

Name: _____

Date: _____

Engine Performance Work Example 1

WorkKey Level: 3

NATEF Automotive Tasks: VIII.F

For every pound of pressure (psi), the boiling point rises 3 degrees Fahrenheit. What is the boiling point of a system with a 16-psi cap, assuming the boiling point of the current coolant mixture is 228 degrees Fahrenheit.

Engine Performance Work Example 2

WorkKey Level: 4

NATEF Automotive Tasks: VIII.F

When filling a 15-quart system with a solution that is 60% coolant and 40% water, how many quarts of coolant would be required?

Engine Performance Work Example 3

WorkKey Level: 3

NATEF Automotive Tasks: VIII.F

According to the following chart, if I have a 14-quart capacity cooling system and I want to obtain protection against freezing down to -54 degrees Fahrenheit, how many quarts of antifreeze should the system contain?

Cooling system capacity in quarts	3	4	5	6	7	8	9	10	11
8	-7	-34	-69						
9	0	-21	-50	-70					
10	4	-12	-34	-62					
11	8	-6	-23	-47	-65				
12	10	0	-15	-34	-57				
13		3	-9	-25	-45	-64			
14		6	-5	-18	-34	-54	-68		
15		8	0	-12	-26	-43	-62		
16		10	2	-8	-19	-34	-52	-64	
17			5	-4	-14	-27	-42	-58	-69

18			7	0	-10	-21	-34	-50	-62
19			9	2	-7	-16	-28	-42	-56
20			10	4	-3	-12	-22	-34	-48

Engine Performance Work Example 4

WorkKey Level: 4

NATEF Automotive Tasks: VIII.F

According to the following chart, if you had a 25-quart system that contained 15 quarts of antifreeze and 10 quarts of water, what would the boiling point of the system be?

Freeze/Boil Protection Chart
*Using a 15-PSI Pressure Cap

% of cooling system capacity	Protects from	
	Freezing down to	Boiling up to *
50	-34° F	265° F
60	-62° F	270° F
70	-84° F	276° F

Engine Performance Work Example 5

WorkKey Level: 4

NATEF Automotive Tasks: VIII.B.3, VIII.B.4, VIII.B.6

The resistance of a coolant temperature sensor reads 1025 ohms. Looking at the chart below, what is the approximate temperature of the coolant in Fahrenheit?

Coolant Temperature Sensor
Temperature-to-Resistance
Values (Approximate)

°F	°C	Ohms
210	100	185
160	70	450
100	38	1,600
70	20	3,400

40	-4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

Engine Performance Work Example 6

WorkKey Level: 3

NATEF Automotive Tasks: VIII.A.8

The following are results from a cylinder power balance test. Fill in the chart and determine which cylinder is weakest.

Cylinder number	Idle speed	RPM it dropped to	Difference between idle speed and test speed
1	850 rpm	720 rpm	
2	850 rpm	700 rpm	
3	850 rpm	780 rpm	
4	850 rpm	695 rpm	

Engine Performance Work Example 7

WorkKey Level: 3

NATEF Automotive Tasks: VIII.B.3, VIII.B.4, VIII.B.6

An engine is operating at 70°C and the coolant temperature sensor has a resistance of 3,400 ohms. Is this a logical temperature resistance temperature relationship?

**Coolant Temperature Sensor
Temperature-to-Resistance
Values (Approximate)**

°F	°C	Ohms
210	100	185
160	70	450
100	38	1,600
70	20	3,400
40	-4	7,500
20	-7	13,500
0	-18	25,000

-40	-40	100,700
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Engine Performance Work Example 8

WorkKey Level: 3

NATEF Automotive Tasks: VIII.E.3.1, VIII.E.3.4

You are testing a catalytic converter using the temperature variation method. The converter temperature variation specification should read at least 600 degrees Fahrenheit. The inlet of the catalytic converter reads 700 degrees. The outlet reads 1200 degrees. Is the catalytic converter working properly? Please explain.

Engine Performance Work Example 9

WorkKey Level: 3

NATEF Automotive Tasks: VIII.E.3.1, VIII.E.3.4

You are testing a catalytic converter using the temperature variation method. The converter temperature variation specification should read at least 600 degrees Fahrenheit. The inlet of the catalytic converter reads 500 degrees. The outlet also reads 500 degrees. Is the catalytic converter working properly? Please explain.

Engine Performance Work Example 10

WorkKey Level: 3

NATEF Automotive Tasks: VIII.E.3.1, VIII.E.3.4

You are testing a catalytic converter using the temperature variation method. The converter temperature variation specification should read at least 600 degrees Fahrenheit. The inlet of the catalytic converter reads 400 degrees. The outlet reads 1800 degrees. Is the catalytic converter working properly? Please explain.

Engine Performance Work Example 11

WorkKey Level: 5

NATEF Automotive Tasks: VIII.D.4

Excessive alcohol (over 10%) will cause drivability problems. You have a beaker with one milliliter of tap water and ten milliliters of fuel from a car's gas tank. After thoroughly mixing

the two liquids and letting them settle, you find that the water level is 0.5 milliliters higher than it originally was. What is the percentage of alcohol in the fuel? Allowing up to 10% alcohol on gasoline, is this acceptable? Note: Water will extract alcohol from fuel.

Engine Performance Work Example 12

WorkKey Level: 5

NATEF Automotive Tasks: VIII.D.4

Excessive alcohol (over 10%) will cause drivability problems. You have a beaker with one milliliter of tap water and ten milliliters of fuel from a car's gas tank. After thoroughly mixing the two liquids and letting them settle, you find that the water level is 0.75 milliliters higher than it originally was. What is the percentage of alcohol in the fuel? Allowing up to 10% alcohol on gasoline, is this acceptable? Note: Water will extract alcohol from fuel.

Engine Performance Work Example 13

WorkKey Level: 5

NATEF Automotive Tasks: VIII.D.5, VIII.D.8

You are testing the injectors on a 4-cylinder engine; the base pressure is 36 psi in the fuel rail. When each injector is energized, the fuel rail pressure drops down to the following readings.

Fuel injector	Reading
1	25
2	27
3	35
4	25

According to the specs, these readings should not vary by more than 10% of the highest reading. Do these end-of-test readings after tests fall within specs? Please explain your answer. Predict which injectors are bad.

Engine Performance Work Example 14

WorkKey Level: 4

NATEF Automotive Tasks: VIII.A.9

The following are compression test results from an engine. Specs state that the results should be within 10% of the highest reading. Are the results acceptable? Show why.

120 psi 115 psi 119 psi 109 psi 117 psi 115 psi

Engine Performance Work Example 15

WorkKey Level: 4

NATEF Automotive Tasks: I.A.8, VIII.A.8

When doing a cylinder balance test, you come up with the following results.

Cylinder	RPM drops from 650 to
1	575
2	560
3	630
4	570

Predict which cylinder is not producing power.

The manufacturer requires at least a 10% drop in RPM when a cylinder is killed. Complete the following chart.

Cylinder	Percentage of drop
1	
2	
3	
4	

According to your calculations in the above chart, which cylinder is not producing enough power?

Engine Performance Work Example 16

WorkKey Level: 6

NATEF Automotive Tasks: I.A.8, VIII.A.8

A vehicle is getting 20 miles per gallon (mpg) with the engine operating at approximately 180°F. For each 10° increase in engine operating temperature above 160° the fuel economy will increase 2.5%. If the 180° thermostat is removed and replaced with a 200° thermostat, what will be the new mpg?

Engine Performance Work Example 17

WorkKey Level: 4

NATEF Automotive Tasks: I.A.9, VIII.A

A good engine will have a fairly even compression from cylinder to cylinder. If the highest and lowest readings vary more than 25% of the highest reading, the engine should be repaired.

Compression readings for a 4-cylinder engine are shown below. Determine whether the engine compression range is within recommendations.

Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4
173	180	147	128

Which, if any, cylinder would you perform a cylinder leakage test on? Please explain.

Engine Performance Work Example 18

WorkKey Level: 6

NATEF Automotive Tasks: Background

You just recently accepted a position at one of the Big 3 automakers setting up auto repair training programs at dealerships throughout the state. As part of your benefit package, you have the choice to 1) use a company car for business, 2) lease a car, or 3) get reimbursement for using your car for business travel. The specifics of each are as follows:

1. **Company car:** You may use a company car on business only. The company car must stay at your work location whenever not in use. You must use your own transportation to and from work. The company pays all costs (gas, maintenance, insurance, and repair) of the car. Your personal car gets 26 miles per gallon and the maintenance and repair costs average out to 28 cents per mile.
2. **Lease a car:** You may lease a car for your business and personal use. (You will not need another car.) The lease costs \$350 per month of which the company pays 70%. (Your company assumes you will use the car 70% of the time on company business and the other 30% of the time will be used for personal business). The company will also pay 70% of the cost of gas, insurance, maintenance, and repair of the car. The leased car averages 31 miles per gallon and the maintenance and repair costs average out to 28 cents per mile.
3. **Reimbursement:** The company reimbursement rate for using a personal car on company business is 37 cents per mile.

Determine the best deal for you assuming you average 1900 miles per month while on business and 1500 miles per month personal (includes commuting to and from work). Also, assume an average cost of gasoline of \$1.50 per gallon and a 20-day work month.

Engine Performance Work Example 19

WorkKey Level: 4

NATEF Automotive Tasks:

A technician has installed a stock cam in an engine with a lobe lift of 0.375 in. He wants to get more performance from it so he decides to replace his stock 1.5 ratio rockers with 1.6 ratio rockers. How much more valve lift will he get from this modification?

Engine Performance Work Example 20

WorkKey Level: 3

NATEF Automotive Tasks: VIII.F.4

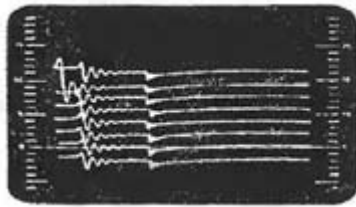
For every pound of pressure (psi), the boiling point rises 3 degrees Fahrenheit. What is the boiling point of a system with a 16-psi cap, assuming the boiling point of the coolant is 228 degrees Fahrenheit?

Engine Performance Work Example 21

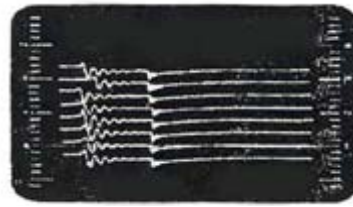
WorkKey Level: 4

NATEF Automotive Tasks:

Using the attached pictures, answer the following questions.



A.



B.

- How many cylinders would you assume this engine that is being analyzed on the oscilloscope has?
 - one
 - two
 - four
 - eight
 - twelve
- On pattern A, which trace looks more unlike any other? (Traces are numbered from bottom to top.)
 - one

- b. five
 - c. six
 - d. seven
 - e. eight
3. On pattern B, which trace looks more unlike any other?
(Traces are numbered from bottom to top.)
- a. one
 - b. five
 - c. six
 - d. seven
 - e. eight

Engine Performance Work Example 22

WorkKey Level: 4

NATEF Automotive Tasks: Background

Joe is keeping a log of mileage in his new car. Complete the following chart.

Mileage	Miles traveled	Gallons purchased	Miles per gallon
720	_____	_____	_____
1080		18	
1424		17	
1803		16	

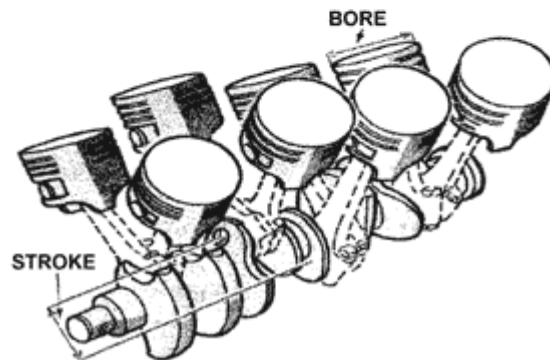
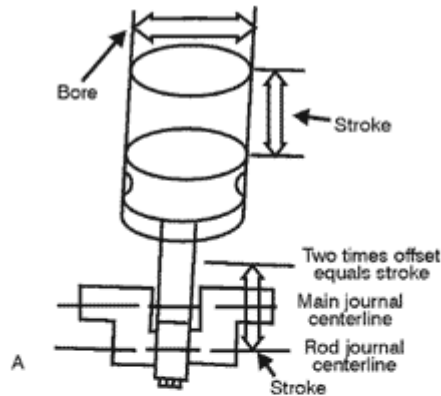
1. Is his mileage getting better or worse?
 - a. Better
 - b. Worse
 - c. About the same
2. What is his average miles per gallon?
 - a. About 17 mpg
 - b. About 19 mpg
 - c. About 21 mpg
 - d. About 23 mpg

Engine Performance Work Example 23

WorkKey Level: 5

NATEF Automotive Tasks:

You are building a racing engine for a customer and he wants more cubic inches. You have an eight-cylinder engine with a bore of 4.00 inches and a stroke of 3.50 inches. You are given the formula for engine displacement of $(\text{Bore}/2)$ squared times π times stroke times number of cylinders.



Facts:

Radius = Diameter of bore divided in half

$\pi = 3.14159\dots$ (Use 3.14)

Volume of a cylinder = $\pi r^2 L$ (L is the stroke length.)

- What is the cubic inches of the stock motor? _____
- What is the cubic inches if the bore is increased by 0.120 inches? _____
- What is the cubic inches if a crankshaft with a stroke of 3.750 inches is used? _____
- It costs \$160 to bore a motor and buy pistons or \$399 to buy a longer stroke crank. What would you tell the customer who wants more cubic inches but wants it cheap?

Engine Performance Work Example 24

WorkKey Level: 5

NATEF Automotive Tasks: VIII.A.6

A technician is doing a cylinder balance test on a 6-cylinder engine. Before performing the test the technician notes an engine RPM of 750. The RPM readings for each cylinder during the test are:

- 1) 680 RPM
 - 2) 650 RPM
 - 3) 660 RPM
 - 4) 638 RPM
 - 5) 733 RPM
 - 6) 668 RPM
- a. Did the engine pass the test? Show your work and explain your answer.
 - b. Which cylinder is doing the least amount of work? Explain your answer.