

GEOS 24705 / ENST 24705

Problem set #17

Due: Th. May 29th

Problem 1: Automobile tour

Find an automobile and take a look under the hood. Take photographs and identify and label as many parts as you can. Also state the make and model of the car, the year if possible, and how you got access to it.

Everyone should muster the resourcefulness to find a car to inspect, even if you don't own one. Googling is fine – encouraged – to understand what you are seeing or what you should expect to see. (There are some good diagrams of systems in the automobile at <http://www.sundevilauto.com/auto-diagrams>). However, do not submit digital photographs taken by someone else, not to mention stock advertising photos from the web. You have to go look with your own eyes.

Note that old cars are generally easier to understand than newer cars (though often dirtier). For extra credit, find a newish car and an old car and compare them. Hybrids are very complicated – you can do a hybrid if it's the only thing you have access to, or for extra credit, but it's best to start by looking at a conventional car.

Please do not feel obliged to crawl underneath a car; what you can see from the top is fine for this problem set. If you do want to crawl underneath, make sure that you have first set the parking brake AND also "chocked" the wheels to prevent inadvertent rolling.

Try to identify something from each of the areas below. If you think the car does not actually have some component, explain why you think it does not. If you can't find something in a category, explain where you looked for it. Extra credit for extra systems or for going over and above in identifications.

- A. **Engine block** – how many cylinders does the car have? Are they vertical, horizontal, or in a V? Remember that for a four-stroke engine, each cylinder will have two valves.
- B. **Ignition system**. Identify the spark plugs that ignite each cylinder, and find the distributor cap that sends electrical signals to the spark plugs. (Recent cars may not have this). The distributor cap should in turn be connected (eventually) to the battery that is providing power for the spark plugs.
- C. **Air/fuel system**. The air that gets mixed with the fuel comes from outside the car. It is piped in through large tubes, passes through an air filter, and is distributed evenly to each cylinder via an "intake manifold". The air filter enclosure should be accessible and readily visible as you have to change filters frequently. Fuel is added before the air enters the cylinder. In a pre-1990 gasoline car, air and fuel are mixed in a flying-saucer-shaped carburetor sitting on top of the engine. Modern cars all operate by fuel injection; you should be able to identify the fuel injectors and the fuel lines that feed them. If you have a turbocharged car, you'll also see a compressor that pre-compresses air before it enters the cylinders. The rest of the fuel

system is typically quite difficult to see, but trace the fuel lines as far as you can.

Somewhere buried way down there is an (electric) fuel pump that moves fuel from your gas tank to the engine; this will be underneath your car at best and possibly actually inside the gas tank.

- D. The **electrical system** of the car, which includes a battery and an alternator (a generator) turned by the engine's rotation that makes electrical power to charge the battery. (There is a picture of an alternator in the first electricity reading – car alternators are usually simple AC generators, with their output rectified to produce DC for the battery). The belt connecting the alternator to the engine should be visible from above, and you should be able to find and identify the alternator. There is an electric starter motor that turns the crankshaft when you are first getting your engine started, but this is likely impossible to see.
- E. The **cooling system** for the engine – if 75% of fuel energy is coming out as waste heat, then something has to remove all that waste heat! The cooling system consists of tubes and hoses that circulate water (or other coolant fluid) around the engine cylinders, a radiator that lets the hot fluid cool off, a fan to blow air around the radiator, and the fan belt that uses the rotation of the engine to turn the fan. There is a water pump that circulates cooling fluid but that is usually difficult to see from above.
- F. The **lubrication system**. At minimum you'll be able to find the "dipstick" that goes into your oil reservoir and lets you check the oil. The oil pan containing the oil might be hard to see. The oil pan is often the lowest part of the car's engine assembly (and therefore the first thing to break if you drive over rocks or other obstacles that are too high). The oil filter is accessible, since you have to change it periodically, but it is likely only visible if you crawl under the car. (Read caution above if you want to try this). There's an electric pump to move the oil around, either in the oil pan or attached to it; again, generally not visible.
- G. (*Optional*) The **transmission** that connects your engine's rotating crankshaft via gears to the front axle (for front-wheel-drive cars) or to the driveshaft and rear axle (for rear-wheel-drive cars) is typically hard or impossible to see from above. You may be able to identify if your car is front-wheel or rear-wheel or all-wheel drive, though.
- H. (*Optional*) If you are looking at a hybrid car, identify the electric motor/s and the generator that charges the battery (which will be much bigger than the little alternator on conventional cars).

Note: while you are doing your auto tour you may want to measure the cross-sectional area of the vehicle (if it's not a big truck) for the Thursday problem set. Just take a tape measure and measure the width of the vehicle and its height from bottom of bumper to roof.