MA 109 — College Algebra FINAL EXAM	FALL 2006 12/12/2006	Name: Answer Key	Sec.: ______

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use a graphing calculator during the exam, but NO calculator with a Computer Algebra System (CAS) or a QWERTY keyboard is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of 20 multiple choice questions worth 5 points each. Record your answers on this page by filling in the box corresponding to the correct answer. For example, if (b) is correct, you must write

a **[b]** c d e

Do not circle answers on this page, but please do circle the letter of each correct response in the body of the exam. It is your responsibility to make it CLEAR which response has been chosen. You will not get credit unless the correct answer has been marked on both this page and in the body of the exam.

GOOD LUCK!

1.	a **[b]** c d e	**11.**	a b c d **[e]**
2.	a b **[c]** d e	**12.**	a **[b]** c d e
3.	**[a]** b c d e	**13.**	a b **[c]** d e
4.	**[a]** b c d e	**14.**	a b **[c]** d e
5.	a **[b]** c d e	**15.**	a b c d **[e]**
6.	**[a]** b c d e	**16.**	**[a]** b c d e
7.	a b **[c]** d e	**17.**	a **[b]** c d e
8.	a b c **[d]** e	**18.**	a **[b]** c d e
9.	a **[b]** c d e	**19.**	a b c d **[e]**
10.	a b c **[d]** e	**20.**	a b c **[d]** e

For grading use:

Total	
	(out of 100 pts)

Please make sure to list the correct section number on the front page of your exam.
In case you forgot your section number, consult the following table:

Section #	Instructor	Lectures
001	R. Cox	MWF 8:00am-8:50am, CP 320
002	S. Speakman	MWF 8:00am-8:50am, CB 337
003	S. Speakman	MWF 9:00am-9:50am, CB 337
004	T. Burus	MWF 9:00am-9:50am, FB 213
005	Y. Shin	MWF 10:00am-10:50am, CB 337
006	P. Busse	MWF 10:00am-10:50am, FB 213
007	W. Guo	MWF 10:00am-10:50am, CB 349
008	W. Guo	MWF 11:00am-11:50am, CB 337
009	P. Busse	MWF 11:00am-11:50am, FB 213
010	T. Jiang	MWF 12:00pm-12:50pm, CB 337
011	J. Askew	MWF 12:00pm-12:50pm, FB 213
012	Y. Shin	MWF 12:00pm-12:50pm, CB 213
013	J. Askew	MWF 1:00pm-1:50pm, FB 213
014	E. Stokes	MWF 1:00pm-1:50pm, CP 183
015	E. Stokes	MWF 2:00pm-2:50pm, CB 337
017	T. Jiang	MWF 2:00pm-2:50pm, CB 243
018	T. Burus	MWF 3:00pm-3:50pm, CB 337
020	J. Robbins	MWF 3:00pm-3:50pm, CP 320
021	D. Wells	TR 8:00am-9:15am, CB 337
023	P. Zhang	TR 8:00am-9:15am, CB 341
024	D. Wells	TR 9:30am-10:45am, CB 339
025	P. Zhang	TR 9:30am-10:45am, CB 341
027	B. Strassner	TR 11:00am-12:15pm, CB 341
028	D. Harrison	TR 11:00am-12:15pm, CB 345
030	B. Strassner	TR 12:30pm-1:45pm, CB 341
031	E. Clark	TR 12:30pm-1:45pm, CB 345
032	D. Harrison	TR 12:30pm-1:45pm, CP 183
033	R. Bai	TR 2:00pm-3:15pm, CB 341
034	E. Clark	TR 2:00pm-3:15pm, CB 345
035	A. Bagchi Misra	TR 2:00pm-3:15pm, CB 217
036	R. Bai	TR 3:30pm-4:45pm, CB 341
038	A. Bagch Misra	TR 3:30pm-4:45pm, CB 237
039	D. Leep	MWF 9:00am-9:50am, BS 116
040	A. Corso	TR 8:00am-9:15am, CB 114
401	C. Norman	TR 6:00pm-7:15pm, CB 337
402	C. Norman	TR 7:30pm-8:45pm, CB 337
403	B. Vanderpool	TR 6:00pm-7:15pm, CB 341
404	B. Vanderpool	TR 7:30pm-8:45pm, CB 341

Formula Sheet:

Compound Interest: If a principal P is invested at an interest rate r for a period of t years, then the amount $A(t)$ of the investment is given by:

$$A(t) = P\left(1+\frac{r}{n}\right)^{nt} \quad \text{(if compounded } n \text{ times per year)}$$

$$A(t) = P\,e^{rt} \quad \text{(if compounded continuously).}$$

Exponential Growth Model If n_0 is the initial size of a population that experiences **exponential growth**, then the population $n(t)$ at time t increases according to the model:

$$\boxed{n(t) = n_0 e^{rt}}$$

where r is the relative rate of growth of the population (expressed as a proportion of the population).

Radioactive Decay Model: If m_0 is the initial mass of a radioactive substance with half-life h, then the mass $m(t)$ remaining at time t is modeled by the function:

$$\boxed{m(t) = m_0 e^{-rt}}$$

where $r = \dfrac{\ln 2}{h}$.

Newton's Law of Cooling: If D_0 is the initial temperature difference between an object and its surroundings, and if its surroundings have temperature T_S, then the temperature of the object at time t is modeled by the function:

$$\boxed{T(t) = T_S + D_0 e^{-kt}}$$

where k is a positive constant that depends on the object.

The pH Scale: Chemists measured the acidity of a solution by giving its hydrogen ion concentration until Sorensen, in 1909, defined a more convenient measure:

$$\boxed{\text{pH} = -\log[H^+]}$$

where $[H^+]$ is the concentration of hydrogen ions measured in moles per liter (M).
Solutions are defined in terms of the pH as follows:

those with pH $= 7$ (or $[H^+] = 10^{-7}$M) are *neutral*,
those with pH < 7 (or $[H^+] > 10^{-7}$M) are *acidic*,
those with pH > 7 (or $[H^+] < 10^{-7}$M) are *basic*.

Change of Base Formula: Let a and b be two positive numbers with $a, b \neq 1$. If $x > 0$, then:

$$\boxed{\log_b x = \frac{\log_a x}{\log_a b}}$$

Multiple Choice Questions (5 points each)
Show all your work on the page where the question appears.
Clearly mark your answer both on the cover page on this exam
and in the corresponding questions that follow.

1. If we simplify the expression

$$\sqrt[3]{(x^3y)^2y^4}$$

we obtain:

$$\sqrt[3]{(x^3)^2 \cdot y^2 \cdot y^4}$$

$$\sqrt[3]{x^6 y^6}$$

$$x^{6/3} y^{6/3}$$

$$x^2 y^2$$

Possibilities:

(a) xy^2
$\boxed{\text{(b)} \quad x^2y^2}$
(c) x^3y^2
(d) $x^2y^{5/3}$
(e) $xy^{5/3}$

2. If we simplify the expression

$$\frac{\frac{1}{x} - \frac{1}{2}}{x - 2}$$

we obtain:

$$\frac{\frac{2-x}{2x}}{x-2}$$

$$\frac{2-x}{2x} \cdot \frac{1}{x-2}$$

$$\frac{-\cancel{(x-2)}}{2x\cancel{(x-2)}} = \boxed{-\frac{1}{2x}}$$

Possibilities:

(a) $\dfrac{1}{(x-2)^2}$
(b) 1
$\boxed{\text{(c)} \quad -\dfrac{1}{2x}}$
(d) $\dfrac{1}{x^2} + \dfrac{1}{4}$
(e) $\dfrac{1}{2x}$

3. The factors of the expression

$$(2x+1)^2 + 3(2x+1) - 10$$

are:

set $u = 2x+1 \rightsquigarrow u^2 + 3u - 10$

$\rightsquigarrow (u+5)(u-2)$

substitute back $\rightsquigarrow [(2x+1)+5][(2x+1)-2]$

$\rightsquigarrow (2x+6)(2x-1)$

Possibilities:

(a) $\boxed{2x-1 \quad \text{and} \quad 2x+6}$

(b) $2x+2$ and $2x-5$

(c) $x-2$ and $x+5$

(d) $x-1$ and $x+6$

(e) $2x-2$ and $2x+5$

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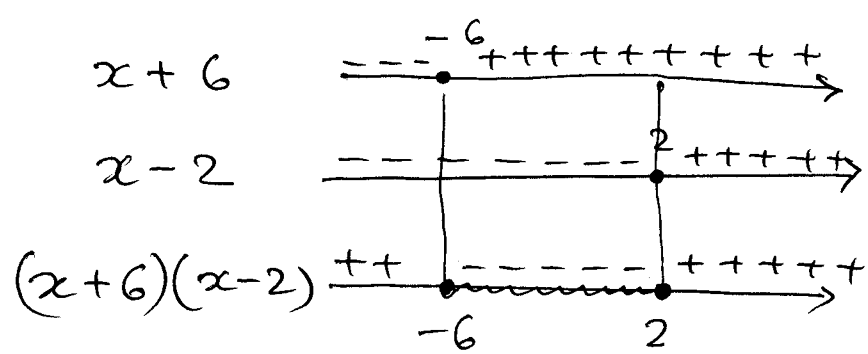
4. If we solve the inequality

$$x^2 + 4x - 12 \le 0$$

then x lies in the interval(s):

want x s/t $(x+6)(x-2) \le 0$

discuss the signs:



$\boxed{-6 \le x \le 2}$

Possibilities:

(a) $\boxed{-6 \le x \le 2}$

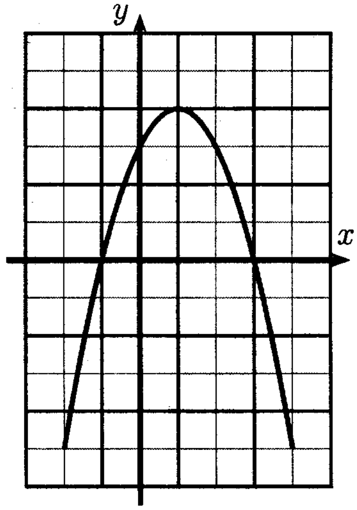
(b) $x \le -6$ and $x \ge 2$

(c) $x \le -2$ and $x \ge 6$

(d) $-2 \le x \le 6$

(e) $-4 \le x \le 12$

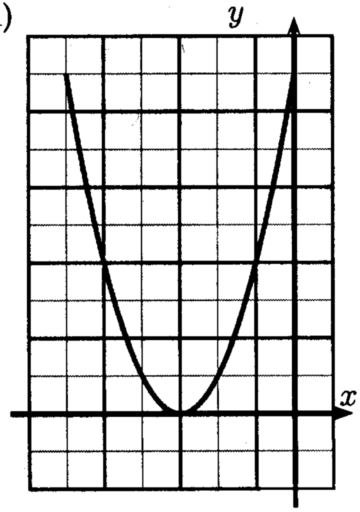
5. The graph of the function g is shown below.



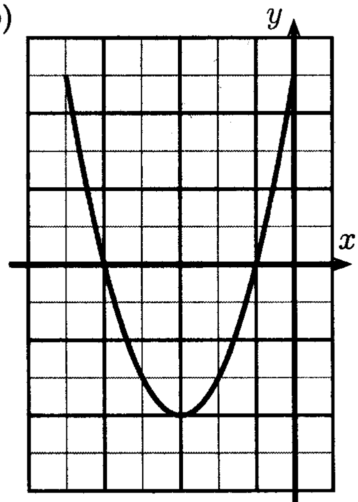
Sketch the graph of the function $y = -g(x+4)$.

Possibilities:

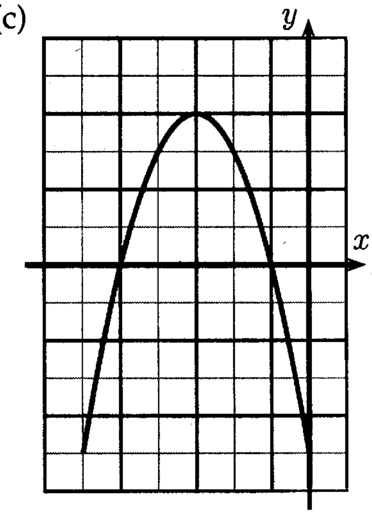
(a)

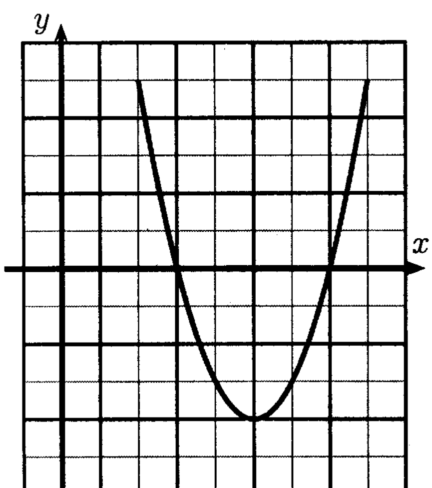


(b)

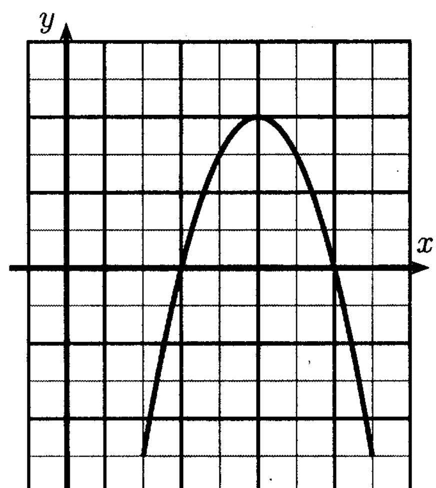


(c)





(d)



(e)

6. An equation of the line through the point $\boxed{P(2,-1)}$ and perpendicular to the line $3x+6y-7=0$ is given by:

$3x+6y-7=0$

$6y = -3x+7 \rightsquigarrow y = -\frac{3}{6}x+\frac{7}{6}$

$\therefore \ m = -3/6 = -1/2$

the perpendicular line has slope $m' = 2$

Possibilities:

(a) $\boxed{y+1 = 2(x-2)}$

(b) $y-1 = 2(x+2)$

(c) $y+1 = -2(x-2)$

(d) $x+2y=0$

(e) $3x+6y-5=0$

$\therefore \ y-(-1) = 2(x-2)$

$\boxed{y+1 = 2(x-2)}$

7. Let $f(x) = 4x-3$. Which of the following expressions represents the inverse function $f^{-1}(x)$?

$y = 4x-3$

Solve for x !

Possibilities:

(a) $f^{-1}(x) = 3x+4$

(b) $f^{-1}(x) = \dfrac{1}{4x-3}$

(c) $\boxed{f^{-1}(x) = \dfrac{x+3}{4}}$

(d) $f^{-1}(x) = \dfrac{1}{3x-4}$

(e) $f^{-1}(x) = \dfrac{x-3}{4}$

$4x = y+3$

$x = \dfrac{y+3}{4}$

Exchange x and y

$y = \dfrac{x+3}{4}$

8. The center C and the radius r of the circle defined by the equation

$$x^2+y^2-4x+6y+9=0$$

are:

$[x^2-4x] + [y^2+6y] = -9$

Complete the squares

Possibilities:

(a) $C(-2,3)$ and $r=4$

(b) $C(-2,3)$ and $r=2$

(c) $C(2,-3)$ and $r=4$

(d) $\boxed{C(2,-3) \text{ and } r=2}$

(e) $C(-4,6)$ and $r=9$

$[x^2-4x+4] + [y^2+6y+9] = -9+4+9$

$[x-2]^2 + [y+3]^2 = 4$

$\therefore \ C(2,-3) \quad r=2$

9. The solution of the system of linear equations

$$\begin{cases} 5x + 2y &= -1 \\ 3x + y &= 3 \end{cases}$$

is given by:

$$\begin{cases} 5x + 2y = -1 \\ -2\,(3x + y = 3) \end{cases}$$

$$\begin{cases} 5x + 2y = -1 \\ -6x - 2y = -6 \end{cases}$$

$$-x + 0 = -7$$

$\therefore$ $x = 7$

From the 2nd equation

$3x+y=3 \rightsquigarrow y = 3-3x \Rightarrow y=-18$

Possibilities:

(a) $x = -1$ and $y = 2$

(b) $\boxed{x = 7 \text{ and } y = -18}$

(c) $x = 1$ and $y = 0$

(d) $x = 0$ and $y = 3$

(e) $x = 10$ and $y = -\dfrac{11}{2}$

10. Let $g(x) = 6x^2 - 5$ and let $h \neq 0$. Then the difference quotient

$$\frac{g(a+h) - g(a)}{h}$$

is equal to one of the following expressions:

$$\frac{[6(a+h)^2 - 5] - [6a^2 - 5]}{h}$$

$$\frac{6(a^2 + 2ah + h^2) \cancel{-5} - 6a^2 \cancel{+5}}{h}$$

$$\frac{\cancel{6a^2} + 12ah + 6h^2 \cancel{-6a^2}}{h}$$

$$\frac{h(12a + 6h)}{h} \longrightarrow \boxed{12a + 6h}$$

Possibilities:

(a) $12x$

(b) 1

(c) $6h$

(d) $\boxed{12a + 6h}$

(e) $2a + h$

11. Determine the coordinates of the point V where the minimum value of the function

$$f(x) = 2x^2 - 4x + 7$$

occurs.

$f(x) = 2\left[x^2 - 2x\right] + 7$

Compete the square

$= 2\left[x^2 - 2x + 1\right] + 7 - 2$

$= 2(x-1)^2 + 5$

$\boxed{V = (1, 5)}$

Possibilities:

(a) $V(-1, 7)$
(b) $V(2, -7)$
(c) $V(0, 7)$
(d) $V(-1, 5)$
(e) $\boxed{V(1, 5)}$

12. Let $f(x) = 5x - 1$ and $g(x) = x - x^2$.

Which of the following expressions represents the composite function $(f \circ g)(x) = f(g(x))$?

$f(g(x)) = 5\,g(x) - 1$

$= 5(x - x^2) - 1$

$= \boxed{5x - 5x^2 - 1}$

Possibilities:

(a) $f(g(x)) = (5x - 1)(x - x^2)$
(b) $\boxed{f(g(x)) = 5x - 5x^2 - 1}$
(c) $f(g(x)) = -25x^2 + 15x - 2$
(d) $f(g(x)) = -25x^2 + 5x - 2$
(e) $f(g(x)) = -x^2 + 6x - 1$

13. The horizontal and vertical asymptotes (if any) of the rational function

$$r(x) = \frac{3-x}{x^2+2x-8} = \frac{3-x}{(x+4)(x-2)}$$

are:

since the denominator has degree bigger than the numerator then $y=0$ is the horizontal asymp

the vertical asymptotes are $x=-4$ and $x=2$

Possibilities:

(a) **Horizontal asymptote:** none ; **Vertical asymptotes:** $x=-4$ and $x=2$

(b) **Horizontal asymptote:** $y=0$; **Vertical asymptotes:** none

(c) **Horizontal asymptote:** $y=0$; **Vertical asymptotes:** $x=-4$ and $x=2$

(d) **Horizontal asymptote:** $y=-1$; **Vertical asymptotes:** $x=-4$ and $x=2$

(e) **Horizontal asymptote:** $y=0$; **Vertical asymptotes:** $x=-2$ and $x=4$

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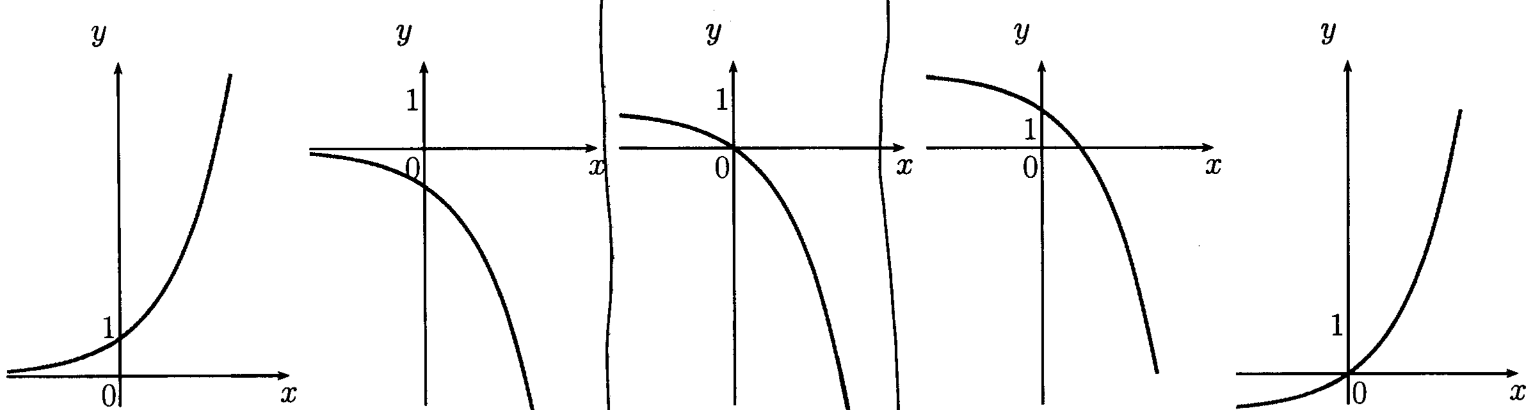
14. The graph of the function

$$y = 1 - e^x$$

is

Possibilities:



(a) (b) (c) (d) (e)

15. The exponential form of the expression

$$\log_9 \frac{1}{3} = -\frac{1}{2}$$

is:

$$9^{-1/2} = 1/3$$

Possibilities:

(a) $9^{1/3} = -\frac{1}{2}$

(b) $9^{1/2} = -3$

(c) $\left(\frac{1}{3}\right)^9 = -\frac{1}{2}$

(d) $\left(-\frac{1}{2}\right)^9 = \frac{1}{3}$

(e) $\boxed{9^{-1/2} = \frac{1}{3}}$

16. If we use common logarithms to find the exact solution of the equation

$$2^{3x-2} = 5,$$

we obtain:

$$\log 2^{(3x-2)} = \log 5$$

$$(3x-2)\log 2 = \log 5$$

$$3x \log 2 - 2\log 2 = \log 5$$

$$3x \log 2 = \log 5 + 2\log 2$$

$$\boxed{x = \frac{\log 5 + 2\log 2}{3\log 2}}$$

Possibilities:

(a) $\boxed{x = \dfrac{\log 5 + 2\log 2}{3\log 2}}$

(b) $x = \dfrac{\log 5 - 2\log 2}{3\log 2}$

(c) $x = \dfrac{\log 5 + 2\log 2}{3}$

(d) $x = \dfrac{1}{3}\left(\dfrac{5}{2} + 2\right)$

(e) $x = \dfrac{\log 5 - \log 2}{\log(2^3)}$

17. The exact value of the expression

$$\log_3 80 - \log_3 18 - \log_3 40$$

is:

$$\log_3 80 - \left[\log_3 18 + \log_3 40\right]$$

$$\log_3 80 - \log_3 (18 \cdot 40)$$

$$\log_3 \left(\frac{\cancel{80}\ 2}{\cancel{18}_{9} \cdot \cancel{40}}\right)$$

$$\log_3 \left(\frac{1}{9}\right) = \log_3 (9^{-1}) =$$

$$= \log_3 3^{-2} = -2$$

Possibilities:

(a) 2

$\boxed{\text{(b) } -2}$

(c) $\frac{1}{9}$

(d) 9

(e) $\log_3(80 \cdot 18 \cdot 40)$

18. How long will it take for an investment of \$5,000 to double in value if the investment is compounded continuously at an interest rate of 6%?

$$A(t) = 5{,}000\, e^{0.06t}$$

want t s/t $\quad 10{,}000 = 5{,}000\, e^{0.06t}$

$$2 = e^{0.06t}$$

Take "ln" of both sides

$$\ln 2 = \ln e^{0.06t}$$

$$\ln 2 = 0.06t$$

$$\therefore t = \frac{\ln 2}{0.06} \cong 11.55$$

Possibilities:

(a) $t = \frac{\ln 2}{6}$ years

$\boxed{\text{(b) } t \approx 11.55 \text{ years}}$

(c) $t = \frac{\ln 10{,}000}{0.06}$ years

(d) $t = 2$ years

(e) $t = \frac{\log 2}{2 \log 1.03}$ years

19. The domain of the function

$$h(x) = \underbrace{\ln x}_{} + \underbrace{\ln(3-x)}_{}$$

is:

defined when
$x > 0$

defined when
$3 - x > 0$

or $3 > x$

$\therefore$ $\boxed{0 < x < 3}$

Possibilities:

(a) $0 \le x \le 3$
(b) $x > 0$
(c) $x > 3$
(d) $x < 0$ and $x > 3$
(e) $\boxed{0 < x < 3}$

20. Polonium-210 has a half-life of 140 days. Suppose a sample of this substance has a mass of 200 mg. The function that models the amount of the sample remaining at time t is:

This is from section 5.5

Possibilities:

(a) $m(t) = 140e^{-0.495t}$
(b) $m(t) = 210e^{0.0495t}$
(c) $m(t) = 210e^{-0.140t}$
(d) $\boxed{m(t) = 200e^{-0.00495t}}$
(e) $m(t) = 200e^{0.0495t}$