The Examination Paper of Jinan University

For Instructor Only	**Academic Year : 20 22 –20 23 Semester: 1st [✓]2nd[ ]** **Course Title: Advanced Mathematics I** **Date of the Examination 26/12/2022** **Instructor's Name Lianghui Xia**	**Course Type** **Compulsory[✓]** **Elective [ ]** **Form of the Examination** **Open-book [ ]** **Closed-book [✓]** **Paper A[✓] Paper B [ ]** **Total Pages 7**
For Student Only	**School/College** _____ **Major** _____ **Name** _____ **Student No.** _____ **Mainland Student [ ] Non-mainland Student [ ]**	

Section No.	I	II	III	IV	V	VI	VII	VIII	**Total Score**
Score									
Evaluator									

Score	Section I: Filling blanks (There are 8 questions, each question is 3 marks, the total score of this section is 24 marks)

1. $\lim\limits_{x\to 0}\dfrac{x+x\cos x}{\sin x\cos x}=$_____ .

2. The domain of the function $f(x)=\sqrt{4-x^2}+\ln(x^2-1)$ is _____.

3. The discontinuous points of the function $f(x)=\dfrac{x-1}{x^2-3x+2}$ are_____

4. $\lim\limits_{x\to\infty}\left(\dfrac{x}{1+x}\right)^x=$_____

5. The horizontal asymptote of the curve $y=\dfrac{x^2+2x-3}{2x^2-x+1}$ is _____

6. $\int(\frac{1}{x}-\cos x+x-\frac{1}{\sqrt{1-x^2}}+2)dx=$_____

7. If $f'(x_0)=5$, then $\lim\limits_{\varepsilon\to 0}\frac{f(x_0-3\varepsilon)-f(x_0)}{5\varepsilon}=$_____.

8. The vertical asymptote of the curve $f(x)=\frac{-2x-4}{x^3+2x^2}$ is_____

Score	Section II: Choice questions (There are 10 questions, each question has four choices, but only one is true, choose the one which is true, each question is 2 marks, and the total score of this section is 20 marks)

1. If $f(x)=\begin{cases}x^2\sin\frac{1}{x}, & x\neq 0\\ 0, & x=0\end{cases}$, then at $x=0$, $f(x)$ is ( )

A. discontinuous; B. continuous but non-differentiable;

C.continuous and differentiable; D. discontinuous but differentiable.

2. For the following limits, ( ) exists

A. $\lim\limits_{x\to 0}\frac{1}{e^x-1}$; B. $\lim\limits_{x\to\infty}\frac{x^2}{1-x^2}$; C. $\lim\limits_{x\to\infty}\sin x$; D. $\lim\limits_{x\to 0}e^{\frac{1}{x}}$.

3. If $f(x)=\begin{cases}x\sin\frac{1}{x}, & x>0\\ \ln(a+x^2), & x\leq 0\end{cases}$ is continuous on $(-\infty,+\infty)$, then $a=$( )

A. 3; B. 2; C. 1; D. 0

4. $\lim\limits_{n\to\infty}\left(\frac{n-2}{n+1}\right)^n=$( )

A. e; B. e^{-1}; C. e^{-2}; D. e^{-3}

5. If $f(x)$ is differentiable at $x=a$, then $f'(a)=$ ( )

A. $\lim\limits_{h\to 0}\frac{f(a)-f(a+h)}{h}$; B. $\lim\limits_{h\to 0}\frac{f(a-h)-f(a)}{h}$;

C. $\lim\limits_{h\to 0}\frac{f(a+2h)-f(a)}{h}$; D. $\lim\limits_{h\to 0}\frac{f(a+2h)-f(a+h)}{h}$.

6. If $f(x)$ satisfies $\lim\limits_{x\to 1}\frac{f(x)}{\ln x}=1$, then ( )

A. $f(1)=0$; B. $\lim\limits_{x\to1}f(x)=0$; C. $f'(1)=1$; D. $\lim\limits_{x\to1}f'(x)=1$

7. If $y=x^x$, then $y'=$( )

A. x^{x-1}; B. $x^x\ln x$; C. $x^x(\ln x+1)$; D. $x^x\left(\frac{1}{x}+\ln x\right)$

8. If the derivative of $y=f(x)$ is continuous, and $\lim\limits_{x\to a}\frac{f'(x)}{x-a}=2$, then ( )

A. $f(x)$ has a local maximum at $x=a$;

B. $f(x)$ has a local minimum at $x=a$;

C. $(a,\ f(a))$ is an inflection point;

D. there is no local extremum at $x=a$.

9. If $\int xf(x)dx=e^{-x^2}+C$, then $f(x)=$( )

A. xe^{-x^2}; B. $-xe^{-x^2}$; C. $-2e^{-x^2}$; D. $2e^{-x^2}$.

10. $\int\frac{1}{1-\sqrt{x}}dx=$( )

A. $\sqrt{x}-\ln(1-\sqrt{x})+C$; B. $-2\left(\sqrt{x}+\ln(1-\sqrt{x})\right)+C$;

C. $\sqrt{x}+\ln(1-\sqrt{x})+C$; D. $2\left(\sqrt{x}-\ln(1-\sqrt{x})\right)+C$.

Score	Section III: Calculation (There are 7 questions, each question is 6 marks, the total score of this section is 42 marks)

1. Find $\lim\limits_{x\to9}\frac{\sqrt{x}-3}{x-9}$

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2. Find $\lim\limits_{n\to\infty}\left(\frac{1}{n^2+\pi}+\frac{2}{n^2+2\pi}+\cdots+\frac{n}{n^2+n\pi}\right)$

3. Find the derivative of $h(\mathrm{x})=\left(\frac{1}{x^2}-5\right)^{-2}$.

4. Given $y-xy^2+x^2+1=0$. Find y'.

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5. Find $\lim\limits_{x\to 1}\left(\dfrac{x}{x-1}-\dfrac{1}{\ln x}\right)$.

6. Find $\int \dfrac{1}{1+e^{x}}dx$.

7. Find $\int x\arctan x dx$.

Student name: _____Student No._____

Score	Section IV: Application problems (There are two questions, each one is 7 marks, the total score of this section is 14 marks.)

1. (7 marks) For $f(x) = x^3(x+2)$

(1) Find all critical points.

(2) Find the open intervals on which the function is increasing and decreasing. Identify the function's local extreme values, if any, saying where they occur.

(3) Find where the graph of f is concave up and where it is concave down.

(4) Find all inflection points.

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2. (7 marks) Find the volume of the largest right circular cone that can be inscribed in a sphere of radius 3.