}{n}\right)=\sin 0=0$

$$e^{\lim_{n\to\infty} n\left[\left(\frac{n}{n+1}\right)^{\alpha}+\sin\frac{1}{n}-1\right]}$$

$$e^{\lim_{n\to\infty} n\left[\left(\frac{(n+1)-1}{(n+1)}\right)^{\alpha}+\sin\frac{1}{n}-1\right]}$$

BT

$$e^{\lim_{n\to\infty} n\left[\left(1-\frac{1}{n+1}\right)^{\alpha}+\sin\frac{1}{n}-1\right]}$$

$$e^{\lim_{n\to\infty} n\left[\cancel{1}-\frac{\alpha}{n+1}+\sin\frac{1}{n}-\cancel{1}\right]}=e^{\lim_{n\to\infty}-\frac{n\alpha}{n+1}+n\cdot\sin\frac{1}{n}}=e^{-\alpha+\lim_{n\to\infty}\frac{\sin\left(\frac{1}{n}\right)}{\left(\frac{1}{n}\right)}}=e^{1-\alpha}$$

$\infty\times0$

$\infty\times\sin 0$

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Q $\lim\limits_{x\to\lambda}\left(2-\dfrac{\lambda}{x}\right)^{\lambda\cdot\tan\left(\frac{\pi x}{2\lambda}\right)} = \dfrac{1}{e}$ then $\lambda = ?$

$\to 1^{\infty}$

$$e^{\lim\limits_{x\to\lambda}\lambda\tan\left(\frac{\pi x}{2\lambda}\right)\left(2-\frac{\lambda}{x}-1\right)} = e^{-1}$$

$$e^{\lim\limits_{x\to\lambda}\lambda\tan\left(\frac{\pi x}{2\lambda}\right)\left(\frac{x-\lambda}{x}\right)} = e^{-1}$$

$\infty \times 0$

$$\lambda\lim_{x\to\lambda}\tan\left(\frac{\pi x}{2\lambda}\right)\left(\frac{x-\lambda}{x}\right) = -1$$

$$\lambda\lim_{x\to\lambda}\frac{\left(1-\frac{\lambda}{x}\right)}{\cot\left(\frac{\pi x}{2\lambda}\right)}\ \frac{0}{0} = -1$$

$$\boxed{\left(\frac{1}{x}\right)' \to -\frac{1}{x^2} \qquad \cot x \to -\operatorname{cosec}^2 x}$$

$$\lambda\lim_{x\to\lambda}\frac{\left(0+\frac{\lambda}{x^2}\right)}{-\frac{\pi}{2\lambda}\cdot\operatorname{cosec}^2\left(\frac{\pi x}{2\lambda}\right)} = \frac{\cancel{\lambda}\times\frac{\cancel{\lambda}}{\cancel{\lambda^2}}}{-\frac{\pi}{2\lambda}\operatorname{cosec}^2\left(\frac{\pi}{2}\right)} = \frac{1}{-\frac{\pi}{2\lambda}}$$

$$+\frac{2\lambda}{\pi} = +1 \leftarrow \text{given}$$

$$\boxed{\lambda = \frac{\pi}{2}}$$

$$\boxed{\cot\left(\frac{\pi x}{2\lambda}\right)' = -\operatorname{cosec}^2\left(\frac{\pi x}{2\lambda}\right)\times\frac{\pi}{2\lambda}\times 1}$$

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① $\lim_{x\to 0}\left(1+ax+bx^2\right)^{\frac{2}{x}} = e^3$ $\longrightarrow 1^\infty$ fu.

find a, b?

$$e^{\lim_{x\to 0}\frac{2}{x}\left(1+ax+bx^2-1\right)} = e^3$$

$$e^{2\lim_{x\to 0} a+bx} = e^3$$

$$e^{2a} = e^3$$

$a = \frac{3}{2}$ $b \in R$

0^0 & ∞^0 type

Step1 take $y = \lim_{x\to a} f(x)$

Step2 take log to Both the sides

Step3 → Solve RHS only & Dont forget to Remove log.

LIMIT

Q $\lim_{x \to 0} (x)^x \to 0^0$

(1) Let $y = \lim_{x \to 0} (x)^x$

(2) TLBTS.

$\log y = \lim_{x \to 0} x \log x \to 0 \times \infty$

$= \lim_{x \to 0} \frac{\log x}{\frac{1}{x}} \quad \frac{\infty}{\infty}$ DL

$\log y = \lim_{x \to 0} \frac{\frac{1}{x}}{-\frac{1}{x^2}} = -\frac{x^{\cancel{2}}}{\cancel{x}} = 0$

$y = e^0 = 1$

0^0 & ∞^0 type

Step1 take $y = \lim_{x \to a} f(x)$

Step2 take log to Both the sides

Step3 → Solve RHS only & Dont forget to Remove log.

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LIMIT

Q $\lim_{x\to 0} (x)^{\frac{1}{\sin x}} + \left(\frac{1}{x}\right)^{\sin x}$

$(0)^{\infty} = 0$, $0 + L = 1$

$\boxed{\infty^0}$ Indeterminate for.

here we have to find $\lim_{x\to 0} \left(\frac{1}{x}\right)^{\sin x}$ only.

$\ln\left(\frac{1}{x}\right) = \ln 1 - \ln x$
$= 0 - \ln x$

① $y = \lim_{x\to 0} \left(\frac{1}{x}\right)^{\sin x}$

② $\log_e y = \lim_{x\to 0} \sin x \cdot \ln\left(\frac{1}{x}\right)$

$= \lim_{x\to 0} -\underline{\sin x}\,\underline{\ln x}$ $\quad 0\times\infty$

$= \lim_{x\to 0} \frac{\ln x}{-\operatorname{cosec} x}$ $\frac{\infty}{\infty}$ DL $= +\lim_{x\to 0} \frac{\frac{1}{x}}{+\operatorname{cosec} x \cot x} = \lim_{x\to 0} \left(\frac{\sin x}{x}\right)(\tan x)$

$\ln y = 1 \times \tan 0 = 0 \Rightarrow y = e^0 = 1$

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LIMIT

Expansion Series (Rambaan ILaaj)

Taylor Series

$$f(x) = f(0) + \frac{f'(0)}{\lfloor 1}x + \frac{f''(0)}{\lfloor 2}x^2 + \frac{f'''(0)}{\lfloor 3}\cdot x^3 + \cdots$$

$f(x) = e^x \rightarrow f(0) = e^0 = 1$

$f'(x) = e^x \Rightarrow f'(0) = e^0 = 1$

$f''(x) = e^x \rightarrow f''(0) = e^0 = 1$

$f'''(x) = e^x \rightarrow f'''(0) = e^0 = 1$

1) $\boxed{e^x = 1 + \frac{x}{\lfloor 1} + \frac{x^2}{\lfloor 2} + \frac{x^3}{\lfloor 3} + \cdots}$

2) $\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} - \cdots \infty \rightarrow \lim_{x\to 0}\frac{\ln(1+x)}{x} = \lim_{x\to 0}\frac{\left(x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots\right)}{x} = \lim_{x\to 0}\frac{\cancel{x}\left(1 - \cancel{\frac{x}{2}} + \cancel{\frac{x^2}{3}} - \cancel{\cdots}\right)}{\cancel{x}}$

$= 1$

3) $\boxed{\sin x = x - \frac{x^3}{\lfloor 3}}\ + \frac{x^5}{\lfloor 5}$ $\quad \sin x < x$

(4) $\boxed{\cos x = 1 - \frac{x^2}{\lfloor 2} + \frac{x^4}{\lfloor 4}}$ $\quad \cos x < 1$

(5) $\boxed{\tan x = x + \frac{x^3}{3}}\ + \frac{2x^5}{15}$ $\quad \tan x > x$

(6) $(1+x)^{\frac{1}{x}} = e - \frac{e}{2}x + \frac{11e}{24}x^2 \longrightarrow$ Q. $\lim_{x\to 0}(1+x)^{\frac{1}{x}} = \lim_{x\to 0}\left(e - \cancel{\frac{ex}{2}} + \cancel{\frac{11e}{24}x^2} + \cancel{x} \cancel{\cdots}\right)$

$= e$

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Q $\lim_{x\to0} \frac{e^{x^3}-1-x^3}{\sin^6(2x)}$

1) $e^x = 1+\frac{x}{\lfloor 1}+\frac{x^2}{\lfloor 3}+\frac{x^3}{\lfloor 3}$

2) $\sin x = x-\frac{x^3}{3!}+\frac{x^5}{5!} \to (\sin 2x)^6 = \left(2x-\frac{(2x)^3}{\lfloor 3}\right)^6$

$\sin^2\theta = (\sin\theta)^2$

$\sin^6\theta = (\sin\theta)^6$

$\lim_{x\to0} \frac{\left(\cancel{1}+\cancel{\frac{x^3}{\lfloor 1}}+\frac{x^6}{\lfloor 2}\right)-\cancel{1}-\cancel{x^3}}{\left(2x-\frac{(2x)^3}{6}\right)^6} = \lim_{x\to0} \frac{\frac{\cancel{x^6}}{\lfloor 2}}{\cancel{x^6}\left(2-\cancel{\frac{(2x)^3}{6x}}\right)^6} = \frac{\frac{1}{2}}{(2)^6} = \frac{1}{2^7} = \frac{1}{128}$

Q $\lim_{x\to0} \frac{\tan x-\sin x}{x^3} = \lim_{x\to0} \frac{\left(\cancel{x}+\frac{x^3}{3}\right)-\left(\cancel{x}-\frac{x^3}{\lfloor 3}\right)}{x^3} = \frac{\cancel{x^3}\left(\frac{1}{3}+\frac{1}{6}\right)}{\cancel{x^3}} = \frac{1}{2}$

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$a-b=-1$ | $b=a+1$

$-3a+b=6$ | $-2a=5$

Expansion Method mostly usable in Qs having Unknown.

Q $\lim_{x\to 0} \dfrac{a\cdot e^{x}-b\cos x+c\,e^{-x}}{x\cdot \sin x}=2 \quad a,b,c=?$

$x\cdot x = x^2$

$\lim_{x\to 0} \dfrac{a\left(1+x+\frac{x^2}{2}\right)-b\left(1-\frac{x^2}{2}\right)+c\left(1-x+\frac{x^2}{2}\right)}{x^2}=2$

$\lim_{x\to 0} \dfrac{a-b+c}{x^2}+\dfrac{x(a-c)}{x^2}+\dfrac{x^2\left(\frac{a}{2}+\frac{b}{2}+\frac{c}{2}\right)}{\cancel{x^2}}=2$

$a-b+c=0 \rightarrow b=2a=2$ | $\frac{a}{2}+\frac{b}{2}+\frac{c}{2}=2$

$a-c=0 \Rightarrow a=c=1$ | $a+2a+a=4 \Rightarrow \boxed{a=1}$

$a=1$

$b=2$

$c=1$

$\lim_{x\to 0} \dfrac{x(1+a\cos x)-b\sin x}{x^3}=1 \quad a,b?$

$-5/2,\ -3/2$

$\lim_{x\to 0} \dfrac{x\left(1+a\cdot\left(1-\frac{x^2}{2}\right)\right)-b\left(x-\frac{x^3}{6}\right)}{x^3}=1$

$\lim_{x\to 0} \dfrac{x\left(1+a-\frac{ax^2}{2}\right)-bx+\frac{bx^3}{6}}{x^3}=1$

$\lim_{x\to 0} \dfrac{x(1+a-b)+x^3\left(-\frac{a}{2}+\frac{b}{6}\right)}{x^3}=1$

$\lim_{x\to 0} \dfrac{(1+a-b)}{x^2}+\dfrac{\cancel{x^3}\left(-\frac{a}{2}+\frac{b}{6}\right)}{\cancel{x^3}}=1$

$1+a-b=0$ | $-\frac{a}{2}+\frac{b}{6}=1$

LIMIT

Q $\lim_{n\to\infty} n^2 \left\{ \sqrt{\left(1-\cos\frac{1}{n}\right)\sqrt{\left(1-\cos\frac{1}{n}\right)\sqrt{\left(1-\cos\frac{1}{n}\right)\cdots\infty}}} \right\}$

$\downarrow 1/2 \qquad 1/4 \qquad 1/8.$

$\lim_{n\to\infty} n^2 \left(1-\cos\frac{1}{n}\right)^{1/2} \cdot \left(1-\cos\frac{1}{n}\right)^{1/4} \left(1-\cos\frac{1}{n}\right)^{1/8} \cdots\infty$

$\lim_{n\to\infty} n^2 \times \left(1-\cos\frac{1}{n}\right)^{\frac{1}{2}+\frac{1}{4}+\frac{1}{8}\cdots\infty}$ $\rightarrow \infty$ GP का Sum $= 1$

$\lim_{n\to\infty} n^2 \left(1-\cos\frac{1}{n}\right) = \lim_{n\to\infty} \frac{1-\cos\left(\frac{1}{n}\right)}{\left(\frac{1}{n}\right)^2} = \frac{1}{2}$

$\downarrow$

$\infty \times (1-\cos 0) = \infty \times 0$

Q

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20 1. $\lim_{x\to 0} \frac{|\cos(\sin(3x))|-1}{x^2}$ equals

(A) $\frac{-9}{2}$ (B) $\frac{-3}{2}$ (C) $\frac{3}{2}$ (D) $\frac{9}{2}$

21 2. Let $a = \min\{x^2+2x+3, x \in R\}$ and $b = \lim_{\theta\to 0} \frac{1-\cos\theta}{\theta^2}$. then value of $\sum_{r=0}^{n} a^r \cdot b^{n-r}$ is :

(A) $\frac{2^{n+1}-1}{3.2^n}$ (B) $\frac{2^{n+1}+1}{3.2^n}$ (C) $\frac{4^{n+1}-1}{3.2^n}$ (D) none of these

(21)

$(x^2+2x+1+2)$

$\boxed{(x+1)^2}+2$

Min = 2

$\sum_{r=0}^{n} 2^r \cdot \left(\frac{1}{2}\right)^{n-r}$

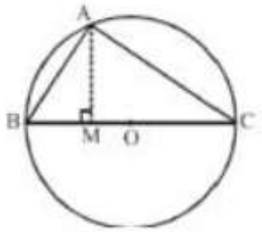
$\sum 2^r \cdot 2^{r-n}$

$\sum_n 2^r \cdot 2^r \cdot (2^{-n})$

$\frac{1}{2^n}\sum_{r=0} 4^r = \frac{1}{2^n}(4^0+4^1+4^2 \cdots 4^n)$

$= \frac{1\cdot(4^{n+1}-1)}{(4-1)\times 2^n}$

3. Let BC is diameter of a circle centred at O. Point A is a variable point, moving on the circumference of circle. if BC = 1 unit, then $\lim_{A\to B} \frac{BM}{(\text{Area of sector OAB})^2}$ is equal to -



(A) 1 (B) 2 (C) 4 (D) 16

4. $\lim_{x\to\infty} \left(\frac{x^2-2x+1}{x^2-4x+2}\right)^x$ is equal to

(A) 1 (B) e (C) $\frac{1}{e^2}$ (D) e^2

5. $\lim_{x\to 0} (1+\sin x)^{\cos x}$ is equal to

(A) 0 (B) e (C) 1 (D) $\frac{1}{e}$

6. $\lim_{x\to 0} (\cos x + a\sin bx)^{1/x}$ is equal to :

(A) e^a (B) e^{ab} (C) e^b (D) $e^{a/b}$

7. $\lim_{x\to 0} \left(\tan\left(\frac{\pi}{4}+x\right)\right)^{1/x}$ is equal to

(A) e^{-2} (B) $\frac{1}{e}$ (C) e (D) e^2

8. $\lim_{n\to\infty} (4^n+5^n)^{1/n}$ is equal to

(A) 5 (B) 4 (C) 0(D) D.N.E.

9. $\lim_{x\to\infty} \left(\frac{1^{1/x}+2^{1/x}+3^{1/x}+\cdots+n^{1/x}}{n}\right)^{nx}$ is equal to

(A) n ! (B) 1 (C) $\frac{1}{n!}$ (D) 0

10. If $\lim_{x\to\lambda} \left(2-\frac{\lambda}{x}\right)^{\lambda\tan\left(\frac{\pi x}{2\lambda}\right)} = \frac{1}{e}$, then λ is equal to -

(A) $-\pi$ (B) π (C) $\frac{\pi}{2}$ (D) $-\frac{2}{\pi}$

11. If $\lim_{x\to 0} (1+ax+bx^2)^{2/x} = e^3$, then

(A) $a = \frac{3}{2}$ and $b \in R$ (B) $a = \frac{3}{2}$ and $b \in R^+$

(C) $a = 0$ and $b = 1$ (D) $a = 1$ and $b = 0$

12. If f(x) is a polynomial of least degree, such that $\lim_{x\to 0} \left(1+\frac{f(x)+x^2}{x^2}\right)^{1/x} = e^2$, then f(2) is -

(A) 2 (B) 8 ss(C) 10 (D) 12

13. Let $f(x) = \frac{\tan x}{x}$, then the value of $\lim_{x \to 0}\left([f(x)] + x^2\right)^{\frac{1}{\{f(x)\}}}$ is equal to (where [], . {.}denotes greatest integer function and fractional part function respectively)-

(A) e^{-3} (B) e^3 (C) e^2 (D) non-existent

14. $\lim_{n \to \infty} \frac{e^n}{\left(1+\frac{1}{n}\right)^{n^2}}$ equals -

(A) 1 (B) $\frac{1}{2}$ (C) e (D) $\sqrt{e}$

15. If f(x) is odd linear polynomial with $f(1) = 1$, then $\lim_{x \to 0} \frac{2^{f(\text{ttan } x)} - 2^{f(\sin x)}}{x^2 f(\sin x)}$ is :

(A) 1 (B) $\ell n2$ (C) $\frac{1}{2}\ell n2$ (D) $\cos 2$

16. $\lim_{x \to 0} \frac{x(1+a\cos x) - b\sin x}{x^3} = 1$ then

(A) $a = -5/2$ (B) $a = -3/2, b = -1/2$

(C) $a = -3/2, b = -5/2$ (D) $a = -5/2, b = -3/2$

17. $\lim_{h \to 0} \frac{\sin(a+3h) - 3\sin(a+2h) + 3\sin(a+h) - \sin a}{h^3}$ is equal to

(A) $\cos a$ (B) $-\cos a$ (C) $\sin a$ (D) $\sin a \cos a$

18. $\lim_{x \to \frac{\pi}{2}} \tan^2 x\left(\sqrt{2\sin^2 x + 3\sin x + 4} - \sqrt{\sin^2 x + 6\sin x + 2}\right)$ is equal to

(A) $\frac{3}{4}$ (B) $\frac{1}{6}$ (C) $\frac{1}{12}$ (D) $\frac{5}{12}$

19. $\lim_{x \to +\infty} x\left(\arctan \frac{x+1}{x+2} - \arctan \frac{x}{x+2}\right)$ is equal to

(A) $\frac{1}{2}$ (B) $-\frac{1}{2}$ (C) 1 (D) D.N.E.