

Name: \_\_\_\_\_

Instructor: \_\_\_\_\_

Date: \_\_\_\_\_

Section or days &amp; time: \_\_\_\_\_

**Instructions:**

2 hours with calculator. Formulas on the last page.

Work problems completely, either on this paper, or on another sheet, which you include with this paper.

Credit will be given for work, so show all necessary work. If you turn in work on another paper, number the problems so they can be found and read. If you answer "none of the preceding," tell what the answer should be.

Work 18 of the 21 problems on this exam. Cross out the 3 problems that will not be graded. The first 18 not marked out will be scored.

1. The total number of passengers riding a certain city bus during the morning shift is 1000. If the child's fare is \$0.50, the adult fare is \$1.50, and the total revenue from the fares in the morning shift is \$1300, how many children and how many adults rode the bus during the morning shift?
  - a) 800 children and 200 adults
  - b) 700 children and 300 adults
  - c) 200 children and 800 adults
  - d) 500 children and 500 adults
  - e) 300 children and 700 adults
  - f) None of the preceding
  
2. Having received a large inheritance, Jing-mei's parents wish to establish a trust for her college education. If 7 yr from now they need an estimated \$70,000, how much should they set aside in trust now, if they invest the money at 10.5% compounded continuously?
  - a) \$35,212.45
  - b) \$32,748.47
  - c) \$34,656.83
  - d) \$33,565.38
  - e) \$36,876.55
  - f) None of the preceding

3. Simplify  $\left[\left(\frac{x^2y^{-3}z^{-4}}{x^{-2}y^{-1}z^2}\right)^{-2}\right]^3$  using positive exponents only.

a)  $x^{24}y^{12}z^{36}$

b)  $y^{24}z^{12}$

c)  $\frac{x^{24}}{y^{12}z^{36}}$

d)  $y^{12}z^{24}$

e)  $\frac{y^{12}z^{36}}{x^{24}}$

f) None of the preceding

4. As a fringe benefit for the past 12 yr, Collin's employer has contributed \$100 at the end of each month into an employee retirement account for Collin that pays interest at the rate of 7%/year compounded monthly. Collin has also contributed \$2,000 at the end of each of the last 8 yr into an IRA that pays interest at the rate of 9%/year compounded yearly. How much does Collin have in his retirement fund at this time?

a) \$41,494.22

b) \$43,367.39

c) \$42,789.81

d) \$44,526.45

e) \$45,217.68

f) None of the preceding

5. Find the indicated limit.

$$\lim_{x \rightarrow 1} \frac{x^2 - 1}{x - 1}$$

a) Does not exist

b) 2

c) 0

d) 1

e) -1

f) None of the preceding

6. The quantity demanded  $x$  (measured in units of a thousand) of a certain commodity when the unit price is set at  $\$p$  is given by the equation  $p = \sqrt{-x^2 + 100}$ . If the unit price is set at  $\$6$ , what is the quantity demanded?

a) 11,662

b) 8,000

c) 10,000

d) 7,000

e) 9,000

f) None of the preceding

7. Find all the values of  $x$  for which  $f(x) = \begin{cases} x & \text{if } x \leq 1 \\ 2x - 1 & \text{if } x > 1 \end{cases}$  is continuous.

a)  $(-\infty, 1)$

b)  $(-\infty, 1) \cup (1, \infty)$

c)  $(-\infty, \infty)$

d)  $(-\infty, 1) \cap (1, \infty)$

e)  $(1, \infty)$

f) None of the preceding

8. The number of bacteria in a certain culture  $t$  min after an experimental bactericide is introduced is given by

$$\frac{10,000}{t^2+1} + 2000$$

Find the time when the number of bacteria will have dropped below 4000.

a) After 1 minute

b) After 5 minutes

c) After 2 minutes

d) After 2 hours

e) After 1 hour

f) None of the preceding

9. The relationship between Cunningham Realty's quarterly profit,  $P(x)$ , and the amount of money  $x$  spent on advertising per quarter is described by the function

$$P(x) = -\frac{1}{8}x^2 + 7x + 30 \quad (0 \leq x \leq 50)$$

Where both  $P(x)$  and  $x$  are measured in thousands of dollars. Find the amount of money in dollars the company should spend on advertising per quarter in order to maximize its quarterly profits.

- |                |                          |
|----------------|--------------------------|
| a) \$28,000.00 | b) \$68,000.00           |
| c) \$98,000.00 | d) \$196,000.00          |
| e) \$56,000.00 | f) None of the preceding |

10. Solve the equation

$$\log_4(x + 1) + \log_4(x - 2) = 1$$

- |          |                          |
|----------|--------------------------|
| a) -2, 3 | b) 2                     |
| c) 1, 3  | d) 3                     |
| e) 2, 3  | f) None of the preceding |

11. Strontium 90 (Sr-90), a radioactive isotope of strontium, is present in the fallout resulting from nuclear explosions. It is especially hazardous to animal life, including humans, because, upon ingestion of contaminated food, it is absorbed into the bone structure. Its half-life is 27 yr. If the amount of Sr-90 in a certain area is found to be four times the "safe" level, find how much time must elapse before an "acceptable level" is reached.

12. Find the domain of the function.

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

13. Kane Manufacturing has a division that produces two models of fireplace grates, model A and model B. To produce each model A grate requires 3 lb of cast iron and 6 min of labor. To produce each model B grate requires 4 lb of cast iron and 3 min of labor. The profit for each model A grate is \$2.00, and the profit for each model B grate is \$1.50. If 1000 lb of cast iron and 20 labor-hours are available for the production of fireplace grates per day, how many grates of each model should the division produce in order to maximize Kane's profit? What is the optimal profit?

14. Find the twentieth term and sum of the first 20 terms of the geometric progression having the first term 3 and ratio  $r=2$ .

15. Metro Department Store's annual sales (in millions of dollars) during the past 5 yr were

|                        |            |            |            |            |            |
|------------------------|------------|------------|------------|------------|------------|
| <b>Annual Sales, y</b> | <b>5.8</b> | <b>6.2</b> | <b>7.2</b> | <b>8.4</b> | <b>9.0</b> |
| <b>Year, x</b>         | 1          | 2          | 3          | 4          | 5          |

- a) Find the linear function  $y(x)$  that predicts the annual sales for a given year.
- b) Using the equation found in part (a), estimate Metro's annual sales 4 yr from now ( $x=9$ ).

16. The concentration of a drug in an organ at any time  $t$  (in seconds) is given by

$$x(t) = 0.08 + 0.12(1 - e^{-0.02t})$$

Where  $x(t)$  is measured in grams/cubic centimeter ( $g/cm^3$ ).

- a) What is the initial concentration of the drug in the organ?
- b) What is the concentration of the drug in the organ after 20 sec? Round your answer to the nearest hundredth.

17. Solve the system of linear equations.

$$2x + y - 2z = 4$$

$$x + 3y - z = -3$$

$$3x + 4y - z = 7$$

18. Use the laws of logarithms to expand and simplify the expression.

$$\ln \frac{x^2}{\sqrt{x}(1+x)^2}$$

19. Find the slope of the tangent line to the graph of  $f(x) = x^2 + 5x$  at any point.

20. Matrix A gives the percentage of eligible voters in the city of Newton, classified according to party affiliation and age group.

$$A = \begin{array}{l} \text{Under 30} \\ \text{30 to 50} \\ \text{Over 50} \end{array} \begin{array}{ccc} \text{Dem.} & \text{Rep.} & \text{Ind.} \\ \left[ \begin{array}{ccc} 0.50 & 0.30 & 0.20 \\ 0.45 & 0.40 & 0.15 \\ 0.40 & 0.50 & 0.10 \end{array} \right] \end{array}$$

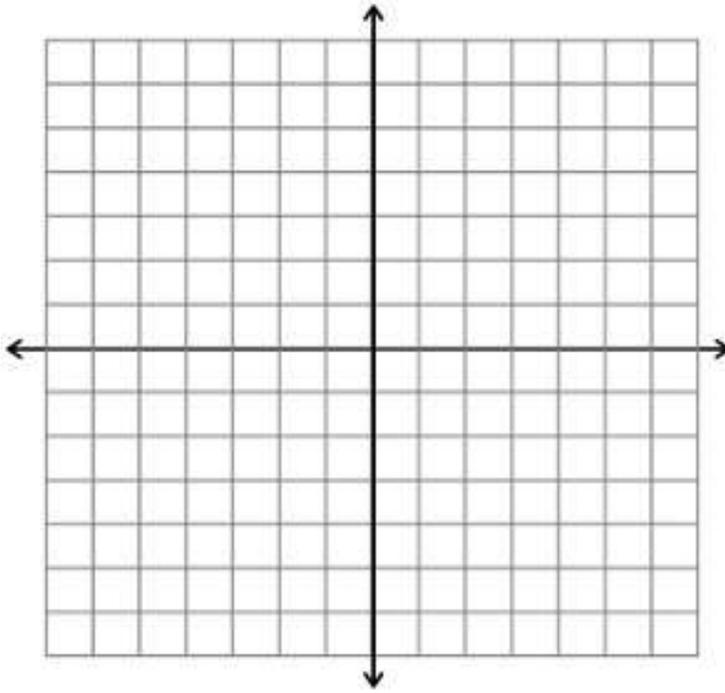
The population of eligible voters in the city by age group is given by the matrix B.

$$B = \begin{array}{ccc} \text{Under 30} & \text{30 to 50} & \text{Over 50} \\ [30,000 & 40,000 & 20,000] \end{array}$$

Find a matrix giving the total number of eligible voters in the city who will vote Democratic, Republican, and Independent.

21. Determine graphically the solution of

$$\begin{aligned}x + 2y &\geq 3 \\5x - 4y &\leq 16 \\0 &\leq y \leq 2 \\x &\geq 0\end{aligned}$$



Formulas:

$$A = P(1 + i)^n$$

$$S = R \left[ \frac{(1+i)^n - 1}{i} \right]$$

$$P = R \left[ \frac{1 - (1+i)^{-n}}{i} \right]$$

$$A = Pe^{rt}$$

$$a_n = a_1 r^{n-1}$$

$$a_n = a_1 + (n - 1)d$$

$$S_n = \frac{a_1(1 - r^n)}{1 - r} \quad (\text{if } r \neq 1)$$

$$S_n = \frac{n(a_1 + a_n)}{2}$$

KEY

SLCC

Math 1090 FINAL EXAM FORM A

Fall 2011

Name: \_\_\_\_\_

Instructor: \_\_\_\_\_

Date: \_\_\_\_\_

Section or days & time: \_\_\_\_\_

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- a) 800 children and 200 adults  
~~b) 200 children and 800 adults~~  
 e) 300 children and 700 adults

- b) 700 children and 300 adults  
 d) 500 children and 500 adults  
 f) None of the preceding

$$\begin{cases} A + C = 1000 \\ 1.5A + 0.5C = 1300 \end{cases}$$

$$A = 800$$

$$C = 200$$

SECTION 5.2 # 55

2. Having received a large inheritance, Jing-mei's parents wish to establish a trust for her college education. If 7 yr from now they need an estimated \$70,000, how much should they set aside in trust now, if they invest the money at 10.5% compounded continuously?

- a) \$35,212.45  
 c) \$34,656.83  
 e) \$36,876.55

- b) \$32,748.47  
~~d) \$33,565.38~~  
 f) None of the preceding

$$A = Pe^{rt}$$

$$70,000 = Pe^{-.105 \times 7}$$

$$P = \$33,565.38$$

SECTION 4.1 # 67

3. Simplify  $\left[\left(\frac{x^2y^{-3}z^{-4}}{x^{-2}y^{-1}z^2}\right)^{-2}\right]^3$  using positive exponents only.

a)  $x^{24}y^{12}z^{36}$

b)  $y^{24}z^{12}$

c)  $\frac{x^{24}}{y^{12}z^{36}}$

d)  $y^{12}z^{24}$

~~e)  $\frac{y^{12}z^{36}}{x^{24}}$~~

f) None of the preceding

$$\left(\frac{x^4}{y^2z^6}\right)^{-6} = \frac{x^{-24}}{y^{-12}z^{-36}} = \frac{y^{12}z^{36}}{x^{24}}$$

SECTION 1.5 #46

4. As a fringe benefit for the past 12 yr, Collin's employer has contributed \$100 at the end of each month into an employee retirement account for Collin that pays interest at the rate of 7%/year compounded monthly. Collin has also contributed \$2,000 at the end of each of the last 8 yr into an IRA that pays interest at the rate of 9%/year compounded yearly. How much does Collin have in his retirement fund at this time?

a) \$41,494.22

b) \$43,367.39

c) \$42,789.81

~~d) \$44,526.45~~

e) \$45,217.68

f) None of the preceding

SECTION 4.2 #19

5. Find the indicated limit.

$$\lim_{x \rightarrow 1} \frac{x^2 - 1}{x - 1}$$

$$\lim_{x \rightarrow 1} \frac{(x-1)(x+1)}{x-1} = 2$$

a) Does not exist

~~b) 2~~

c) 0

d) 1

e) -1

f) None of the preceding

SECT 9.1 #49

6. The quantity demanded  $x$  (measured in units of a thousand) of a certain commodity when the unit price is set at  $\$p$  is given by the equation  $= \sqrt{-x^2 + 100}$ . If the unit price is set at  $\$6$ , what is the quantity demanded?

- a) 11,662  
c) 10,000  
e) 9,000

- ~~b) 8,000~~  
d) 7,000  
f) None of the preceding

$$P = \sqrt{-x^2 + 100}$$

$$6 = \sqrt{-x^2 + 100}$$

$$-x^2 + 100 = 36$$

$$x^2 = 64$$

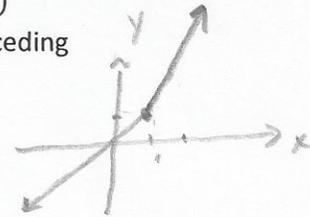
$$x = \pm 8$$

SECTION 1.8 # 76

7. Find all the values of  $x$  for which  $f(x) = \begin{cases} x & \text{if } x \leq 1 \\ 2x - 1 & \text{if } x > 1 \end{cases}$  is continuous.

- a)  $(-\infty, 1)$   
~~c)  $(-\infty, \infty)$~~   
e)  $(1, \infty)$

- b)  $(-\infty, 1) \cup (1, \infty)$   
d)  $(-\infty, 1) \cap (1, \infty)$   
f) None of the preceding



SECTION 9.2 # 53

8. The number of bacteria in a certain culture  $t$  min after an experimental bactericide is introduced is given by

$$\frac{10,000}{t^2 + 1} + 2000$$

Find the time when the number of bacteria will have dropped below 4000.

- a) After 1 minute  
~~c) After 2 minutes~~  
e) After 1 hour

- b) After 5 minutes  
d) After 2 hours  
f) None of the preceding

$$\frac{10,000}{t^2 + 1} + 2000 < 4000$$

$$\frac{10,000}{t^2 + 1} = 2000$$

$$10,000 = 2000t^2 + 2000$$

$$2000t^2 = 8000$$

$$t^2 = 4$$

$$t = \pm 2$$

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

SECTION 1.9 # 63

9. The relationship between Cunningham Realty's quarterly profit,  $P(x)$ , and the amount of money  $x$  spent on advertising per quarter is described by the function

$$P(x) = -\frac{1}{8}x^2 + 7x + 30 \quad (0 \leq x \leq 50)$$

Where both  $P(x)$  and  $x$  are measured in thousands of dollars. Find the amount of money in dollars the company should spend on advertising per quarter in order to maximize its quarterly profits.

- a) \$28,000.00  
 b) \$68,000.00  
 c) \$98,000.00  
 d) \$196,000.00  
 e) \$56,000.00  
 f) None of the preceding

$$x = \frac{-7}{2(-\frac{1}{8})} = 28$$

SECTION 2.6 # 38

10. Solve the equation

$$\log_4(x+1) + \log_4(x-2) = 1$$

- a) -2, 3  
 b) 2  
 c) 1, 3  
 d) 3  
 e) 2, 3  
 f) None of the preceding

$$\log_4(x+1)(x-2) = 1$$

$$x^2 - x - 2 = 4 \quad x = 3$$

$$x^2 - x - 6 = 0 \quad x = -2$$

$$(x-3)(x+2) = 0$$

SECTION 3.2 # 42

11. Strontium 90 (Sr-90), a radioactive isotope of strontium, is present in the fallout resulting from nuclear explosions. It is especially hazardous to animal life, including humans, because, upon ingestion of contaminated food, it is absorbed into the bone structure. Its half-life is 27 yr. If the amount of Sr-90 in a certain area is found to be four times the "safe" level, find how much time must elapse before an "acceptable level" is reached.

$$\frac{1}{2} = e^{27k}$$

$$k = \frac{\ln 1/2}{27}$$

$$\frac{1}{4} Q_0 = Q_0 e^{kT}$$

$$\frac{1}{4} = e^{kT}$$

$$\frac{\ln 1/4}{k} = T$$

$$T = 54 \text{ YEARS}$$

SECTION 3.3 # 10

12. Find the domain of the function.

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

$$x^2 + x - 2 = 0$$

$$(x+2)(x-1) = 0$$

$$x = -2 \quad x = 1$$

$$D: \{x / x \neq -2, x \neq 1\}$$

SECTION 2.3 # 32

13. Kane Manufacturing has a division that produces two models of fireplace grates, model A and model B. To produce each model A grate requires 3 lb of cast iron and 6 min of labor. To produce each model B grate requires 4 lb of cast iron and 3 min of labor. The profit for each model A grate is \$2.00, and the profit for each model B grate is \$1.50. If 1000 lb of cast iron and 20 labor-hours are available for the production of fireplace grates per day, how many grates of each model should the division produce in order to maximize Kane's profit? What is the optimal profit?

sect 6.3

# 31

|       | A     | B     | AVAIL.   |
|-------|-------|-------|----------|
| IRON  | 3lb   | 4lb   | 1000 lb  |
| LABOR | 6 MIN | 3 MIN | 1200 MIN |

$$3A + 4B \leq 1000$$

$$6A + 3B \leq 1200$$

$$A \geq 0 \quad B \geq 0$$

| CORNERS   | PROFIT |
|-----------|--------|
| (0,0)     | \$ 0   |
| (200,0)   | \$ 400 |
| (0,250)   | \$ 375 |
| (120,160) | \$ 480 |

$$\text{PROFIT} = 2A + 1.5B$$

120 MODEL A FOR \$480  
160 MODEL B IN PROFIT

14. Find the twentieth term and sum of the first 20 terms of the geometric progression having the first term 3 and ratio  $r=2$ .

$$a_1 = 3 \quad r = 2$$

$$a_n = a_1 r^{n-1}$$

$$S_n = a_1 \left( \frac{1-r^n}{1-r} \right)$$

$$a_{20} = 3 \cdot 2^{19} = 1,572,864$$

$$S_{20} = 3 \left( \frac{1-2^{20}}{1-2} \right) = 3,145,725$$

sect 4.4 # 29

15. Metro Department Store's annual sales (in millions of dollars) during the past 5 yr were

|                 |     |     |     |     |     |
|-----------------|-----|-----|-----|-----|-----|
| Annual Sales, y | 5.8 | 6.2 | 7.2 | 8.4 | 9.0 |
| Year, x         | 1   | 2   | 3   | 4   | 5   |

sect 2.2  
# 65

a) Find the linear function  $y(x)$  that predicts the annual sales for a given year.

$$y = 0.86x + 4.74$$

b) Using the equation found in part (a), estimate Metro's annual sales 4 yr from now ( $x=9$ ).

$$12.48 \text{ MILLION DOLLARS}$$

16. The concentration of a drug in an organ at any time  $t$  (in seconds) is given by

$$x(t) = 0.08 + 0.12(1 - e^{-0.02t})$$

Where  $x(t)$  is measured in grams/cubic centimeter ( $g/cm^3$ ).

a) What is the initial concentration of the drug in the organ?

$$x(0) = 0.08 \text{ g/cm}^3$$

b) What is the concentration of the drug in the organ after 20 sec? Round your answer to the nearest hundredth.

$$x(20) = 0.08 + 0.12(1 - e^{-0.02(20)})$$

$$x(20) = 0.12 \text{ g/cm}^3$$

SECTION 3.1 # 43

17. Solve the system of linear equations.

$$2x + y - 2z = 4$$

$$x + 3y - z = -3$$

$$3x + 4y - z = 7$$

$$x = 6$$

$$y = -2$$

$$z = 3$$

$$(6, -2, 3)$$

SECTION 5.2 # 40

18. Use the laws of logarithms to expand and simplify the expression.

$$\ln \frac{x^2}{\sqrt{x}(1+x)^2}$$

$$2 \ln x - \frac{1}{2} \ln x - 2 \ln(1+x) = \boxed{\frac{3}{2} \ln x - 2 \ln(1+x)}$$

SECTION 3.2 # 28

19. Find the slope of the tangent line to the graph of  $f(x) = x^2 + 5x$  at any point.

$$f(x+h) = (x+h)^2 + 5(x+h) = x^2 + 2xh + h^2 + 5x + 5h$$

$$\lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 + 5x + 5h - x^2 - 5x}{h} = \lim_{h \rightarrow 0} \frac{h(2x + h + 5)}{h}$$

$$= \boxed{2x + 5}$$

SECTION 9.3 # 16

20. Matrix A gives the percentage of eligible voters in the city of Newton, classified according to party affiliation and age group.

|          | Dem. | Rep. | Ind. |
|----------|------|------|------|
| Under 30 | 0.50 | 0.30 | 0.20 |
| 30 to 50 | 0.45 | 0.40 | 0.15 |
| Over 50  | 0.40 | 0.50 | 0.10 |

$$A = \begin{bmatrix} 0.50 & 0.30 & 0.20 \\ 0.45 & 0.40 & 0.15 \\ 0.40 & 0.50 & 0.10 \end{bmatrix}$$

SECTION 5.5

The population of eligible voters in the city by age group is given by the matrix B.

# 47

| Under 30 | 30 to 50 | Over 50 |
|----------|----------|---------|
| 30,000   | 40,000   | 20,000  |

$$B = [30,000 \quad 40,000 \quad 20,000]$$

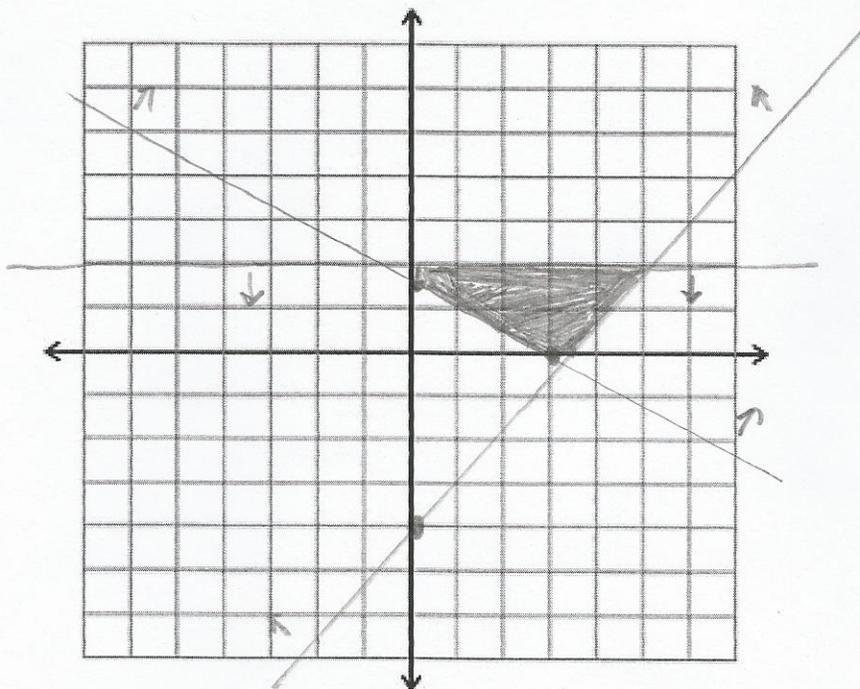
Find a matrix giving the total number of eligible voters in the city who will vote Democratic, Republican, and Independent.

$$B \times A = (30,000 \quad 40,000 \quad 20,000) \begin{pmatrix} 0.50 & 0.30 & 0.20 \\ 0.45 & 0.40 & 0.15 \\ 0.40 & 0.50 & 0.10 \end{pmatrix}$$

$$= \boxed{\begin{pmatrix} 41,000 & 35,000 & 14,000 \\ \text{DEM} & \text{REP} & \text{IND} \end{pmatrix}}$$

21. Determine graphically the solution of

$$\begin{aligned} x + 2y &\geq 3 \\ 5x - 4y &\leq 16 \\ 0 &\leq y \leq 2 \\ x &\geq 0 \end{aligned}$$



SECTION 6.1 # 31

Formulas:

$$A = P(1 + i)^n$$

$$S = R \left[ \frac{(1+i)^n - 1}{i} \right]$$

$$P = R \left[ \frac{1 - (1+i)^{-n}}{i} \right]$$

$$A = Pe^{rt}$$

$$a_n = a_1 r^{n-1}$$

$$a_n = a_1 + (n - 1)d$$

$$S_n = \frac{a_1(1 - r^n)}{1 - r} \quad (\text{if } r \neq 1)$$

$$S_n = \frac{n(a_1 + a_n)}{2}$$