UNIVERSITY OF VICTORIA Last name:_____

**MATH 120: Precalculus Mathematics** First name:_____

**Final exam** April 10, 2018 V number:_____

Lecturer: Jephian Lin
[A01 - CRN 21993]
Contents: cover page,
**11 pages** of questions,
blue instructions page at the end
To be answered: on the test paper
Duration: **180 minutes**

| Page | Points | Score |
|---|---|---|
| 1 | 7 | |
| 2 | 5 | |
| 3 | 6 | |
| 4 | 3 | |
| 5 | 3 | |
| 6 | 3 | |
| 7 | 6 | |
| 8 | 3 | |
| 9 | 8 | |
| 10 | 8 | |
| 11 | 4 | |
| Total | 56 | |

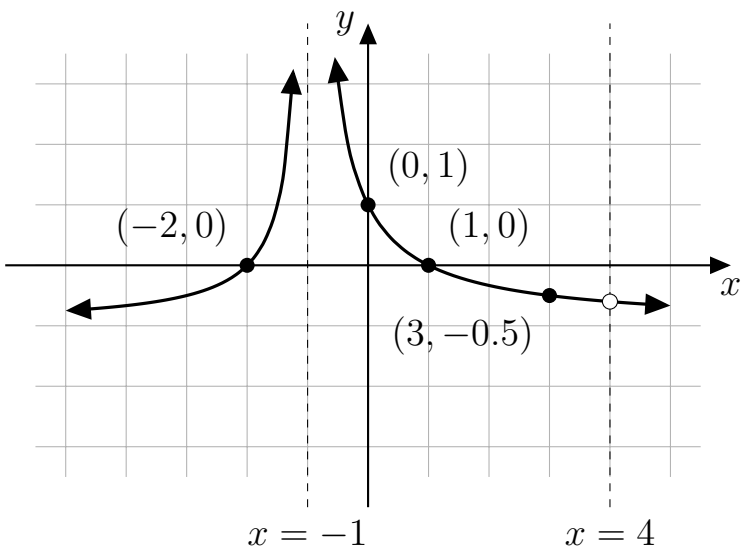
---

**Do not open this packet until instructed to do so.**

Instructions:

- Enter your **Name** and **V number** before you start.
- Sign the **blue instruction page** now.
- The only calculator permitted is the Sharp EL-510R, EL-510RN or EL-510RNB. No other electronic devices are permitted.
- Any work necessary to arrive at an answer must be shown on the examination paper. Marks will not be given for final answers that are not supported by appropriate work.
- Clearly indicate your final answer to each question either by **underlining it or circling it**. If multiple answers are shown then no marks will be awarded.

1. Let $f(x)$ be the function with the graph below.




(a) [1pt] Find $f(1)$ and $f(3)$.

(b) [1pt] Find the value(s) of $x$ where $f(x)$ is not defined.

(c) [1pt] Find the $y$-intercept.

(d) [1pt] Find the $x$-intercept(s).

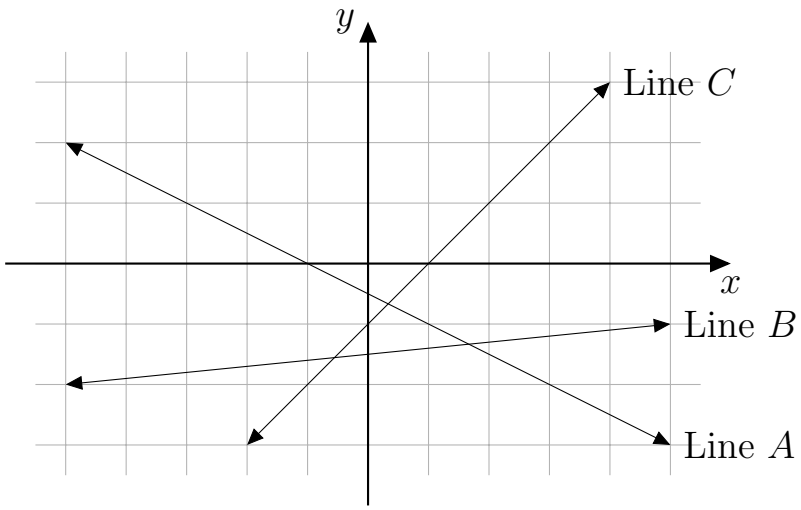
(e) [1pt] Solve $f(x) > 0$ and give your answer in interval notation.

(f) [1pt] Find the intervals(s) on which $f(x)$ increasing.

(g) [1pt] Does this function have an inverse? Give a brief reason for your answer.

2. [1pt] Find the equation of the line with slope 5 that passes through $(3, 2)$.

3. [1pt] Let $A$, $B$, $C$ be the three lines drawn below.




Let $m_A$, $m_B$, and $m_C$ be the slopes of Line $A$, Line $B$, and Line $C$, respectively. Find the order of them. That is, fill in the blanks with $m_A$, $m_B$, and $m_C$.

$$\_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_$$

4. [1pt] Let $f(x) = x^2$. Compute and expand $f(x - 1)$.

5. [2pt] Let $h(x) = (x^2 + 1)^3 + (x^2 + 1)^6$. Find $f(x)$ and $g(x)$ such that $h(x) = f(g(x))$.

6. Let $f(x) = x^2 - 2x - 3$.

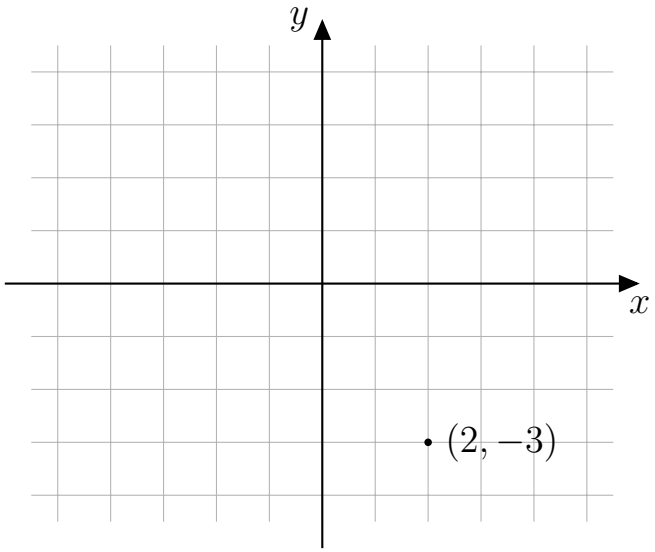
   (a) [1pt] Write $f(x)$ in vertex form. That is, find $p$ and $q$ such that

   $$f(x) = (x + p)^2 + q.$$

   (b) [1pt] Find the minimum of $f(x)$. Also, find the value of $x$ at which this minimum occurs.

   (c) [1pt] Find all the roots of $f(x)$.

   (d) [2pt] Plot the function $f(x)$. [One point has been plotted for you.]




   (e) [1pt] Solve $f(x) < 0$ and give your answer in interval notation.

7. [3pt] Let $f(x) = x^3 - 3x^2 + x + 5$. Given that $x = -1$ is one of the roots, find the other two (imaginary) roots.

8. Let $f(x) = \dfrac{(x-3)(x+2)}{(x+1)(x+2)}$.

(a) [1pt] Find all value(s) of $x$ where $f(x) = 0$.

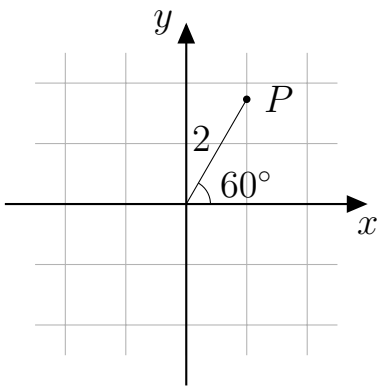
(b) [1pt] Find all value(s) of $x$ where $f(x)$ is not defined.

(c) [1pt] When $x$ is very close to $-2$, the value of $f(x)$ will be very close to the number _____. [You may use your calculator to guess an answer.]

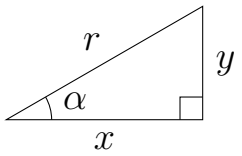
9. [1pt] Find an angle $\alpha$ such that $\sin(\alpha) = \cos(\alpha)$ with $0° \leq \alpha \leq 90°$. [There is only one solution; try the special angles you know.]

10. [1pt] Find a value $x$ such that $\arcsin(x) = \arccos(x)$. [There is only one solution; think about Problem 9.]

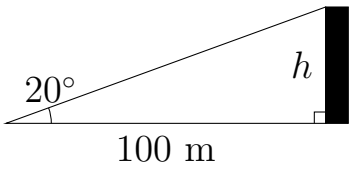
11. [1pt] The point $P$ is on the terminal side of $60°$ and of distance 2 to the origin; see the graph below. Find the coordinates of $P$.



12. [2pt] Suppose $x = 8$, $y = 6$, and $\alpha$ is an acute angle. Find the values of $r$, $\sin(\alpha)$, $\cos(\alpha)$, and $\tan(\alpha)$.




13. [2pt] Use the information given in the picture below to find the height $h$ of the building. [Approximately, $\sin(20°) = 0.34202$, $\cos(20°) = 0.93969$, and $\tan(20°) = 0.36397$; round your answer to the nearest hundredth.]




14. [2pt] Use your calculator to solve $\tan(\alpha) = 2$ with $180° \leq \alpha \leq 270°$. [Round your answer to the nearest hundredth.]

15. Consider the formulas

$$\sin(\alpha - \beta) = \sin(\alpha)\cos(\beta) - \cos(\alpha)\sin(\beta)$$
$$\cos(\alpha - \beta) = \cos(\alpha)\cos(\beta) + \sin(\alpha)\sin(\beta).$$

(a) [2pt] Use the formulas with $\alpha = 45^\circ$ and $\beta = 30^\circ$ to find the exact values of $\sin(15^\circ)$ and $\cos(15^\circ)$. [You don't have to rationalise your answers, but numerical answers are not accepted.]

(b) [1pt] Use part (a) to find the exact values of $\cos(165^\circ)$ and $\sin(165^\circ)$. [Numerical answers are not accepted.]

16. [1pt] Find the values of $9^{-\frac{1}{2}}$ and $8^{\frac{2}{3}}$.

17. [1pt] Find the values of $\log_9(\frac{1}{3})$ and $\log_8(4)$.

18. [2pt] Determine the sign (positive or negative) of each of $e^4$, $e^{-3}$, $-e^2$, and $-e^{-1}$.

19. [1pt] Solve $e^{x^2-1} = 0$. [If there is no solution to this equation, you may write "no solution".]

20. [1pt] Provided that $\pi = 3.14\cdots$, $\pi^2 = 9.89\cdots$, and $\pi^3 = 31.00\cdots$, find the integer part of $\log_\pi(10)$.

21. [2pt] A bank offers a certificate deposit (CD) with 2.4% annual interest rate, and the interest is compounded monthly. Suppose you purchased \$1000 of this CD for 5 years. What is your ending balance? [Round your answer to the nearest hundredth.]

22. [1pt] Use your calculator to find $\log_{1.1}(2)$. [Round your answer to the nearest hundredth.]

23. [2pt] Solve $2^{3x+1} = 1024$.

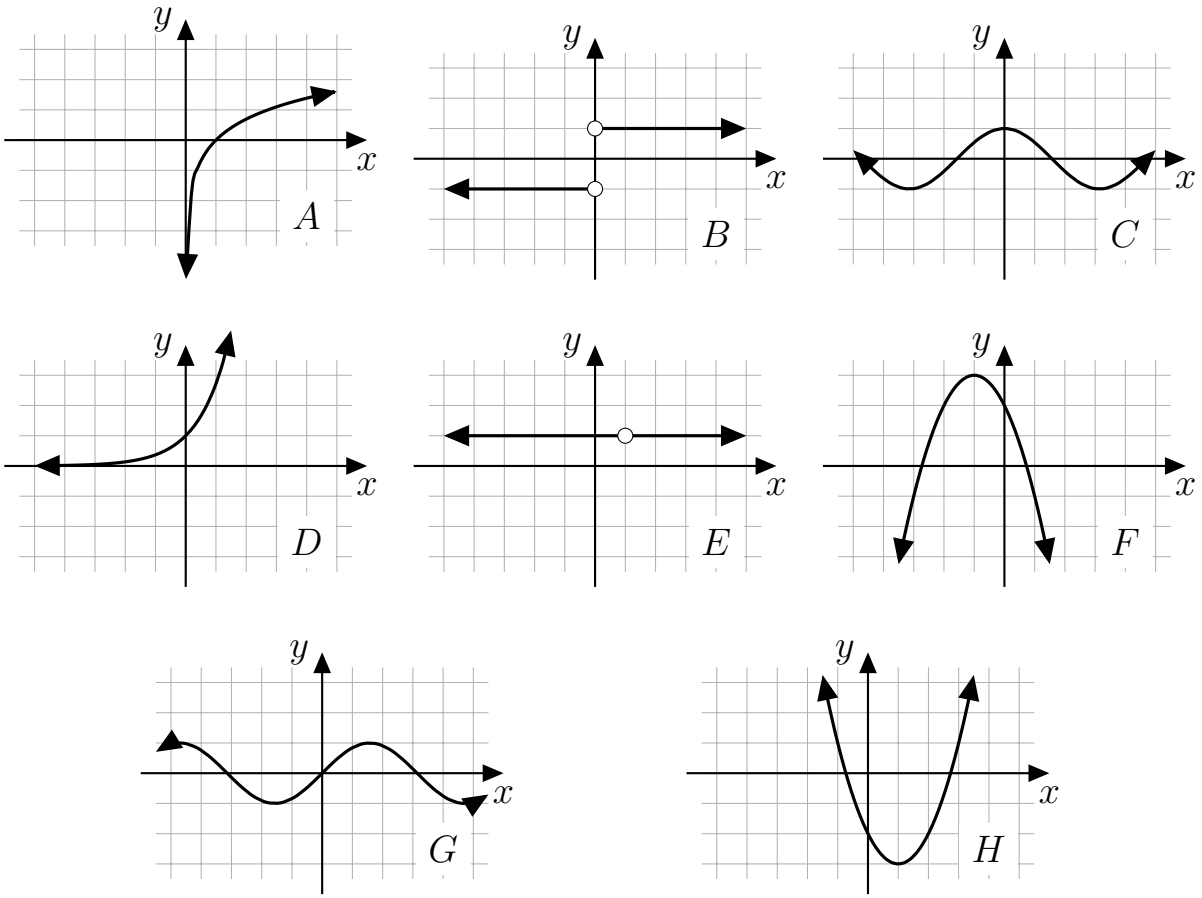
24. [2pt] Solve $\ln(x^3) - \ln(x^2) = 2$.

25. [3pt] Solve $2^{5x+1} = 3^{2x+3}$. [Hint: First apply ln to both sides.]

26. [4pt] Match the graphs to the functions by writing the appropriate letter ($A$–$H$) in the blank.

| function | graph |
|---|---|
| $\ln(x)$ | |
| $e^x$ | |
| $(x-1)^2-3$ | |
| $-(x+1)^2+3$ | |

| function | graph |
|---|---|
| $\sin(x)$ | |
| $\cos(x)$ | |
| $\frac{x-1}{x-1}$ | |
| $\frac{\lvert x\rvert}{x}$ | |




**[END]**