Homework 9

The **due date** for this homework is **Tue 7 May 2013 12:00 AM EDT**.

Question 1

$$\lim_{x \to +\infty} \frac{x^2 + x + 1}{x^4 - 3x^2 + 2} =$$

- $+\infty$
- $-\infty$
- $\frac{1}{2}$
- 0
- $-\frac{1}{3}$
- 1

Question 2

$$\lim_{x \to +\infty} \frac{6x^2 - 3x + 1}{3x^2 + 4} =$$

- $\frac{1}{4}$
- $-\infty$
- 2
- $\frac{1}{3}$
- $+\infty$
- 0

Question 3

$$\lim_{x \to +\infty} \frac{(x^2 - 3)(x^2 + 3)}{2x^4 - 2x^2 + 1} =$$

- 0
- $+\infty$
- -9
- The limit does not exist.
- 1
- $\frac{1}{2}$

Question 4

$$\lim_{x \to +\infty} \frac{e^{2x}}{x^3 + 3x^2 + 4} =$$

- e^2
- 0
- $\frac{1}{3}$
- $+\infty$
- $\frac{1}{4}$
- $-\infty$

Question 5

$$\lim_{x \to +\infty} \frac{\ln x}{\sqrt{x}} =$$

- $\ln 2$
- $\sqrt{2}$

- 1
- $-\infty$
- 0
- $+\infty$

Question 6

$$\lim_{x \to +\infty} \frac{x^3 \ln x}{e^x} =$$

- $+\infty$
- The limit does not exist.
- 1
- e^{-1}
- $-\infty$
- 0

Question 7

$$\lim_{x \to +\infty} \frac{e^{x^2}}{e^{3x}} =$$

- 0
- $+\infty$
- $e^{-1/3}$
- e
- The limit does not exist.
- $\frac{1}{3}$

Question 8

$$\lim_{x \to +\infty} \frac{e^x (x-1)!}{x!} =$$

- 0
- e
- $+\infty$
- 1
- e^x
- e

Question 9

$$\lim_{x \to +\infty} \frac{(x+1)!}{2^x + 1} =$$

- $-\infty$
- $+\infty$
- 1
- $\frac{1}{2}$
- 0
- 2

Question 10

Evaluate the following limit, where n is a positive integer: $\lim_{x \to +\infty} \frac{(3 \ln x)^n}{(2x)^n}$.

- $\frac{3^n}{2^n}$

- 3
- $\frac{3}{2}$
- 0
- 2
- $+\infty$

Question 11

Which of the following are in $O(x^2)$ as $x \to 0$? Select all that apply.

Hint: remember $O(x^2)$ consists of those functions which go to zero at least as quickly as Cx^2 for some constant C.

- $\sinh x$
- $\sin x^2$
- $5x$
- $\ln(1+x)$
- $5x^2 + 3x^4$
- $\sqrt{x + 3x^4}$

Question 12

Which of the following are in $O(x^2)$ as $x \to +\infty$? Select all that apply.

Hint: recall $O(x^2)$ consists of those functions that are $\leq Cx^2$ for some constant C as $x \to +\infty$.

- $\ln(x^{10} + 1)$
- $\arctan x^2$
- $\sqrt{x^5 - 2x^3 + 1}$

- $5\sqrt{x^2+x-1}$
- $x^3-5x^2-11x+4$
- $e^{\sqrt{x}}$

Question 13

Simply the following asymptotic expression:

$$f(x)=\left(x-x^2+O(x^3)\right)\cdot\left(1+2x+O(x^3)\right)$$

(here, the big-O means as $x\to 0$)

Hint: do not be intimidated by the notation; simply pretend that $O(x^3)$ is a cubic monomial in x and use basic multiplication of polynomials.

- $f(x)=x+x^2+O(x^4)$
- $f(x)=x+x^2+O(x^3)$
- $f(x)=1+x+x^2+O(x^3)$
- $f(x)=1+3x-x^2+O(x^3)$
- $f(x)=x+x^2-2x^3+O(x^6)$
- $f(x)=x+x^2-2x^3+O(x^3)$

Question 14

Simplify the following asymptotic expression:

$$f(x)=\left(x^3+2x^2+O(x)\right)\cdot\left(1+\frac{1}{x}+O\left(\frac{1}{x^2}\right)\right)$$

(here, the big-O means as $x\to+\infty$)

Hint: do not be intimidated by the notation! Pretend that $O(x)$ is of the form Cx for some C and likewise with $O(1/x^2)$. Multiply just like these are polynomials,

then simplify at the end.

- $f(x) = x^3 + 2x^2 + O(x)$
- $f(x) = x^3 + 3x^2 + 2x + O(x) + O(1) + O(\frac{1}{x})$
- $f(x) = x^3 + 3x^2 + 2x + O(x)$
- $f(x) = x^3 + 3x^2 + O(x)$
- $f(x) = x^3 + 3x^2 + 2x + O(\frac{1}{x})$

☐ In accordance with the Honor Code, I certify that my answers here are my own work.

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