MSDS 400 Practice Final

1. Northwest Molded molds plastic handles which cost $1.00 per handle to mold. The fixed cost to run the molding machine is $3,008 per week. If the company sells the handles for $3.00 each, how many handles must be molded to break even?

2. For the following table of data,

x	1	2	3	4	5	6	7	8	9	10
y	0.3	1.0	1.3	2.3	3.1	3.3	3.3	4.3	4.8	5.3

   a. Draw a scatterplot.
   b. Calculate the correlation coefficient.
   c. Calculate the least squares line.
   d. Predict the y-value when x = 11.

3. The amount of nitrogen (in lb/acre), phosphate (in lb/acre), and labor (in hr/acre) needed to grow honeydews, yellow onions, and lettuce in a particular state is given in the table below.

	Honeydews	Yellow onions	Lettuce
Nitrogen	130	140	150
Phosphate	170	70	70
Labor	4.97	4.45	4.65

   If the farmer has 230 acres, 31,500 lb of nitrogen, 28,100 lo of phosphate, and 1095.9 hours of labor are available, is it possible to use all resources completely? If so, how many acres should he allot for each crop?

4. A basketball fieldhouse seats 15,000 people. Courtside seats cost $8, endzone seats cost $7, and balcony seats cost $4. The total revenue for a sellout is $78,000. If half the courtside seats, half the balcony seats, and all the endzone seats are sold, then the total revenue is $46,000. How many of each seat type are there?

5. An airline with two types of airplanes, P_1 and P_2, has contracted with a tour group to provide transportation for a minimum of 400 first class, 750 tourist class, and 1500 economy class passengers. For a certain trip, airplane P_1 costs $10,000 to operate and can accommodate 20 first class, 50 tourist class, and 110 economy class passengers. Airplane P_2 costs $8500 to operate and can accommodate 18 first class, 30 tourist class, and 44 economy class passengers. How many of each type of airplane should be used in order to minimize operating cost and what is the minimum cost?

6. As part of a weight reduction program, a man designs a monthly exercise program consisting of bicycling, jogging, and swimming. He would like to exercise at most 36 hours, devote at most 4 hours to swimming, and jog for no more that the total number of hours bicycling and swimming. The calories burned by this person per hour by bicycling, jogging, and swimming are 200, 445, and 255, respectively. How many hours should be allotted to each activity to maximize the number of calories burned? What is the maximum number of calories he will burn?

7. A company's lawn seed mixtures contain three types of seeds: bluegrass, rye, and Bermuda. The costs per pound of the three types are 12 cents, 16 cents, and 6 cents, respectively. In each batch there must be at least 20% bluegrass seed and the amount of rye must be at least two-thirds the amount of Bermuda. To fill the current orders, the company must make at least 9000 pounds of the mixture. How much of each kind of seed should be used to minimize cost and what is the minimum cost?

8. A blood test indicates the presence of a particular disease 95% of the time when the disease is actually present. The same test indicates the presence of the disease 0.7% of the time when the disease is not present. Two percent of the population actually has the disease. Calculate the probability that a person has the disease given that the test indicates the presence of the disease.

9. Suppose a box contains 4 red and 4 blue balls. A ball is selected at random and removed, without observing its color. The box now contains either 4 red and 3 blue balls or 3 red and 4 blue balls.

    a. Nate removes a ball at random from the box, observes its color and puts the ball back. He performs this experiment 6 times and each time the ball is blue. What is the probability that a red ball was initially removed from the box?
    b. Ray removes a ball at random from the box, observes its color and puts the ball back. He performs this experiment 84 times. Out of these, the ball was blue 48 times and red 36 times. What is the probability that a red ball was initially removed from the box?

10. The projected population of a certain ethnic group (in millions) can be approximated by $p(t) = 35.03(1.013)^t$ where $t = 0$ corresponds to 2000 and $0 \leq t \leq 50$.

    a. Estimate the population of this group in the year 2010. (Round to 3 decimals as needed.)
    b. What is the instantaneous rate of change for the population when $t = 10$? (Round to 4 decimals as needed.)

11. Since the creation of a social program, the percent of persons 65 years and over with a family below the poverty level has declined. The percent can be approximated by the function $P(t) = 30.95 - 5.79 \ln t$, where t is the number of years since 1965.

    a. Find the percent of persons 65 years and over with family income below the poverty level and the rate of change in 1970.
    b. Find the percent of persons 65 years and over with family income below the poverty level and the rate of change in 1990.
    c. Find the percent of persons 65 years and over with family income below the poverty level and the rate of change in 2010.
    d. What happens to the rate of change over time?

12. The percent of concentration of a certain drug in the bloodstream x hours after the drug is administered is given by

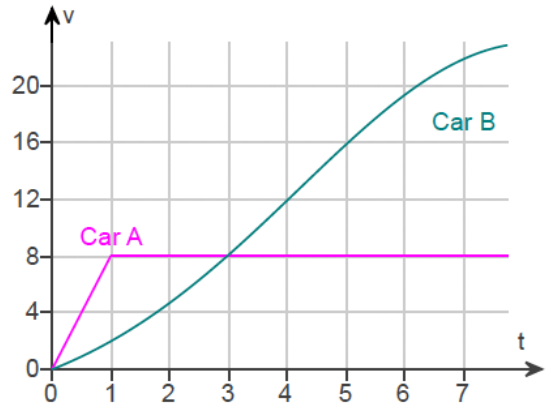
$$K(x) = \frac{3x}{x^2 + 16}$$

    a. Find the time at which the concentration is a maximum.
    b. Find the maximum concentration.

13. A company sells square carpets for $7 per square foot. It has a simplified manufacturing process for which all the carpets each week must be the same size, and the length must be a multiple of a half foot. It has found that it can sell 200 carpets in a week when the carpets are 2 ft by 2 ft, which is the minimum size. Beyond this, for each additional foot of length and width, the number sold goes down by 3.

    a. Write the equation for the revenue, R, the company will earn as a function of the length, x, of the carpet squares sold.
    b. What size carpets should the company sell to maximize its weekly revenue?
    c. What is the maximum weekly revenue?

14. Two cars start from rest at a traffic light and accelerate for several minutes. The graph below shows their velocity (in feet per second) as a function of time (in seconds). Car A is the one that initially has the greater velocity.



a. How far has car A traveled after 3 seconds?
b. When is car A the farthest ahead of car B?
c. Estimate the farthest that car A gets ahead of car B. For car A, use formulas from geometry. For car B, use n = 3 and the value of the function at the midpoint of each interval. Round to 1 decimal as needed.
d. Give a rough estimate of when car B catches up with car A
   i. Between t = 5 and t = 6
   ii. Between t = 3 and t = 4
   iii. Between t = 7 and t = 8
   iv. Between t = 4 and t = 5

15. An oil tanker is leaking oil at a rate given in barrels per hours by the function shown below, where t is the time in hours after the tanker hits a hidden rock.

$$L'(t) = \frac{72\ln(t+1)}{t+1}$$

a. Find the total number of barrels that the ship will leak on the first day. (Round to the nearest whole number as needed.)
b. Find the total number of barrels that the ship will leak on the second day. (Round to the nearest whole number as needed.)
c. What is happening to over the long run to the amount of oil leaked per day?
   i. The amount of oil leaked per day is decreasing to _____
   ii. The amount of oil leaked per day is constant at _____
   iii. The amount of oil leaked per day is increasing to _____

16. It is found that the time (in minutes) required by a predator to find a prey is a random variable that is exponentially distributed with $\mu = 24$.

a. According to this distribution, what is the longest time within which the predator will be 85% certain of finding prey?
b. What is the probability that the predator will have to spend more than 1 hour looking for a prey?

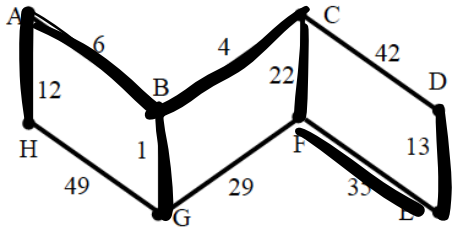
17. The total revenue (in hundreds of dollars) from the sale of x spas and y solar heaters is approximated by $R(x, y) = 14 + 278x + 206y - 7x^2 - 4y^2 - 6xy$.

a. Find R_{xx}, R_{yy}, and R_{xy}.
b. Find the number of each that should be sold to produce maximum revenue.

c. Find the maximum revenue.

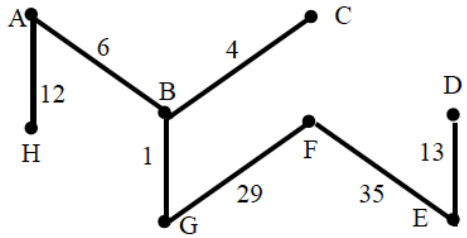
18. The production function for a particular product is $N(x, y) = 80x^{0.7}y^{0.3}$, where x is the number of units of labor and y is the number of units of capital required to produce $N(x, y)$ units of the product. Each unit of labor costs \$40 and each unit of capital costs \$120. If \$800,000 is budgeted for production of the product, determine how the amount should be allocated to maximize production.

19. Determine the minimum cost spanning tree for the graph.

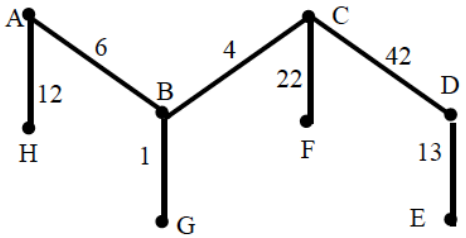


Choose the correct minimum-cost spanning tree below.

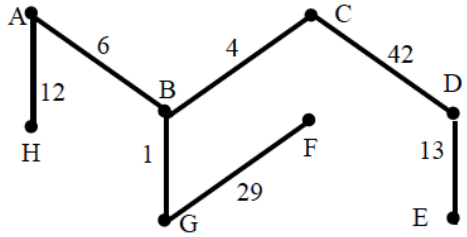
○ **A.**



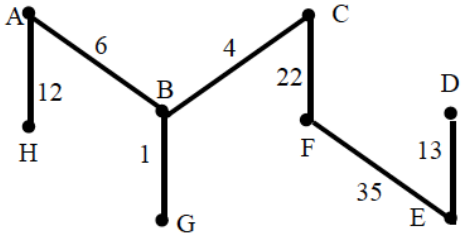
○ **B.**



○ **C.**



○ **D.**

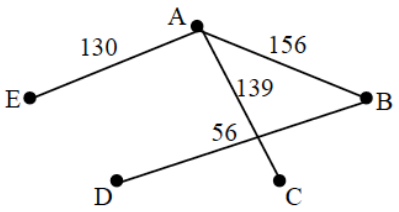


20. A town wishes to build a trail between city A, city B, city C, city D, and city E. The distances in miles between any two of the destinations are given in the table.

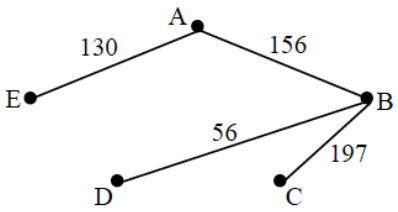
	A	B	C	D	E
A	*	156	139	212	130
B	156	*	197	56	249
C	139	197	*	225	214
D	212	56	225	*	303
E	130	249	214	303	*

a. Use Kruskal's algorithm to determine the minimum-cost spanning tree that would link each location to create the least expensive trail. Choose the correct graph below.

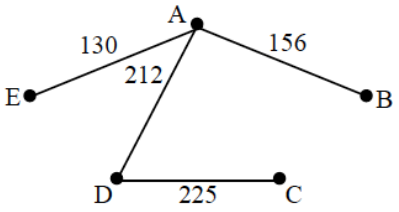
○ **A.**



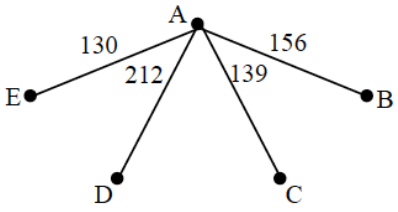
○ **B.**



○ **C.**



○ **D.**

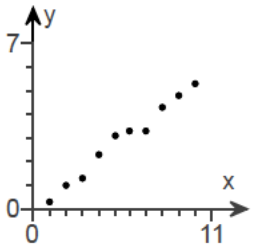


b. If the cost of building the trail is $3700 per mile, what is the cost of building the trail determined in part (a)?

Answer Key

1. 1504 handles

2. a.



   b. 0.989
   c. y = 0.54x – 0.09
   d. 5.89

3. Yes, the farmer should all 120 acres for honeydew, 60 acres for yellow onions, and 50 acres for lettuce.

4. 3000, courtside seats, 2000 endzone seats, and 10,000 balcony seats

5. 9 P_1 planes and 13 P_2 planes for a minimum cost of $200,500

6. 14 hours bicycling, 18 hours jogging, and 4hours swimming for a maximum of 11,830 calories burned

7. 1800 pounds of bluegrass seed, 2880 pounds of rye seed, and 4320 pounds of Bermuda seed for a minimum cost of $936.00

8. 0.735

9. (a) 0.8489; (b) 0.9693

10. (a) 39.86 million people; (b) 0.515 million people

11.
   a. 21.63% of persons 65 years and over had a family income below the poverty level in 1970 and the rate of change was –1.1580% per year.
   b. 12.31% of persons 65 years and over had a family income below the poverty level in 1990 and the rate of change was –0.2316% per year.
   c. 8.91% of persons 65 years and over had a family income below the poverty level in 1970 and the rate of change was –0.1287% per year.
   d. The rate of change over time is approaching 0.

12. (a) 4 hours; (b) 3/8%

13. (a) $R(x) = -21x^3 + 1442x^2$; (b) 46 ft; (c) $1,007,216.00

14. (a) 20 ft; (b) 3 seconds; (c) 9.9 ft; (d) Between t = 5 and t = 6

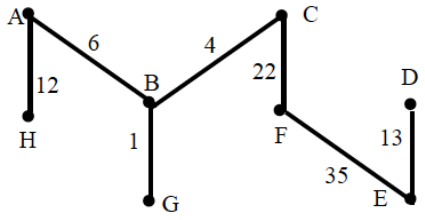
15. (a) 373 barrels; (b) 172 barrels; (c) The amount of oil leaked per day is decreasing to 0.

16. (a) 45.5 minutes; (b) 0.0821

17. (a) $R_{xx} = -14$, $R_{yy} = -8$, and $R_{xy} = -6$; (b) Sell 13 spas and 16 solar heaters; (c) $346,900

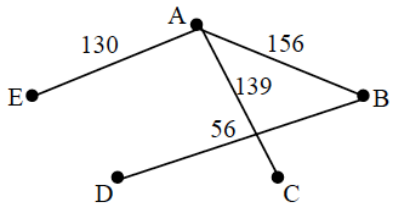
18. Use 14,000 units of labor and 2,000 units of capital.

19.



20.

a.



b. $1,779,700