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ANSWER BANK

ELEMENT ONE
Demonstrate knowledge of fuel emissions.

1. **Describe how fuel emissions can make people sick.**

   Carbon monoxide reduces the flow of oxygen in the bloodstream and is particularly dangerous to people with heart disease.

   Hydrocarbons react in the presence of nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. An increase in skin cancer due to ozone layer depletion.

2. **Describe how fuel emissions can harm plant and animal life.**

   With an increase in UV radiation reaching the earth's surface the base of all marine life can be seriously threatened as many fish and marine animals have a surface dwelling larval stage, which can be injured or destroyed by UV radiation.

3. **Describe how fuel emissions can contribute to the depletion of the ozone layer in the earth's atmosphere.**

   CFC's from fuel emissions contribute to the depletion of the ozone by trapping oxygen molecules that are needed for reformation of the ozone layer.

4. **Which vehicle emission gases are considered greenhouse gases and how do they contribute to global warming?**

   Carbon dioxide (CO2) and Nitrogen Oxide (NOx)
   Fuel emissions contain these gases which become trapped within the earth's atmosphere. This results in the more heat energy from the sun remaining and gradual global warming. This melts the polar ice caps and raises sea levels resulting in damaging flooding.

5. Explain how environmental regulations/laws have affected each of the following:

5a. Urban design

With the growth of our cities and the increasing use of vehicles issues such as traffic congestion, pollution and parking have all become major problems. Manufacturers have had to respond to the public demand for smaller more fuel efficient vehicles that are easier to park and cheaper to run in busy urban settings.

5b. Use of bio-fuels and alternative fuels

In response to the emission standards manufacturers have begun to look at using bio-fuels and alternative fuels which have lower emissions. This has also led to new engine developments such as hybrids and electric powered vehicles.

5c. Technology improvements (Engines and fuel systems)

In response to the emission standards all manufacturers have introduced more engine efficient vehicles with modern engine and transmission computers to control vehicle behaviour and fuel economy.

5d. Land transport rules

The NZ transport rules requires that all vehicles manufactured since 1990 must meet an approved emission standard

5e. Environmental legislation (laws)

Laws such as the Ozone Layer Protection Act have led to the phasing of CFC's in vehicles. Manufacturers can no longer use CFC in air conditioning systems for example.

5f. Fuel specifications (Petrol and diesel)

Petrol engines now need to run on unleaded fuel and diesel engines must have low sulphur levels.

5g. International emission standards affecting vehicle specifications

Standards from USA, Europe and Japan have forced vehicle manufacturers to develop engines that produce lower emissions. These standards are regularly updated, becoming stricter each time.

6. For each of the following gases and by-products of combustion describe both their composition (makeup) and what engine performance condition is most likely to contribute to the production of them.

6a. **Particulates**

Composition: Typically made up of a variety of atoms, including Sulphur, Carbon, Nitrogen, and Oxygen.

Engine performance condition that would produce excess particulates:

The underlying cause is likely to be an excessively rich mixture, blocked air intake system or faulty injectors. A vehicle that is producing particulates will have reduced engine power and poor fuel economy. If ignored could result in engine damage.

6.b. **NOx**

Composition:
NO_x is made up of nitrogen and oxygen atoms.

Engine performance condition that would produce excess NOx:
Nitrogen Oxide is produced by very high combustion temperatures. Typically this happens when the engine is operated in a "cruise" mode where the air/fuel mixture is leaner than normal.

6.c. **HC**

Composition: Hydrocarbons are made up of hydrogen and carbon elements

Engine performance condition that would produce excess HC:

High Hydrocarbon (HC) levels is the result of unburnt fuel in the exhaust gases. There could be a number of reasons but the most likely include faulty spark plugs or HT leads, low compression in one or more cylinders, incorrect air/fuel ratio, incorrect ignition timing. High HC will result in poor fuel economy and will likely reduce engine power. The underlying cause if ignored may result engine damage.

6. d. **CO**
<u>Composition:</u> CO is made up of one carbon atom and one oxygen atom.

<u>Engine performance condition that would produce excess CO:</u>

High Carbon monoxide (CO) levels occur when the air/fuel ratio (stoichiometric ratio) becomes too rich. Most likely causes include faulty injectors, false input to ECU (O2 sensor, throttle position, air/water temp, airflow) causing the ECU to think that the mixture is too lean, incorrect mixture (carburettor models). A vehicle that is producing high CO will not be operating at the ideal stoichiometric level. Engines with high CO will have poor fuel economy and will have lower power output than specified.

7. **The relationship between Oxygen (O_2) and Carbon dioxide (CO_2) levels present in exhaust emissions is often described as the best indicators of how good the combustion is.**

   Consider the following scenario;

   A technician is testing the exhaust emissions of a vehicle.
   The results show <u>very low levels of O_2</u> (.3%) and <u>high levels of CO_2</u> (18%).

What would this indicate to you about the combustion process in this vehicle?

This would indicate that the combustion process is good.

Describe why you reached this conclusion.

A perfect combustion will burn all of the oxygen and hydrocarbon and produce Carbon dioxide along with nitrogen and water. In reality there is usually a very small amount of O2 left. So if the reading shows O_2 less than **.5%** and CO_2 more than **15%** this is the first indication that the combustion process is good.

ELEMENT TWO

Demonstrate knowledge of vehicle emission control systems and their components.

1 Name the component in a modern car exhaust system that;

- **Measures exhaust gas emissions;**

  Oxygen sensor

- **Greatly reduces exhaust gas emissions**

  Catalytic converter

- **Minimises noise pollution**

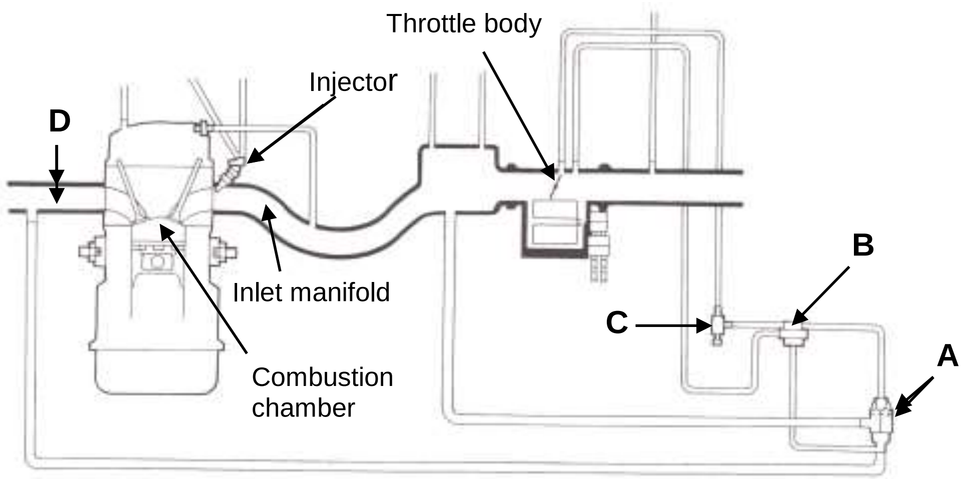
  Muffler, resonator

2. Describe how an exhaust system with these components built in is able to reduce emissions.

The O2 sensor measures any oxygen left after the combustion has occurred and sends this information to the ECU which can make adjustments to the air/fuel ratio to make sure it stays within specifications. As the exhaust gases pass through the catalytic converter any remaining hydrocarbons (HC), carbon monoxide (Co) and Nitrogen Oxide (NOx) is converted to Carbon dioxide (CO2) and water (H2o). The mufflers and resonators in the system eliminate most of the noise created by the explosions as the fuel is ignited.

3. **From the list below identify the system and the components listed from A – C.**

EGR Control Valve: Solenoid Valve: Modulator Valve: Exhaust Manifold.



SYSTEM: Exhaust gas return system (**EGR**)

A: EGR valve
B: Solenoid valve
C: Modulator valve
D: Exhaust manifold

4. **Which gas is the system above targeting and explain how it is reduced.**

The exhaust gas return system is designed to reduce the production of Nitrogen oxide (NOx) which occurs during peak combustion temperatures. The introduction of small amounts of exhaust gas at these times reduces the amount of hydrocarbon and oxygen in the combustion chamber and thereby lowers the temperature of the combustion.

5. Name the component in a modern car air intake system that;

- **Measures air flow or volume;**

  Air flow meter or map (manifold absolute pressure) sensor

- **Measures the throttle position;**

  Throttle position sensor

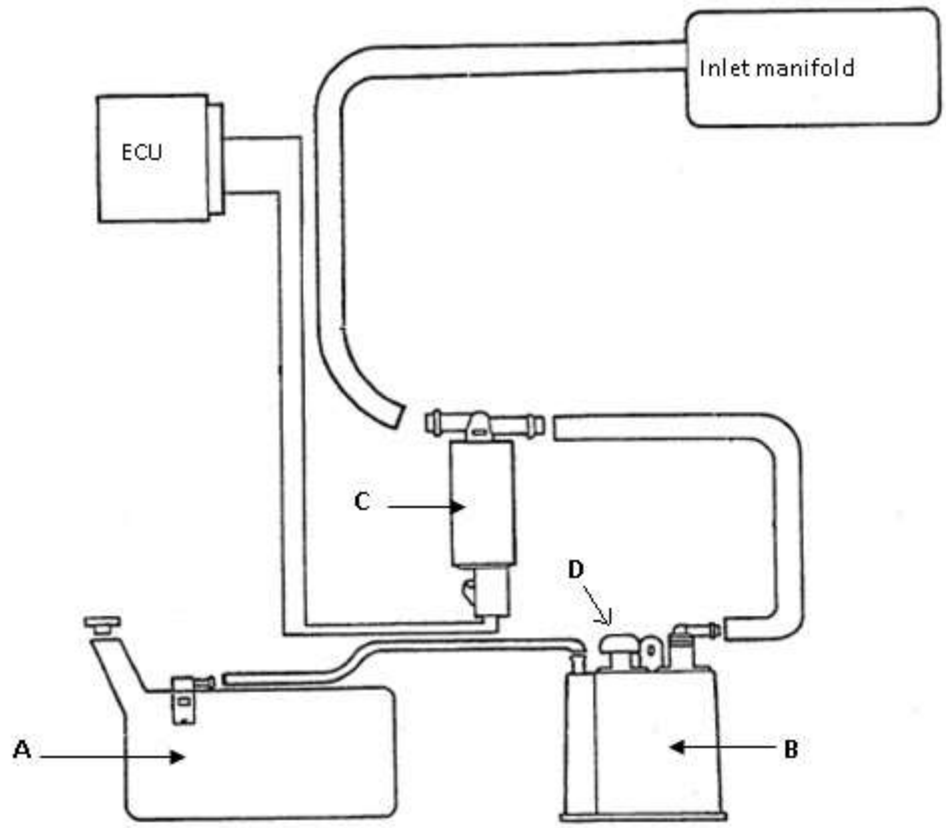
- **Cleans the air;**

  Air filter

6. Describe the role of the air intake system above in controlling exhaust emissions;

The air flow is controlled by the throttle butterfly which has a position sensor attached. Any dust particles are removed by the air cleaner as the air passes through. The air volume entering the inlet manifold is measured by the air flow meter/sensor. The ECU receives the information about the throttle position and air flow from which it can calculate exactly how much fuel is required at the injection cycle. This enables the correct air/fuel ratio to be achieved for the operating conditions.

7. **Name this system, and identify the components labelled A, B, C and D.**



SYSTEM: **Evaporative emission control system**

A: Fuel tank
B: Charcoal canister
C: Purge control valve
D: Atmospheric port

8. **What does the system above do to reduce emissions?**

The evaporation control system is designed to prevent fuel vapours from evaporating into the atmosphere by preventing fuel vapour build up in the sealed fuel tank.

9. **Also in the evaporative emission control system; explain how these components reduce emissions.**

Roll over valve:
A roll over valve is commonly located in the vapour valve assembly and is designed to allow fuel vapours to pass through to the charcoal canister. However, in the event that the vehicle has rolled over, the rollover valve closes to prevent fuel from leaking.

Fuel cap:
Fuel caps are sealed to prevent the escape of fuel and fuel vapours from the tank. The fuel cap pressure valve is designed to release this pressure build up by redirecting vapours to the charcoal canister.

10. Match up the EFI fuel components with the most likely location and function.

A	Throttle position sensor	**1**	1	Mounted on the throttle body to measure throttle position.
B	Engine temperature sensor	**6**	2	Is mounted on the cylinder head or inlet manifold and delivers a metered amount of atomised fuel to the engine.
C	EGR valve	**8**	3	Controls release of crankcase gases and vapours into the inlet manifold. Usually located in the rocker cover.
D	ECU	**9**	4	Usually mounted in the exhaust manifold or close to it inside the engine pipe, this component measures oxygen content in the exhaust gases.
E	Fuel injector	**2**	5	Mounted in the intake ducting and measures intake air volume electronically.
F	Oxygen sensor	**4**	6	Mounted on the hottest point of the engine to measure engine temperature.
G	PCV valve	**3**	7	Mounted under the vehicle towards the rear and is fitted with an expansion chamber so that it cannot be completely filled to allow for expansion of heated fuel.
H	Air flow meter	**5**	8	Designed to recirculate a small amount of exhaust gas back into the inlet manifold during peak temperatures. Usually located on the intake manifold.
I	Fuel tank	**7**	9	Receives and interprets information from various sensors to deliver the appropriate amount of fuel and timing of the spark for the engine operating conditions.

11. **A technician is working on a modern vehicle that has some problems with the emissions control systems. He/she decides to diagnose the actual cause by accessing the diagnostic test codes.**

Describe the procedure the technician should use to access the diagnostic test codes to help identify the faults.

The technician will usually connect an OBD-II scan tool which communicates with the vehicle ECU. The tool will usually compare vehicle data with the manufacturer's specifications which are stored in the tool and warn the technician when data is absent, incorrect or outside a range. The technician can then adjust, repair or replace any faulty sensors or other components, and recheck with the scan tool to ensure that the problem has been fixed. Clear any existing codes once repairs have been carried out.

12. **The vehicle in question 11 above has now been repaired. The technician must check that the exhaust emissions are within specification.**

The workshop has a 5 gas exhaust analyser. Describe the correct procedure that the technician should use to test the exhaust emissions with the 5 gas analyser.

The vehicle is started and run to normal operating temperature. An exhaust gas analyser probe is inserted into the exhaust tail pipe and an emission reading is registered and displayed on the exhaust gas analyser screen.

The analyser measures the amount of (5 gases) hydrocarbons, carbon monoxide, carbon dioxide, NOx and oxygen that is being emitted from a vehicle.

This measurement is expressed in percentage terms or parts per million. These readings can be compared to the manufacturer's specifications.

13. **Name four of the gases that can be measured by an exhaust gas analyser.**
Any four of the following

1:	Oxygen	O2
2:	Hydrocarbons	HC
3:	Carbon monoxide	Co
4:	Carbon dioxide	Co2
5:	Nitrogen oxide	NOx

14. **Name two possible causes of high Hydrocarbon levels (HC).**

Faulty spark plug or HT lead.
Faulty injector
Incorrect mixture
Air leak in inlet manifold

15. **How would the car's owner benefit from having regular maintenance carried out on the vehicle?**
Maximum engine performance is achieved
Maximum fuel economy is achieved
Lower vehicle emissions produced

16. **Why is regular maintenance of emissions systems important?**
Regularly maintained emission systems will produce lower vehicle emissions.