This mathematics curriculum is designed to be taught by the technology education teacher during the power technology class over a period of 2 years. It is intended to be elective in nature; upon successful completion of both years, one-half credit in mathematics is to be awarded. A list of the academic competencies contained in the curriculum cites the chapters in which the competencies are located. Each of the 13 units consists of these components: competencies, lesson, and hands-on or written activity sheet. Unit titles are as follows: orientation and safety, tools of the trade, measuring, preventive maintenance, types of engines, engine disassembly, engine lubrication and cooling, electricity and the battery, charging system, starting system, fuel system, brake systems, and careers. Unit worksheets, unit quizzes, and answer keys are appended. (YLB)
MATHEMATICS IN POWER TECHNOLOGY

PREPARED BY

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PREPARED FOR

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AUGUST 31, 1991

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The following curriculum is the result of a joint effort by two instructors from the Naugatuck High School. Ms. Colleen Palmer, representing the Mathematics Department and Mr. Harrison Baker, representing the Technology Education Department. It was felt that a program was needed to help make general mathematics more relevant to high school students and to provide the opportunity for a student to earn academic credit while taking a vocational course. The material will be taught by the Technology Education teacher, during the Power Technology class, over a period of two years. It will be elective in nature and upon successful completion of both years one half credit in mathematics will be awarded. It is hoped that this curriculum will lead to the development of other cross credit activities in different areas.
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The following is a list of the academic competencies contained in this curriculum and the chapters in which they are located.

**CONCEPTUAL UNDERSTANDINGS:**

1. comparing numbers........................................... 2, 8
2. fractions, decimals, and ratios.............................. 2, 6, 7, 9, 10, 11, 12

**COMPUTATIONAL SKILLS:**

1. addition and subtraction of whole numbers.................. 1
2. multiplication and division of whole numbers................ 1, 3, 4, 8, 9, 11
3. computation with decimals..................................... 3, 4, 7, 9, 11, 12
4. computation with fractions..................................... 2, 3, 4, 6, 7, 9
5. percents......................................................... 3, 5, 7

**PROBLEM SOLVING:**

1. solve process problems........................................ 1, 4, 7, 8, 9, 11, 12
2. solve problems involving whole numbers, decimals, fractions and measurement........................................ 1, 2, 3, 4, 7, 8, 9, 11
3. identify needed information in problem situations........... 1, 4, 7, 8, 9, 10, 11
4. solve problems involving measurement.......................... 1, 2, 3
5. solve 1 and 2 step problems involving fractions............. 2, 4, 9
6. interpret graphs, tables and charts.......................... 3, 4, 7, 8

**MEASUREMENT:**

1. Identify figures using geometric terms........................ 1
2. measure and determine perimeters and areas.................. 1
3. estimate lengths, areas, volumes, and angles measurement..... 1, 2
4. make measurement conversions within systems................ 1, 2, 4, 7
ORIENTATION AND SAFETY

MATH COMPONENT

I. Competency:

The student will compute the perimeter, area and volume of a given space.

A. Determining the Perimeter

B. Determining the Area

C. Determining the Volume

Problem #1

1. Based on State of Connecticut recommendations for classroom size the students will compute the space necessary for their class to be conducted safely.

STATE RECOMMENDATIONS

1. # of students in shop/lab should not exceed 16
2. recommended = 144 square feet per pupil
3. minimum = 120 square feet per pupil

(Net total sq.ft. Recommended 3600 / Minimum 3000)
1. Assignment:
   Working in teams of two, measure and record the following information:

   a. Room length = _____ ft. _____ in.
   b. Room width = _____ ft. _____ in.
   c. Room height = _____ ft. _____ in.

2. Using the information above, compute the following:

   a. Room perimeter (distance around)
      Room Perimeter = _____ ft. _____ in.
   b. Area of the room (Area = Length x Width)
      Room Area = ________
   c. Volume of the room (Volume = Length x Width x Height)
      Room Volume = ________

4. Using the data above determine if room size is sufficient for the number of students attending this class. (see State Requirements previous page)

5. Using the data above determine how long it would take a 2500 cubic ft. per minute air purification system to change the air in our room.

6. How many air purification units would be required to change all the air in the room in one-half hour?
TOOLS OF THE TRADE

MATH COMPONENT

I. Competencies:

1. Given the necessary measuring equipment, students will correctly identify the fractional sizes of wrenches and sockets used in the power mechanics lab.

2. Given a list of fractional wrench sizes from $\frac{1}{4}$" through 2", the student will arrange them from smallest to largest.

II. Lesson:

1. Each student will be given a ruler, sheet of paper and five wrenches/sockets with their sizes covered. The student will then be instructed how to measure each tool and instructed to record their findings.

2. The student will be instructed on how to find the common denominator of the fractional sizes recorded and then instructed to arrange the wrenches/sockets and fractional sizes recorded in order from smallest to largest.
TOOLS OF THE TRADE
HANDS ON ACTIVITY

I. Assignments:

1. Using the ruler provided measure the tools you were given and record their sizes below.

1.____ 2.____ 3.____ 4.____ 5.____

2. Arrange the wrench sizes above from the smallest to the largest.

1.____ 2.____ 3.____ 4.____ 5.____

3. Find a common denominator for the following fractional wrench sizes and convert each fraction to the common denominator.

3/16" 5/8" 1/2" 3/4" 7/8" 7/16" 9/16" 5/32"

4. Arrange the wrenches above from smallest to largest.

5. A mechanic has a combination wrench set (one size per wrench) which contains wrenches from 1/4" to 1" in 1/16" increments. How many wrenches are in this set?

6. While working on a vehicle a mechanic discovers that his/her 1/2" wrench is too small and the 5/8" wrench is too large. Knowing that it's not a metric size what wrench size should he/she try next?
MEASURING
MATH COMPONENT
CUBIC INCH DISPLACEMENT

I. Competency:

1. Given the necessary measurements and formula the student will compute the cubic inch displacement of an engine.

II. Lesson:

1. Students will be instructed in how to compute the cubic inch displacement of an engine using the formula below, and how to round off their answers to the nearest whole number.

Formula: \[ \text{Bore}^2 \times \pi \times \text{Stroke} \times \text{Number of cylinders} = \text{C.I.D.} \]

EXAMPLE:

<table>
<thead>
<tr>
<th>Bore (in)</th>
<th>Stroke (in)</th>
<th>Number of Cylinders</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

STEPS:

\[
\frac{(4'' \times 4'') \times 3.1416 \times 5''}{4} \times 6 \text{ cylinders} = \text{C.I.D.}
\]

\[
\frac{16'' \times 3.1416 \times 5''}{4} \times 6 = \text{C.I.D.}
\]

\[
\frac{50.2656 \times 5''}{4} \times 6 = \text{C.I.D.}
\]

\[
\frac{251.328}{4} \times 6 = \text{C.I.D.}
\]

\[
62.832 \times 6 = \text{C.I.D.}
\]

\[
376.992 = \text{C.I.D.}
\]
CUBIC INCH DISPLACEMENT

WORKSHEET

Formula: \[ \text{Bore}^2 \times \pi \times \text{Stroke} \times \text{Number of cylinders} = \text{C.I.D.} \]

Directions

Using the formula above and the measurements below compute the cubic inch displacement of the following engines. Round off your answers to the closest whole number.

<table>
<thead>
<tr>
<th>Bore</th>
<th>Stroke</th>
<th>Number of Cylinders</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 4&quot;</td>
<td>5&quot;</td>
<td>6</td>
<td>______</td>
</tr>
<tr>
<td>2. 3&quot;</td>
<td>2&quot;</td>
<td>4</td>
<td>______</td>
</tr>
<tr>
<td>3. 6&quot;</td>
<td>4&quot;</td>
<td>8</td>
<td>______</td>
</tr>
<tr>
<td>4. 5&quot;</td>
<td>4&quot;</td>
<td>6</td>
<td>______</td>
</tr>
<tr>
<td>5. 3.5&quot;</td>
<td>4.5&quot;</td>
<td>8</td>
<td>______</td>
</tr>
<tr>
<td>6. 3.75&quot;</td>
<td>5.5&quot;</td>
<td>4</td>
<td>______</td>
</tr>
<tr>
<td>7. 4.25&quot;</td>
<td>4&quot;</td>
<td>6</td>
<td>______</td>
</tr>
<tr>
<td>8. 2.5&quot;</td>
<td>3&quot;</td>
<td>4</td>
<td>______</td>
</tr>
<tr>
<td>9. 4&quot;</td>
<td>3&quot;</td>
<td>4</td>
<td>______</td>
</tr>
<tr>
<td>10. 2&quot;</td>
<td>4&quot;</td>
<td>8</td>
<td>______</td>
</tr>
</tbody>
</table>
MEASURING
HANDS ON ACTIVITY

Formula: \( \text{Bore}^2 \times \pi \times \text{Stroke} \times \text{Number of cylinders} = \text{C.I.D.} \)

I. Assignments:

1. Using a ruler and micrometer, measure the bore and stroke of one of the engines in the classroom. Using that information compute its cubic inch displacement.

   a. Engine Number Selected

   b. Bore Diameter

   c. Length of Stroke

   d. Number of Cylinders

2. Using the manuals in the room choose a vehicle and record the following information:

   Vehicle Make

   Vehicle Model

   Name of Manual Used

   Information found on Pg.#

   a. Engine bore

   b. Engine Stroke

   c. Number of Cyl.
MEASURING
MATH COMPONENT
COMPRESSION TESTING

I. Competency:

1. Students will accurately interpret compression readings by taking a percentage of a reading and subtracting that number from the reading. (see further information and example below)

COMPRESSION TEST PROCEDURE

When comparing compression test results from various cylinders in an engine, you have to subtract 15% of the highest reading from itself. None of the remaining cylinders should be lower than that reading.

EXAMPLE: A compression test on a four cylinder engine results in the following:

#1 = 195 psi #2 = 180 psi #3 = 175 psi #4 = 185 psi

The highest cylinder is #1 which reads 195 psi.

15% of this reading is .15 x 195 = 29.25

195 psi - 29.25 psi = 165.75 psi (this is the lowest any other cylinder can be)

The lowest cylinder reading was #3 = 175 psi so this engine is still within specifications.
MEASURING
HAN DS ON ACTIVITY
COMPRESSION TESTING

I. Assignment:

Using a vehicle provided (or your own) perform a compression test and record the readings below:

<table>
<thead>
<tr>
<th>Cylinder Number</th>
<th>Psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

II. Assignment:

Use the data above and the information you’ve obtained to determine if this engine is in good mechanical condition.

1. Highest reading = _________
2. Subtract 15% = _________
3. Compare this to lowest reading.
4. Check One
   ____ Engine Good
   ____ Engine Bad
Directions

Solve the following problems using the information in your notebooks and a calculator.

During a compression test a mechanic gets the following readings:

#1 = 160 psi  #2 = 190 psi  #3 = 165 psi  #4 = 180 psi

1. What is the lowest acceptable reading for this situation?

ans. ______

2. What is 15% of the reading on cylinder Number 2?

ans. ______

3. How many more psi would be required to make #1 cylinder acceptable?

ans. ______

4. How many psi difference is there between the highest and the lowest cylinder above?

ans. ______
I. Competencies:

1. Student will determine when preventive maintenance is to be performed based on time and mileage requirements.

2. The student will add various capacities together.

II. Lesson:

1. Preventive maintenance must be performed on both a mileage and time basis. Each car manufacturer has its own recommendations.

2. How often an engine's oil is changed depends on:
   a. the conditions the vehicle is operated in
   b. how many miles the vehicle has traveled
   c. how long it has been since the last oil change

   EXAMPLE: How many times a year does a driver have to change his/her oil if he/she drives 500 miles each week and changes his/her oil every 3 months or 3000 miles?

   \[
   \begin{align*}
   500 \text{ miles per week} & \times 52 \text{ weeks per year} \\
   & = 26,000 \text{ miles each year} \\
   \frac{26,000}{3000} & = 8.66666 \text{ times per year based on mileage} \\
   \end{align*}
   \]

   \[
   \begin{align*}
   \frac{26,000}{3000} & = \frac{4}{12} \text{ times per year based on time} \\
   & = \frac{1}{3} \text{ times per year} \\
   \end{align*}
   \]

3. Different vehicles require different amounts of oil. Adding whole numbers and fractions is often necessary.
I. Assignments:

A customer comes in to the garage with a 1989 Ford Mustang with a 5.0 liter High Output engine. The car is operated in very hot, dusty conditions.

Using the manuals in the room, determine the following:

1. How often does the manufacturer say the oil should be changed?
   a. Every _________ months.
   b. Every _________ miles.
   c. Manual used ____________ .
   d. Pg. # where you found information ________ .

2. If the manufacturer recommends you change your oil every 3 months or 3000 miles........
   a. Based on time only, how often should you change your oil each year?
   b. How many times a year should you change your oil if you drive 2000 miles each month?

3. Three cars are in the garage for oil changes. The first car requires 4 1/2 quarts of oil, the second 3 3/4 quarts and the last 5 1/3 quarts. How much oil will you need to complete all three oil changes?

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PREVENTIVE MAINTENANCE

WORKSHEET

DIRECTIONS: Complete the following problems using the information in your notebooks and a calculator. Be sure to show the steps you take. For each problem below use 3 months or 3000 miles for your oil change specifications.

1. If ball joints require lubrication every other oil change, how often should they be lubricated?
   a. Every _________ miles
      or
   b. Every _________ months

2. Your records indicate you did an average of two oil changes a day last year. The average oil change produces 4 1/2 quarts of drain oil. Using 365 as the number of days per year, answer the following questions:
   a. How many quarts of drain oil did your garage produce last year?
   b. How many quarts of drain oil did your garage produce each month?
   c. How many quarts of drain oil did your garage produce each week?
   d. How much did it cost to have the oil removed if the waste oil company charged you 28 cents per gallon?
      _________ per week
      _________ per month
      _________ per year
I. Competencies:

1. The student will compute what percentage each cylinder represents in various sized engines.

2. Given a graphic illustration, the student will calculate the percentage represented.

II. Lesson:

1. Each cylinder in a 8 cylinder engine represents what % of the total engine?

\[
\begin{align*}
\text{\text{12.5}} \quad \% \\
8 \quad 100
\end{align*}
\]

2. Each cylinder in a 6 cylinder engine represents what % of the total engine?

\[
\begin{align*}
\text{\text{16.666}} \quad \% \\
6 \quad 100
\end{align*}
\]

3. 75 % of the cylinders in a 4 cylinder were found to be faulty. How many cylinders were faulty?

\[
\begin{align*}
\text{.75} \\
x \quad \text{4}
\end{align*}
\]

\[
\text{3.00 cylinders}
\]

4. What % of the engine cylinders below are shaded?

\[
\begin{align*}
A. & \quad \text{\text{17}} \\
B. & \quad \text{\text{17}} \\
C. & \quad \text{\text{17}}
\end{align*}
\]
I. Directions: Using your notebook and calculator compute the following percentages.

1. Each cylinder in a 5 cylinder engine represents what % of the total engine?

2. Each cylinder in a 4 cylinder engine represents what % of the total engine?

3. 25 % of the cylinders in an 8 cylinder were found to be faulty. How many cylinders were faulty?

4. What % of the engine cylinders below are shaded?

   A.
   \[
   \begin{array}{ccc}
   \bigcirc & \bigcirc & \bigcirc \\
   \bigcirc & \bigcirc & \bigcirc \\
   \bigcirc & \bigcirc & \bigcirc \\
   \bigcirc & \bigcirc & \bigcirc \\
   \end{array}
   \]

   B.
   \[
   \begin{array}{cccc}
   \bigcirc & \bigcirc & \bigcirc & \bigcirc \\
   \end{array}
   \]
I. Assignment:

1. Select a vehicle on which to perform a cylinder balance test.
   a. Vehicle Type
   b. Number of cylinders
   c. What percent of the whole does each cylinder represent?

   NOTE: PERFORM THE FOLLOWING ONLY WITH THE TEACHER'S PERMISSION

   2. Connect the vehicle above to the diagnostic scope.

   3. Choose the cylinder balance test mode and start the vehicle.

   4. Electrically "kill" one cylinder and record the % of change.

      Percent of change =

   5. Compare your answers for #1.c. and #4. above. Are they the same? Should they be?
ENGINE DISASSEMBLY

MATH COMPONENT

I. Competency:

The student will compute ratios and fractional parts using various engine parts.

Example:

An engine has 8 cam bearings and 4 main bearings. What fractional part of the engines bearings are used for the cam? What fractional part of the engines bearings are used for main bearings?

\[
\text{8 cam bearings} + \text{4 main bearings} = 12 \text{ engine bearings}
\]

a. 8 out of 12 are cam bearings or \(\frac{8}{12}\) reduced = \(\frac{2}{3}\)

b. 4 out of 12 are main bearings or \(\frac{4}{12}\) reduced = \(\frac{1}{3}\)

Conclusion: \(\frac{2}{3}\) of the engines bearings are for the cam and \(\frac{1}{3}\) for the main bearings.
ENGINE DISASSEMBLY
HANDS ON ACTIVITY

I. COMPUTE THE FOLLOWING FRACTIONAL PARTS

1. While removing the spark plugs from an eight cylinder engine a mechanic found that 3 plugs were carbon-fouled, 5 plugs were oil-fouled and 4 plugs had detonation damage.

In fractional terms answer the following:

1. What fractional part of the engine's plugs was carbon-fouled?
   
   ans. ____________

2. What fractional part of the engine's plugs was oil-fouled?
   
   ans. ____________

3. What fractional part of the engine's plugs was damaged by detonation?
   
   ans. ____________
ENGINE LUBRICATION AND COOLING

MATH COMPONENT

DIRECTIONS: PLACE THE CORRECT ANSWER IN THE SPACE PROVIDED. REFER TO THE ATTACHED CHART FOR ALL INFORMATION.

1. Engine operation is considered to be "clean" above what temperature?

2. What happens to rings and valves at 60 degrees Fahrenheit?

3. How much cylinder wear was there on the engine that was operated at 160 degrees?

4. How many gallons of gasoline did the engine operating at 100 degrees use per hour? How much did it use during the entire test?

5. How much horsepower did the engine operating at 40 degrees develop?

6. At what temperature do "oil screens" begin to freeze?

7. How much cylinder wear was there on the engine that was operated at 40 degrees?

8. How much horsepower did the engine operating at 160 degrees develop?

9. How many gallons of gasoline did the engine operating at 40 degrees use per hour? How much did it use during the entire test?

10. At what temperature does the "etching of parts" begin?
ENGINE LUBRICATION AND COOLING

60 HOUR GASOLINE ENGINE TEST

<table>
<thead>
<tr>
<th>DEGREES FAHRENHEIT</th>
<th>350°F</th>
<th>300°F</th>
<th>250°F</th>
<th>200°F</th>
<th>150°F</th>
<th>100°F</th>
<th>50°F</th>
<th>32°F</th>
<th>0°F</th>
<th>-50°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>REACTION WITHIN ENGINE CRANKCASE TO TEMPERATURES DURING OPERATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>350°F</td>
<td>CLEAN ENGINE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300°F</td>
<td>GAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>250°F</td>
<td>LIQUID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200°F</td>
<td>CONDENSATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150°F</td>
<td>SLUDGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100°F</td>
<td>ETCHING OF PARTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50°F</td>
<td>RING &amp; VALVE STICKING &amp; BURNING OF BEARINGS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32°F</td>
<td>SLUDGE &amp; FREEZING OF OIL SCREENS &amp; PUMPS RESULTING IN BURNED BEARINGS &amp; STRIPPED PUMP GEARS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0°F</td>
<td>SNOW &amp; ICE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-50°F</td>
<td>ICE</td>
<td></td>
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</tbody>
</table>

60 HOUR GASOLINE ENGINE TEST

OPERATING TEMPERATURE

- 40°F
- 100°F
- 140°F
- 160°F
- 180°F

CYLINDER WEAR

- .008 in.
- .002 in.
- .001 in.
- .0005 in.
- .0003 in.

FUEL CONSUMPTION

- 38 GPH
- 35 GPH
- 32 GPH
- 29 GPH
- 28 GPH

POWER

- 26 HP
- 27.2 HP
- 28.5 HP
- 29 HP
- 29.5 HP

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ENGINE LUBRICATION AND COOLING
MATH COMPONENT

I. Competency:

The student will convert fractions to decimals and vice versa; calculate a percentage; and identify correct points on a graph or line.

Example:

1. If the capacity of a car’s cooling system is 21 qts. and 45% of the coolant is antifreeze, how many qts. of antifreeze does the car have in it? How many qts. of water?

   \[ 21 \text{ qts.} \times 45\% = \quad \text{qts. of antifreeze} \]
   \[
   \begin{array}{c}
   21 \\
   \times 0.45 \\
   \hline
   9.45 \text{ qts. of antifreeze}
   \end{array}
   \]

   \[ 21 \text{ qts.} \times 55\% = \quad \text{qts. of water} \]
   \[
   \begin{array}{c}
   21 \\
   \times 0.55 \\
   \hline
   11.55 \text{ qts. of water}
   \end{array}
   \]

2. The manufacturer recommends a mixture of 50% water and 50% antifreeze. The car you are servicing has a cooling system capacity of 17 qts. How many qts. of antifreeze will you need to refill the system after it has been drained?

   \[ 50\% \text{ of } 17 \text{ qts.} = \quad \text{number of quarts required} \]
   \[
   \begin{array}{c}
   17 \\
   \times 0.50 \\
   \hline
   8.5 \text{ qts. of antifreeze}
   \end{array}
   \]

3. Using the chart on the antifreeze container, determine the amount of antifreeze needed for a car with a cooling system capacity of 23 qts.
ENGINE LUBRICATION AND COOLING

HANDS ON ACTIVITY

1. Using the manuals in front of the room look up the following car and calculate the amount of antifreeze you will need after draining and flushing the cooling system.

1988 Chev. Caprice, 305 cubic inch engine, with air conditioning

Cooling system capacity = ________ qts.

Recommended mixture 50 / 50

Qts. of antifreeze required = ________ qts.

2. A customer enters your garage and asks to have his/her car winterized. You determine that the car has a 19 qt. cooling system. How many qts. of antifreeze will you need to complete the job?

_______ qts.

3. Looking at the jobs scheduled for the next day you find that you have two cars to be winterized. One car has a 13 qt. capacity and the other a 13 1/2 qt. capacity. How many qts. of antifreeze will be needed to complete both jobs?

_______ qts.

4. How many gallons would you have to purchase to complete all the jobs on this page?

_______ gals.
ELECTRICITY AND THE BATTERY
MATH COMPONENT

1. Competency:

The student will solve for the unknown value when given the Ohms' Law formula.

\[ E = I \times R \quad I = \frac{E}{R} \quad R = \frac{E}{I} \]

\[ E = \text{VOLTS (volts)} \quad I = \text{CURRENT (amps)} \quad R = \text{RESISTANCE (ohms)} \]

1. A mechanic is testing a component on a vehicle that has a 12 volt battery and he/she gets a reading of 6 ohms. How many amps are there in the circuit?

\[ I = \frac{E}{R} \]

2. During a battery draw test a mechanic gets a reading of 100 amps. The starter's resistance measures 1200 ohms. What is the battery voltage?

\[ E = I \times R \]

3. An old VW beetle with a 6 volt battery comes into your garage. While testing the wiper motor you get a reading on your ammeter of .05 amps. What is the resistance of this motor?

\[ R = \frac{E}{I} \]

4. How much current will a light bulb with 12K ohms (12,000 ohms) draw when connected to a 36 volt battery?

\[ I = \frac{E}{R} \]

5. How many volts are being applied to a circuit with a reading .004 amps if the resistance is equal to 6K (6000 ohms)?

\[ E = I \times R \]
ELECTRICITY AND THE BATTERY

OHMS LAW

DIRECTIONS: USING THE FOLLOWING FORMULAE SOLVE THE PROBLEMS BELOW. BE SURE TO SHOW ALL WORK AND LABEL YOUR ANSWERS.

\[ E = I \times R \quad I = \frac{E}{R} \quad R = \frac{E}{I} \]

\[ E = \text{VOLTS (volts)} \quad I = \text{CURRENT (amps)} \quad R = \text{RESISTANCE (ohms)} \]

1. \( 3 \text{ volts} \quad .005 \text{ amps} \quad \text{resistance} = \) ________

2. \( 6 \text{ volts} \quad 1200 \text{ ohms} \quad \text{current} = \) ________

3. \( 2.5 \text{ amps} \quad 300 \text{ ohms} \quad \text{voltage} = \) ________

4. \( .06 \text{ amps} \quad 12 \text{ volts} \quad \text{resistance} = \) ________

5. \( 2400 \text{ ohms} \quad 12 \text{ volts} \quad \text{current} = \) ________

6. \( I = .002 \quad E = 36 \quad R = ? \) ________

7. \( I = ? \quad E = 6 \quad R = 1500 \) ________

8. \( I = .08 \quad E = ? \quad R = 1650 \) ________

9. \( I = 2 \quad E = .5 \quad R = ? \) ________

10. \( I = ? \quad E = 3 \quad R = 900 \) ________

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ELECTRICITY AND THE BATTERY

OHMS LAW

DIRECTIONS: USING THE FOLLOWING FORMULAS SOLVE THE PROBLEMS BELOW. DO NOT WRITE ON THIS TEST. PLACE YOUR ANSWER ON THE SHEET PROVIDED.

\[ E = I \times R \quad I = \frac{E}{R} \quad R = \frac{E}{I} \]

\[ E = \text{VOLTS (volts)} \quad I = \text{CURRENT (amps)} \quad R = \text{RESISTANCE (ohms)} \]

11. A mechanic is testing a component on a vehicle that has a 12 volt battery and he gets a reading of 3 ohms. How many amps are there in the circuit?

12. During a battery draw test a mechanic gets a reading of 200 amps. The starters resistance measures 2400 ohms. What is the battery voltage?

13. An old VW beetle with a 6 volt battery comes into your garage. While testing the wiper motor you get a reading on your ammeter of .02 amps. What is the resistance of this motor?

14. How much current will a light bulb with 12K ohms (12,000 ohms) draw when connected to a 12 volt battery?

15. How many volts are being applied to a circuit with a reading .003 amps if the resistance is equal to 6K (6000 ohms)?

16. 6 volts .005 amps resistance = 

17. 4 volts 1200 ohms current = 

18. 2.5 amps 800 ohms voltage = 

19. .04 amps 12 volts resistance = 

20. 1200 ohms 12 volts current = 

- 28 -

\[ \text{30} \]
ELECTRICITY AND THE BATTERY
HANDS ON ACTIVITY

OHMS LAW

DIRECTIONS: USING THE EQUIPMENT PROVIDED IN THE FRONT OF THE ROOM MEASURE THE AMOUNT OF CURRENT, VOLTAGE AND RESISTANCE IN EACH OF THE CIRCUITS.

PART I

CIRCUIT # 1
1. AMPS = __________
2. VOLTAGE = __________

CIRCUIT # 2
1. AMPS = __________
2. RESISTANCE = __________

CIRCUIT # 3
1. VOLTAGE = __________
2. RESISTANCE = __________

PART II

DIRECTIONS: USING THE FORMULAE GIVEN BELOW AND THE READINGS YOU OBTAINED ABOVE SOLVE FOR THE UNKNOWN VALUE.

\[ E = I \times R \quad I = \frac{E}{R} \quad R = \frac{E}{I} \]

\[ E = \text{VOLTS (volts)} \quad I = \text{CURRENT (amps)} \quad R = \text{RESISTANCE (ohms)} \]

CIRCUIT 1 - RESISTANCE = __________
CIRCUIT 2 - VOLTAGE = __________
CIRCUIT 3 - AMPERAGE = __________
THE CHARGING SYSTEM

MATH COMPONENT

1. Competency:

The student will determine the condition of an alternator by multiplying the alternator's output by a fraction.

EXAMPLE:

While testing an alternator a mechanic reads the following: "During this test alternator output should not be less than 2/3's of the total rated alternator output."

1. If the alternator rated output is 60 amps, what is the minimum acceptable output?

2. If the alternator rated output is 100 amps, what is the minimum acceptable output?

3. If the alternator rated output is 50 amps, what is the minimum acceptable output?
THE CHARGING SYSTEM
HANDS ON ACTIVITY

DIRECTIONS: USING THE EQUIPMENT PROVIDED MEASURE AND RECORD THE FOLLOWING INFORMATION ABOUT YOUR / TEST VEHICLE.

1. BATTERY VOLTAGE = __________ VOLTS

2. CHARGING AMPERAGE = __________ AMPS

3. CHARGING VOLTAGE = __________ VOLTS

4. STARTER DRAW = __________ AMPS
I. Competency:

Given the size of two mechanical components the student will determine their ratio.

EXAMPLE:

There are 200 teeth on an engine's flywheel and 10 teeth on the engine's starter drive.

What is the ratio between the starter drive and the flywheel?

200 to 10 or 20 to 1

20:1

How many times must the drive turn in order to turn the flywheel once?

20 times
THE STARTING SYSTEM
HANDS ON ACTIVITY


ENGINE SIZE

STARTER TYPE

DRIVE DIAMETER

# TEETH ON DRIVE

# TEETH ON FLYWHEEL

FLYWHEEL DIAMETER

RATIO BY DIAMETER

RATIO BY # OF TEETH

- 33 -
I. Competencies: 

1. Given the necessary information students will:  
   a. accurately compute "miles per gallon"  
   b. accurately compute necessary fuel requirements for different length trips  
   c. accurately compute the cost of travel based on M.P.G., distance traveled and current fuel prices

II. Lesson: 

1. How many miles per gallon does a vehicle get if it travels 300 miles on 15 gallons of fuel? 

   \[
   \frac{300 \text{ miles}}{15 \text{ gallons}} = \frac{20 \text{ mpg}}{15} \text{)300}
   \]

2. You are planning a trip across country which will be about 5200 miles. Your car gets 26 miles per gallon.  

   a. How much fuel will you need to complete your trip? 

   \[
   \frac{200 \text{ Gallons}}{26} \text{)5200}
   \]

   b. How much money will you need for fuel if fuel costs $1.28 per gallon? 

   \[
   200 \text{ gallons} \times 1.28 \text{ = } 256.00
   \]
I. Assignment:

Within the next three weeks compute the MPG of your family car. Record the following information:

1. Odometer reading after filling the gas tank completely.

______________ miles

2. Odometer reading at next fill up, the number of gallons it took to fill the tank, type of gas (regular, unleaded, super) and the price per gallon.

   a. ______________ miles
   b. ______________ number of gallons to fill tank
   c. ______________ type of gasoline
   d. ______________ price per gallon

3. Subtract the odometer reading recorded in number 1. from the one you recorded in number 2. and record the number of miles traveled.

   Odometer reading #1. ____________
   - Odometer reading #2. ____________
   Miles traveled ______________

   a. ______________ number of miles traveled

4. Divide the number of miles that were traveled by the number of gallons of gasoline it took to fill the tank in #2. Your answer will be the number of miles per gallon your vehicle gets.

   miles traveled
   # gallons

   - 35 -
   \[ \frac{35}{3} \]
HANDS ON ACTIVITY

THE FUEL SYSTEM: GENERAL

I. Assignment:

Using the map provided:

1. Compute and record the distance, in miles, between your house and the High School.

__________ miles

2. How many miles would you travel if you drove round trip from your house to school every day during the school year? (NOTE: there are 180 school days each year)

# miles X 2 = miles driven per year to school

__________ miles

3. Based on the information above how many gallons of gas would you require during the school year?

# of gallons required

\[
\text{MPG} \div \text{miles traveled}
\]

4. How much will it cost you to drive to school each day based on your gas stations current prices?
I. Competency:

Given the necessary measuring equipment students will:

1. determine the thickness of a brake rotor and the diameter of a brake drum

2. calculate the amount of material that can be safely removed during a rotor/drum resurfacing operation

II. Lesson:

1. As part of a good brake job, mechanics must be able to resurface brake drums and rotors correctly and safely. A good visual inspection and cleaning followed by accurate measuring is essential.

2. Students will:
   
a. measure both a drum and rotor recording the drums diameter and the rotors thickness
      
      drum dia. ____________
      
      rotor thickness ________

   b. determine the maximum diameter the drum can be using references found in the room
      
      max. drum dia. ____________

   c. using references found in the room determine the minimum thickness the brake rotor may be turned
      
      min. rotor thick. ________

   d. calculate the maximum amount of material which may be removed from both the drum and the rotor and record below
      
      rotor ________
      
      drum ________
BRAKE SYSTEMS
WORKSHEET

Directions: Calculate the following and record your answers.

1. While performing a brake job on a 1969 Chevy Camero a mechanic measures the brake drum and obtains a reading of 9.535". The manual indicates that the drums original diameter was 9.5". The following information is stamped on the brake drum; "MAX. DIA. 9.560". How much material can the mechanic safely remove?

2. A mechanic measures a used brake rotor and finds that it is .997" thick. The manual indicates that the original thickness was 1.00" and that the discard thickness is .960" How much material can be removed from this used rotor? How much material can be removed from a new rotor?

3. A drum measures 11.046" in diameter. This is .046" oversize. If the drum was never resurfaced what was the original drum diameter?

4. A rotor measures .892" thick. Discard thickness is listed as .860". How much material may still be removed?
I. Assignment: Make the following measurements, using the appropriate system (standard or metric), and record your findings in the space provided.

A. Rotor -

1. Select a rotor, measure its thickness and record below.
   a. _________ in./mm thick

2. Determine this rotor's original thickness and record below.
   a. _________ in./mm

3. Find this rotor's minimum or discard thickness and record below.
   a. _________ in./mm

4. Using the information you recorded above, calculate how much the rotor has worn and how much material may still be removed.
   a. _________ in./mm of wear
   b. _________ in./mm of material remaining

B. Drum -

1. Select a drum and measure its diameter.
   a. _________ in./mm diameter

2. Determine this drum's original diameter and record below.
   a. _________ in./mm diameter

3. Calculate the amount this drum is worn.
   a. _________ in./mm of wear

4. Using the information you recorded above, calculate how much material may be safely removed.
   a. _________ in./mm of remaining material
CAREERS
MATH COMPONENT

I. Competency:

With the use of reference materials in the room students will correctly fill out a "work order form" (see attached) including:

1. Owner information

2. Description of vehicle, date, mileage....

3. Description of work performed, and amount of time necessary to complete the work.

II. Lesson:

All members of the class will complete an estimate using a Work Order Form for the following job:

Replace the exhaust system on a 1986 Buick Station Wagon from the catalytic converter back. It has a 350 cu. in. engine, 4 barrel carb. and 2 1/2" tailpipe. Use your name and address where customer information is needed. Be sure to list all pipes, hangers and clamps required. List all prices and the amount of time it will take to perform this job. Finally, compute how much the labor will be using an hourly rate of $33.50/hr. Add both the labor and parts together for the total cost of the repair.
I. Assignment:

Complete a work order form for a "major engine tune-up" for your or your family car. Be sure to fill out form completely. Use references in the room to determine necessary parts, hours required etc. Calculate the cost of this operation.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>鮮 (quantity)</th>
<th>PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
</table>

H.S. POWER TECH.

[Form Details]

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BEST COPY AVAILABLE
UNIT 1 WORKSHEET

1. Calculate the following:

1. \( \begin{array}{c} 684 \\ 827 \\ +139 \end{array} \)

2. \( 2 \times (643 + 524) \)

3. \( 6 \times (87) + 3 \times (60) \)

4. \( 64 \times 192 \)

5. \( \begin{array}{c} 753 \\ \times 281 \end{array} \)

6. \( (82) \times (95) \times (17) \)

CARRY OUT TO 3 DECIMAL PLACES. ROUND OFF TO TWO DECIMAL PLACES.

7. \( 24 \sqrt{647} \)

8. \( 159 \sqrt{3008} \)

9. \( 373 \sqrt{82194} \)

10. Convert the following:

\[
\begin{align*}
2 \text{ ft. 6 inches} & = \quad \text{_____ inches} \\
102 \text{ inches} & = \quad \text{_____ ft. _____ inches} \\
6.4 \text{ mm} & = \quad \text{_____ cm} \\
1472 \text{ cm} & = \quad \text{_____ meters} \\
1 \text{ inch} & = \quad \text{_____ cm}
\end{align*}
\]
UNIT 1 QUIZ

Directions: Calculate the following and place your answer on the paper provided.

1. \( 6 \times (86 + 15) \)

2. \( (383) \times (26) \)

3. \( (43) \times (17) \times (52) \)
   CARRY OUT TO THREE DECIMAL PLACES. ROUND TO TWO DECIMAL PLACES

4. \( 38 \div 6671 \)

5. Directions: Convert the following and place your answer on the paper provided.

   \[
   \begin{align*}
   4 \text{ ft.} \ 8 \text{ inches} & = \underline{\hspace{2cm}} \text{ inches} \\
   303 \text{ inches} & = \underline{\hspace{2cm}} \text{ ft.} \ \underline{\hspace{1cm}} \text{ inches} \\
   62 \text{ cm} & = \underline{\hspace{2cm}} \text{ m} \\
   10 \text{ m} & = \underline{\hspace{2cm}} \text{ cm} \\
   1 \text{ inch} & = \underline{\hspace{2cm}} \text{ cm}
   \end{align*}
   \]

Use the following information for questions 6 - 10

A room measures 20' 4" wide, 22' 6" long and is 10' 2" high.

6. The rooms perimeter = \\

7. The rooms area = \\

8. The rooms volume = \\

9. How many gallons of paint will it take to cover the floor of the room if each gallon of paint covers 100 square feet?

10. How long would it take a 1500 cubic ft. per minute air purification system to change the air in the room?
UNIT 2 WORKSHEET

Directions: Place all your answers in the space provided.

1. Using the ruler provided, measure the length of the following line segment to the nearest 1/16 of an inch.

   [ ] answer ________

2. Using the ruler draw a line segment that is 2 3/8" long in the space provided.

FOR PROBLEMS # 3 –5, FIND THE COMMON DENOMINATOR AND CONVERT EACH FRACTION TO COMMON DENOMINATOR FORM. ORDER FRACTIONS FROM SMALLEST TO LARGEST IN EACH PROBLEM.

3. 1/2, 1/4, 2/3
   smallest _______ _______ _______ largest

4. 2/5, 2/4, 3/10, 7/20
   smallest _______ _______ _______ largest

5. 5/16, 4/8, 17/32, 1/2, 1/4, 3/16
   smallest _______ _______ _______ _______ largest

COMPUTE PROBLEMS # 6 - 9 BY ADDING THE GIVEN FRACTIONS. REDUCE ALL ANSWERS IF POSSIBLE.

6. 4/12 + 3/12 + 1/12 = __________

7. 1/2 + 1/4 + 1/8 = __________

8. 5/12 + 2/3 + 2/4 = __________

9. 2/20 + 7/15 + 4/10 = __________

10. Name a fraction that is larger than 1/4 and smaller than 7/16.

    answer ________

    - 45 - 47
UNIT 2 QUIZ

Directions: Calculate the following and place your answer on the paper provided.

1. Estimate to the nearest 1/16 of an inch the length of the following line segment.
   
2. Using a ruler draw a line segment that is 1 7/8" long.

3. Add the following: (reduce if possible)
   \[\frac{3}{16} + \frac{2}{8} + \frac{1}{32} = \]

4. Add the following: (reduce if possible)
   \[\frac{2}{7} + \frac{6}{77} + \frac{4}{11} = \]

5. Add the following: (reduce if possible)
   \[\frac{1}{4} + \frac{2}{5} + \frac{1}{6} = \]

FOR PROBLEMS # 6 - 7 FIND THE COMMON DENOMINATOR AND CONVERT EACH FRACTION TO COMMON DENOMINATOR FORM. ORDER FRACTIONS FROM SMALLEST TO LARGEST IN EACH PROBLEM.

6. \[
\begin{array}{cccc}
\frac{1}{16} & \frac{1}{2} & \frac{3}{8} & \frac{14}{32} & \frac{2}{4} \\
\text{smallest} & & & & \text{largest}
\end{array}
\]

7. \[
\begin{array}{cccc}
\frac{2}{5} & \frac{3}{10} & \frac{4}{5} & \frac{5}{20} \\
\text{smallest} & & & \text{largest}
\end{array}
\]

8. A mechanic has a combination wrench set (one size per wrench) which contains wrenches from 1/4" to 2" in 1/4" increments. How many wrenches are there in this set?

9. While working on a vehicle a mechanic discovers that a 3/4" wrench is too small for the job and a 7/8" is too large. Knowing that it's not a metric size what wrench size should he try next?

10. A mechanic needs a 3/8" wrench. He takes three wrenches from the tool box and tries each. Two wrenches are too small and one is too large. The 3 wrenches were labeled 1/4", 1/2" and 5/16" which wrench was too large and which were too small?

   small: _______, _______  large: _______
UNIT 3 WORKSHEET

Directions: Compute the following problems. Place all your answers in the space provided.

MULTIPLY:

1. 2.8
   x.63

2. 64.9
   x.035

3. (14.6) (29.8)

4. (8.2) (4.6) (.613)

5. (23.6) (10.4) (8)

DIVIDE: CARRY OUT TO THREE DECIMAL PLACES AND ROUND TO TWO

6. 6|824.6

7. 4|28.04

ROUND TO THE NEAREST WHOLE NUMBERS:

8. 62.019

9. Find 28% of 82

10. Find 83% of 104

- 47 -
UNIT 3 QUIZ

Directions: Calculate the following problems and place your answers on the paper provided.

MULTIPLY

1. \( 46.2 \times 90.5 \)

2. \( (63.6) (1.83) \)

DIVIDE

3. \( \frac{7182.06}{X} \)

ROUND TO THE NEAREST WHOLE NUMBER

4. \( 6.496 \)

5. Find 42\% of 16

USE THE FOLLOWING INFORMATION FOR #6-9. DURING A COMPRESSION TEST A MECHANIC GETS THE FOLLOWING READINGS:

Cylinder #1 = 150 psi
Cylinder #2 = 185 psi
Cylinder #3 = 165 psi
Cylinder #4 = 175 psi

6. What is the lowest acceptable reading for this situation?

7. What is 15\% of the reading on cylinder #2?

8. How many more psi would be required to make #1 cylinder acceptable?

9. If the highest reading were 165 psi, would cylinder #1 be acceptable? (Show your work.)

USE THE FOLLOWING FORMULA TO CALCULATE THE PROBLEMS BELOW.

\[ \text{BORE}^2 \times \text{PI} \times \text{STROKE} \times \frac{\text{NUMBER OF CYLINDERS}}{4} = \text{C.I.D.} \]

10. BORE \hspace{1cm} STROKE \hspace{1cm} # of CYL. \hspace{1cm} ANS.
    a. 3" \hspace{1cm} 3.5" \hspace{1cm} 6
    b. 4.25" \hspace{1cm} 4.5" \hspace{1cm} 8
        \hspace{1cm} - 48 -
UNIT 4 WORKSHEET

Directions: Compute the following problems. Place all your answers in the space provided.

ADD:

1. \( \frac{21}{2} + \frac{61}{3} \)
2. \( \frac{33}{4} + \frac{21}{8} \)

MAKE THE FOLLOWING CONVERSIONS

3. a. 4 gallons = _____ quarts
   b. 18 quarts = _____ gallons _____ quarts
   c. 1 year = _____ days
   d. 1 year = _____ weeks
   e. 1 year = _____ months

MULTIPLY

4. \( 3 \frac{1}{2} \times 3 \) = _____
5. \( 4 \times 5 \frac{3}{7} \) = _____

ADD: (simplify improper fractions)

6. \( 2 + 3 \frac{1}{3} \) = _____
7. \( 6 + 2 \frac{1}{2} \) = _____
8. \( 2 \frac{3}{4} + 3 \frac{1}{2} + 6 \frac{2}{3} \) = _____

9. Multiply 32 cents by 485 and write in dollar notation.

DIVIDE

10. \( \frac{38}{462} \) = \( \frac{49}{51} \)
UNIT 4 QUIZ

Directions: Calculate the following problems and place your answers on the paper provided.

ADD

1. \[3 \frac{2}{3} + 4 \frac{1}{4} = \]
2. \[8 \times 2 \frac{2}{3} = \]

CONVERT

3. \[33 \text{ quarts} = \quad \text{gallons} \quad \text{quarts}\]
4. \[3 \text{ gallons} = \quad \text{quarts}\]
5. \[1 \text{ year} = \quad \text{weeks}\]

4. Multiply 27 cents by 618 and express in dollar notation.

5. Divide \[57 \div 8601\] and round to the hundredths decimal place.

6. If the manufacturer recommends you change your oil every 3 months or 3 thousand miles; how many times per year should you change your oil if you drive 1800 miles each month? (show your work)

USE THE FOLLOWING INFORMATION FOR # 7 - 9.

Records indicate that your business did an average of two oil changes per day last year. The average oil change produces 4 1/4 quarts of drain oil. Using 365 as the number of days in a year....

7. How many quarts of drain oil did your garage produce last year?
8. The waste oil company will come each time you accumulate 100 gallons of waste oil. How many times during the year did the waste oil company need to come?

9. How much did it cost to have the oil removed for one year if the waste oil company charged you 34 cents per gallon?

10. A customer drives their car 27,000 miles in one year. They change the oil every 3000 miles. If oil costs $1.69 per quart and each oil change requires 3 quarts of oil to complete, what is the cost for the oil for 1 year?
UNIT 5 WORKSHEET

Directions: Compute the following problems. Place all your answers in the space provided. Round to whole percentages.

CONVERT TO PERCENTAGES:

1. 2 out of 4 _________ %

2. 3 out of 7 _________ %

3. \( \frac{12}{35} = \) _________ %

4. 10% of what number is 4? _________

5. 25% of 16 is what number? _________

6. 62 is what percent of 248? _________

7. What percent is shaded? _________

8. What percent is shaded? _________

9. What percent is shaded? _________

10. What percent is shaded? _________
UNIT 5 QUIZ

Directions: Convert to a percentage: (round to 2 decimal places if necessary)

1. 7 out of 9 = _____ %

2. \( \frac{9}{12} \) = _____ %

3. 14\% \text{ of what number is } 2.8? _____

4. What percent is shaded? _____ %

5. What percent is shaded? _____ %

6. Each cylinder in a four cylinder engine represents what \% of the total engine cylinders?
   _____

7. 75\% \text{ of the cylinders in a 8 cylinder engine were found to be faulty. How many cylinders were faulty?}
   _____ cylinders

8. If 3 of the cylinders in a 8 cylinder engine were found to be faulty what \% of the cylinders are faulty?
   _____

9. Two vehicles come to your garage each have faulty cylinders. The first, a 6 cylinder, has 2 faulty cylinders the second, a 4 cylinder, has 1 faulty cylinder. Which engine has the higher \% of faulty cylinders? (show all work)
   _____

10. A 4 cylinder car with 2 faulty cylinders gets 1 of its cylinders repaired. What percent of the damaged gets repaired?
    _____

- 53 -
UNIT 6 WORKSHEET

Directions: Compute the following problems. Reduce answers if possible and place in the space provided.

USE THE FOLLOWING INFORMATION FOR # 1 - 5

A car dealer has 4 red, 3 green, 8 purple, 1 black, and 2 blue cars on the lot.

1. What fractional part of the total lot is the purple cars?

2. What fractional part of the total lot is the green cars?

3. By combining the red and green cars, what fractional part of all the cars does this represent?

4. If all but the black car are considered 1 group, what fractional part of all the cars does this represent?

5. What fractional part of the total cars on the lot is the collection of cars with even numbered amounts?

6. Express 11 out of 121 as a reduced fraction.

7. Express 9 out of 9 as a reduced fraction.

8. A box of twelve spark plugs contained two different sizes of spark plugs. One third of the spark plugs were type A. How many were type B?
9. Two different kinds of hex wrenches were combined to form a collection of twenty five wrenches. Ten of the wrenches were small sizes. Express as a reduced fraction the number of larger type of wrenches out of the total number of wrenches.

10. 5 out of 6 cars on the dealers lot have 4 cylinder engines. Express in words what this statement means.
UNIT 6 QUIZ

Directions: Calculate the following and place your answer in the space provided. Reduce answer if possible.

USE THE FOLLOWING INFORMATION FOR # 1 - 5

A car dealers lot contains 9 white, 7 blue, 5 red and 3 yellow cars.

1. What fractional part of the total lot is the collection of blue cars? __________

2. If red and yellow cars were combined into one group what fractional part of the total number of cars would they represent? __________

3. If the red and blue cars were combined what fractional part of all the cars does this represent? __________

4. What fractional part of the total lot is the collection of white cars? __________

5. Express as a reduced fraction 34 out of 51 __________.

6. If half of all the spark plugs in an 8 cylinder engine were carbon fouled, this could be expressed as _____ out of every _______ plugs would be carbon fouled.

USE THE FOLLOWING INFORMATION FOR # 7 - 10

While removing the spark plugs from a 12 cylinder engine a mechanic found that 4 plugs were carbon fouled, 6 plugs were oil fouled and two plugs had detonation damage.
In fractional terms answer the following:

7. What fractional part of the engine's spark plugs was carbon fouled?

8. What fractional part of the engine's spark plugs was oil fouled?

9. What fractional part of the engine's spark plugs was damaged by detonation?

10. What fractional part of the engine's spark plugs was not damaged by detonation?
UNIT 7 WORKSHEET

Directions: Compute the following problems and place in the space provided.

1. **CONVERT THE FOLLOWING % TO DECIMALS**

<table>
<thead>
<tr>
<th>PERCENT</th>
<th>DECIMAL EQUIVALENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 8%</td>
<td></td>
</tr>
<tr>
<td>b. 2.4%</td>
<td></td>
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<tr>
<td>c. 185%</td>
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<tr>
<td>d. .03%</td>
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<tr>
<td>e. 47%</td>
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</tbody>
</table>

2. Find 62% of 50 __________

3. 13% of 92 is __________

4. 4.6% of 75 is __________

5. 120% of 238 is __________

**ADD**

6. 14 3/4 + 11 2/4 = __________

7. 6 1/2 + 4 1/3 + 8 3/4 = __________

8. **CONVERT THE FOLLOWING**

   a. 16 gallons = _________ quarts
   b. 102 quarts = _________ gallons ______ quarts
   c. 8 gallons = _________ quarts
   d. 40 quarts = _________ gallons ______ quarts
   e. 3 liters = _________ ml
   f. 82 liters = _________ ml
   g. 1043 ml = _________ liters
   h. 64 ml = _________ liters
USE THE FOLLOWING CHART TO DETERMINE HOW MUCH ANTIFREEZE IS REQUIRED TO PROVIDE PROTECTION TO -34 F FOR THE COOLING SYSTEM CAPACITIES LISTED (#9 - 12)

QUARTS OF ETHYLENE GLYCOL REQUIRED FOR PROTECTION TO TEMPERATURES SHOWN

<table>
<thead>
<tr>
<th>Cooling System Capacity Quarts</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
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<tbody>
<tr>
<td>10</td>
<td>+24°F.</td>
<td>+16°F.</td>
<td>+4°F.</td>
<td>-12°F.</td>
<td>-34°F.</td>
<td>-52°F.</td>
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<tr>
<td>11</td>
<td>+25 18 8 6 -23 -47</td>
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<td>12</td>
<td>+28 19 10 0 -15 -34 -57°F.</td>
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<td>13</td>
<td>+27 21 13 3 -9 -25 -45</td>
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<td>14</td>
<td>+15 6 - 5 -16 -34</td>
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<td>15</td>
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<td>16</td>
<td>+17 10 +2 -8 -19 -34°F. -52°F.</td>
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<td>17</td>
<td>+18 12 +5 -4 -14 -27 -42</td>
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<tr>
<td>18</td>
<td>+19 14 +7 0 -10 -21 -34 -50°F.</td>
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<td>19</td>
<td>+20 15 +9 +2 -7 -16 -28 -42</td>
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<td>20</td>
<td>+18 10 +4 -3 -12 -22 -34 -48°F.</td>
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<td>21</td>
<td>+17 12 +6 0 -9 -17 -28 -41</td>
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<td>22</td>
<td>+18 13 +8 +2 -6 -14 -23 -34 -47°F.</td>
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<td>23</td>
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<td>24</td>
<td>+18 15 +10 +5 0 -8 -15 -23 -34 -48°F.</td>
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<td>26</td>
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<td>28</td>
<td>+18 15 +10 +6 +1 -5 -11 -18 -25 -34</td>
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<td>29</td>
<td>+19 16 +12 +7 +2 -3 -8 -15 -22 -29</td>
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<td>30</td>
<td>+20 17 +13 +8 +4 -1 -6 -12 -18 -25</td>
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</tbody>
</table>

9. A car with a 14 quart capacity cooling system enters your garage to have the cooling system flushed. How much anti freeze will be needed to complete the job?

___________ gallons _________ quarts

10. Which Job would require more antifreeze to complete?

Job 1. 3 cars each with a 12 quart capacity

Job 2. 2 cars each with a 19 quart capacity

Answer __________

How many quarts of antifreeze would be required to complete both jobs? How many gallons?

Answer _________ quarts

___________ gallons

GIVEN THE SYSTEM CAPACITY FIND THE AMOUNT OF ANTIFREEZE NEEDED TO PROTECT THE SYSTEM TO -34 F

<table>
<thead>
<tr>
<th>System Capacity</th>
<th>Antifreeze required</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. 24 quarts</td>
<td>_______ gallons _______ quarts</td>
</tr>
<tr>
<td>12. 18 quarts</td>
<td>_______ gallons _______ quarts</td>
</tr>
</tbody>
</table>
UNIT 7 QUIZ

Directions: Calculate the following and place your answer in the space provided.

1. Find 20% of 87

2. 93% of 33 is

ADD

3. \(6 \frac{1}{4} + 8 \frac{1}{2} + 3 \frac{2}{4} = \)

4. Using the chart below, how much antifreeze is recommended for a car with a cooling system capacity of 17 quarts? (-34 degrees F)

_____ gallons _____ quarts

QUARTS OF ETHYLENE GLYCOL REQUIRED
FOR PROTECTION TO TEMPERATURES SHOWN

<table>
<thead>
<tr>
<th>Cooling System Capacity Quarts</th>
<th>Number of Quarts of ETHYLENE GLYCOL Required for Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 +24°F. +18°F. +14°F. -12°F. -34°F. -62°F.</td>
<td></td>
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<tr>
<td>11 +25 +18 +8 -6 -22 -47</td>
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<tr>
<td>12 +26 +19 +10 0 -15 -34 -57°F.</td>
<td></td>
</tr>
<tr>
<td>13 +27 +21 +13 +3 -9 -25 -45</td>
<td></td>
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<tr>
<td>14 +15 +8 -5 -18 -34</td>
<td></td>
</tr>
<tr>
<td>15 +16 +8 0 -12 -26</td>
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<td>17 +18 +12 +5 -4 -14 -27 -42</td>
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<tr>
<td>18 +19 +14 +7 0 -10 -21 -34 -50°F.</td>
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<td>19 +20 +15 +9 +2 -7 -16 -28 -42</td>
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<td>20 +16 +10 +4 -3 -12 -22 -34 -48°F.</td>
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<tr>
<td>22 +18 +13 +8 +2 -8 -14 -23 -34 -47°F.</td>
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<tr>
<td>23 +19 +14 +9 +4 -3 -10 -19 -29 -40</td>
<td></td>
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<tr>
<td>24 +19 +15 +10 +5 0 -8 -15 -23 -34 -48°F.</td>
<td></td>
</tr>
<tr>
<td>25 +20 +18 +12 +7 +1 -5 -12 -20 -29 -50°F.</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: +32°F is freezing. For capacities under 10 quarts multiply true capacity by 3, find quarts of anti-freeze for the tripled volume, divide by 3 for the number of quarts to add. For capacities over 30 quarts divide true capacity by 3, find quarts of anti-freeze for the \(\frac{3}{4}\) of volume, multiply by 3 for the number of quarts to add.
5. 6 gallons = ______ quarts
14 quarts = ______ gallons
6 liters = ______ ML
5400 ML = ______ liters

6. If a manufacturer recommended a solution of water and antifreeze that required 60% antifreeze, what percent would be water?

7. The car you are servicing has a cooling system capacity of 19 quarts. How many quarts of antifreeze will you need to refill the system after it has been drained?

8. If three cars were scheduled to be winterized how much antifreeze would you need for all three jobs if the first car had a 12 quart capacity, the second a 14 1/2 quart capacity and the third a 17 3/4 quart capacity?

   _______ gallons _______ quarts

9. A car with a 14 quart capacity cooling system enters your garage to have the cooling system flushed. How much antifreeze will be needed to complete the job?

   _______ gallons _______ quarts

10. Which job would require more antifreeze to complete?

    Job 1. 3 cars each with a 12 quart capacity
    Job 2. 2 cars each with a 19 quart capacity

    Answer _______

    How many quarts of antifreeze would be required to complete both jobs? How many gallons?

    Answer _______ quarts

    _______ gallons
UNIT 8 WORKSHEET

Directions: Using the formulas provided calculate the value of the missing variable in the following problems. Place your answer in the space provided.

FORMULAS

\[ E = I \times R \quad I = \frac{E}{R} \quad R = \frac{E}{I} \]

COMPUTE THE FOLLOWING

1. \[ E = 12 \quad I = 5 \quad R = \square \]
2. \[ E = 6 \quad R = 1200 \quad I = \square \]
3. \[ I = 0.02 \quad R = 2400 \quad E = \square \]
4. \[ E = 12 \quad R = 150 \quad I = \square \]
5. \[ E = 36 \quad I = 2 \quad R = \square \]
6. \[ R = 1500 \quad I = 0.08 \quad E = \square \]
7. \[ R = 900 \quad E = 6 \quad I = \square \]
8. \[ I = 0.06 \quad E = 0.5 \quad R = \square \]
9. \[ R = 700 \quad I = 0.04 \quad E = \square \]
10. \[ I = 4 \quad E = 24 \quad R = \square \]
UNIT 8 QUIZ

Directions: For questions #1 - 5 use the following formulas to solve the problems below. Be sure to show all work and label your answers.

FORMULAS

\[ E = I \times R \quad I = \frac{E}{R} \quad R = \frac{E}{I} \]

E = Volts (volts) \quad I = Current (amps) \quad R = resistance (ohms)

1. 4 volts \( \quad \) .12 amps \( \quad \) R = __________
2. 3.5 amps \( \quad \) 200 ohms \( \quad \) E = __________
3. 2000 ohms \( \quad \) 15 volts \( \quad \) I = __________
4. 2 volts \( \quad \) .10 amps \( \quad \) R = __________
5. 1.5 amps \( \quad \) 500 ohms \( \quad \) E = __________

6. How much current will a light bulb with 10K (10,000) ohms draw when connected to a 36 volt battery?

7. How many volts are being applied to a circuit which is reading .002 amps if the resistance is equal to 3000 ohms?

8. A mechanic is testing a vehicle component that has a 9 volt battery. The circuit has a measured resistance of 10 ohms. How many amps are there in this circuit?

9. During a battery draw test a mechanic obtains a reading of 250 amps. The starter's resistance measures 1000 ohms. What is the battery voltage of this vehicle?

10. A car equipped with a 12 volt battery gives you a reading of 2 amps while testing the wiper circuit. What is the resistance in the wiper motor?
UNIT 9 WORKSHEET

Directions: Round the following to two decimal places.

1. \( \frac{2}{16} \) of 80 =

2. \( \frac{5}{7} \) of 77 =

3. \( \frac{3}{4} \) of 100 =

4. \( \frac{11}{13} \) of 169 =

5. \( \frac{7}{8} \) of 25 =

6. \( \frac{6}{7} \) of 83 =

7. \( \frac{9}{15} \) of 75 =

8. \( \frac{3}{5} \) of 60 =

9. \( \frac{4}{11} \) of 23 =

10. \( \frac{19}{20} \) of 2400 =

- 66 -
UNIT 9 QUIZ

Directions: Calculate the following. (Round to two decimal places if necessary)

1. \( \frac{1}{2} \) of 43 = 

2. \( \frac{3}{5} \) of 35 = 

3. \( \frac{7}{11} \) of 100 = 

4. \( \frac{2}{9} \) of 17 = 

5. \( \frac{3}{4} \) of 73 = 

USE THE FOLLOWING INFORMATION FOR QUESTIONS # 6 - 10

Before testing an alternator a mechanic reads the following: "During this test alternator output should not be less than \( \frac{3}{4} \)'s of the total rated alternator output."

6. If the alternators rated output is 75 amps, what is the minimum value that will be acceptable for output?

7. If the alternators rated output is 120 amps, what is the minimum value that will be acceptable for output?

8. If the alternators rated output is 90 amps, what is the minimum value that will be acceptable for output?

9. If the alternator rated output is 80 amps, would 75 be an acceptable output? (Show all work)

10. If the alternator rated output is 120 amps, would 85 be an acceptable output? (Show all work)
UNIT 10 WORKSHEET

Directions: Determine the following: (reduce answers if possible to two decimal places)

1. Ratio of 6 to 8
2. Ratio of 12 to 156
3. Ratio of 21 to 72

USE THE FOLLOWING INFORMATION FOR QUESTIONS #4 - 8
A car dealers lot has a total of 9 Chevrolets and 4 Fords.

4. What is the ratio of Chevys to Fords? _____ to _____
5. What is the ratio of Fords to Chevys? _____ to _____
6. What is the ratio of Chevys to the total cars on the lot? _____ to _____
7. What is the ratio of Fords to the total cars on the lot? _____ to _____
8. What is the ratio of the sum of the Fords and Chevys to the total cars on the lot? _____ to _____

USE THE FOLLOWING INFORMATION FOR QUESTIONS #9 - 10
A wrench set contains 8 metric and 12 standard wrenches.

9. What is the ratio of standard wrenches to metric wrenches? _____ to _____
10. What is the ratio of the total set of wrenches to non-metric wrenches? _____ to _____
UNIT 10 QUIZ

Directions: Determine the following ratios: (reduce answers if possible)

1. 12 to 16 = ___ to ___
2. 25 to 180 = ___ to ___
3. 110 to 15 = ___ to ___
4. 7 to 72 = ___ to ___
5. 36 to 48 = ___ to ___

6. A car's ring gear has 80 teeth and the pinion gear has 8. What is the ratio of this rear axle?
   ___ to ___

7. Each rotation of the car's driveshaft causes the vehicle's tire to rotate 1/4 turn. What is the ratio between the driveshaft and the tire?
   ___ to ___

8. A transmission input shaft rotates 1/2 turn causing the output shaft to rotate 1 time. What is the ratio between the input and output shafts?
   ___ to ___

9. To paint a car, an autobody man mixes 1 gallon of paint with 1 quart of reducer. What is the ratio of paint to reducer?
   ___ to ___

10. A mechanic has 150 bolts. 100 are coarse thread and 50 are fine thread. What is the ratio of coarse to fine thread bolts?
    ___ to ___
UNIT 11 WORKSHEET

Directions: Round to two decimal places if necessary

1. 18436.9
   -6908.6

2. 23004.1
   -7825.8

3. 6.4 \overline{181.7}

4. 0.18 \overline{346.2}

5. 5.7 \overline{60.08}

6. 0.116 \overline{970.4}

7. 237
   \times 1.08

8. 718
   \times 0.89

9. 8652
   \times 2.26

10. 549
    \times 4.83

- 68 - 70
UNIT 11 QUIZ

Directions: Calculate: Round to two decimal places if necessary.

1. \(764.3 - 587.6\)

2. \(6040.1 - 1604.6\)

3. \(5.8 \div 479.2\)

4. \(63 \div 745.6\)

5. \(672 \times 4.51\)

USE THE FOLLOWING INFORMATION FOR QUESTIONS 6 - 10

A customer purchased an automobile with 12,462.3 miles recorded on the odometer. One month later the odometer read 14711.2 miles.

6. How many miles did the new owner drive the first month?

   ans. 

7. If the car consumed 104.6 gallons of gas in that time, what was the car's gas mileage?

   ans. 

- 69 -
8. If gas costs $1.21 per gallon how much did the owner spend on gas during the first month? (round to nearest cent)

ans. _______

9. The next month the owner drove 1846.5 miles and decided to use a higher octane fuel costing $1.34 per gallon. What was the cost of fuel the second month?

ans. _______

10. The owner gets a tune-up which increases the milage by 5 miles per gallon. Assuming the car will be driven the same distance the third month as the second, and the owner will continue to use the more expensive gas, how much money will be saved over the second of driving in the cost of fuel?

ans. _______
UNIT 12 WORKSHEET

Directions: Calculate the following examples. Round to two decimal places if necessary.

1. \[0.980 - 0.033 = 0.947\]

2. \[11.600 - 0.060 = 11.540\]

3. \[9.560 - 0.052 = 9.508\]

4. \[0.860 - 0.015 = 0.845\]

5. \[7.500 - 0.034 = 7.466\]

6. A mechanic is turning a drum that measures 9.553. The manual says the drum may only be turned to 9.560. How much material can be safely removed from this drum?

7. A brake rotor measures .808 inches thick. Discard thickness for this rotor is .815. How much was this rotor turned undersize?

8. A brake lathe cuts on both sides of a rotor. If each cutter is set to .015" what will the total amount of material being removed equal?

9. A mechanic cutting a brake drum removes .008" on the first cut, .006" on the second cut and a final cut of .002. What is the total amount of material removed?

10. A mechanic cutting a brake rotor removes .004" on each side during the first pass and .002" on each side during the final pass. What is the total amount of material removed?
UNIT 12 QUIZ

Directions: Calculate. Round to two decimal places if necessary.

1. \( .980 - .014 \)

2. \( 11.600 - .022 \)

3. \( 9.560 - .044 \)

4. \( .860 - .024 \)

5. \( 7.500 - .022 \)

6. A mechanic is turning a drum that measures 9.512. The manual says the drum may only be turned to 9.560. How much material can be safely removed from this drum?

7. A brake rotor measures .812 inches thick. Discard thickness for this rotor is .815. How much was this rotor turned undersize?

8. A brake lathe cuts on both sides of a rotor. If each cutter is set to .003" what will the total amount of material being removed equal?

9. A mechanic cutting a brake drum removes .010" on the first cut, .008" on the second cut and a final cut of .004. What is the total amount of material removed?

10. A mechanic cutting a brake rotor removes .006" on each side during the first pass and .003" on each side during the final pass. What is the total amount of material removed?
ANSWER KEY

PG. 7
5. 13
6. 9/16"

PG. 9
1. 337 CID
2. 57 CID
3. 905 CID
4. 471 CID
5. 346 CID
6. 243 CID
7. 340 CID
8. 60 CID
9. 151 CID
10. 101 CID

PG. 13
1. 138 PSI
2. 28.5 PSI
3. 1.5 PSI
4. 30 PSI

PG. 15
2. A. 4 TIMES
   B. 8 TIMES
3. 13 7/12 QTS.

PG. 16
1. A. 6000 MILES
   B. 6 MONTHS
2. A. 3,285 QTS./YR.
   B. 273.75 QTS./YR.
   C. 63.17 QTS./WEEK
   D. $4.41/WEEK
      $19.18/MONTH
      $229.95/YEAR
4. A. 66.66%  B. 37.5%  C. 50%

20%
25%
2 CYLINDERS

1/4  5/12  1/3

130 DEGREES
RING AND VALVE STICKING
.0005 IN.
35 GPH
2100 GALLONS
26 HP

9.5 QTS.
14.75 QTS.

600 OHMS
.005 AMPS
750 VOLTS
200 OHMS
.005 AMPS

18,000 OHMS
.004 AMPS
132 VOLTS
.25 OHMS
.0033 AMPS

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PG. 28

11. 4 AMPS
12. 48,000 VOLTS
13. 300 OHMS
14. .001 AMPS
15. 18 VOLTS
16. 1200 OHMS
17. 4800 AMPS
18. 1500 VOLTS
19. 300 OHMS
20. .01 AMPS

PG. 30

1. 40 AMPS
2. 66 2/3 AMPS
3. 33 1/3 AMPS

PG. 38

1. .025 IN.
2. .037 IN.
3. 11 IN.
4. .032 IN.

PG. 42

1. 1650
2. 2334
3. 702
4. 12288
5. 211,593
6. 132,430
7. 26.958
7. 26.96
8. 189.182
8. 189.18
9. 220.359
9. 220.36
10. 30 INCHES
10. 8 FT. 6 IN.
10. .64 CM
10. 14.72 METERS
10. 2.54 CM

- 75 -
PG. 44

1.  608
2.  9958
3.  38,012
4.  175.552
5.  56 IN.
    25 FT. 3 IN.
    .62 M
    1000 CM
    2.54 CM

6.  85.666 OR 85'8"
7.  457.5 SQ. FT.
8.  4347.43 CU. FT.
9.  5 GALLONS
10. 3.1 MIN OR 3 MIN 6 SEC.

PG. 45

1.  2 3/16"
2.  MEASURE
3.  3/12, 6/12, 8/12
4.  6/20, 7/20, 8/20, 10/20
5.  6/32, 8/32, 10/32, 16/32, 17/32

6.  8/12 = 2/3
7.  7/8
8.  19/12 = 1 7/12
9.  58/60 = 29/30
10. 4/16, 5/16, 6/16, 7/16

PG. 46

1.  1 5/16"
2.  MEASURE
3.  15/32
4.  8/11
5.  49/60
6.  2/32, 12/32, 14/32, 16/32
7.  5/20, 6/20, 8/20, 16/20

8.  8
9.  13/16"
10. 1/4", 5/16" - 1/2"

- 76 -
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PG. 50

1. 13 5/12  
2. 21 1/3  
3. 8 GALLONS 1 QT.  
4. $166.86  
   12 QTS.  
   52 WEEKS  
5. 150.89  
6. 7 TIMES  
7. 3102.5 QTS.  

PG. 51

8. 7 TIMES  
9. $238.00  
10. 9 OIL CHANGES  
   27 QTS OIL REQ.  
   $45.63  

PG. 52

1. 50%  
2. 43%  
3. 34%  
4. 40  
5. 4  
6. 25%  
7. 33%  
8. 37.5%  
9. 70%  
10. 53%  

PG. 53

1. 78%  
2. 75%  
3. 20%  
4. 75%  
5. 50%  
6. 25%  
7. 6 CYLS.  
8. 38%  
9. 25%  
10. 50%  

PG. 54

1. 4/9  
2. 3/18  
3. 7/18  
4. 17/18  
5. 7/9  
6. 1/11  
7. 1  
8. 2/3 OF 12 8, TYPE B  

PG. 55

9. 3/5  

10. FOR EVERY 6 CARS THE DEALER HAS ON THE LOT, ONLY ONE CARS DOES NOT HAVE 4 CYLINDERS.  

PG. 56

1. 7/24  
2. 1/3  
3. 1/2  
4. 3/8  
5. 2/3  
6. 1, 2  

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81
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1. 3/4 OF 120 = 90
   90 > 85 NO

### Page 66

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82
PG. 70
8. $126.57 9. $115.11 16. $21.71

PG. 71
1. .947" 2. 11.54" 3. 9.508" 4. .845" 5. 7.466"
6. .007" 7. .007" 8. .030" 9. .016" 10. .012"

PG. 72
1. .966" 2. 11.578" 3. 9.516" 4. .836" 5. 7.478"
6. .048" 7. .003" 8. .006" 9. .022" 10. .018"