

# WORK-ENERGY-POWER

Units 10 & 11 Dr. John P. Cise, Professor of

Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 [jpcise@austincc.edu](mailto:jpcise@austincc.edu) & New York Times April 1, 2016 by Tom Voelk

## Volvo's XC90 T8 Is Another Step Up



**INTRODUCTION:** Volvo.com says weight of this Volvo is 4394 lb. Plug-in hybrid (**electric + gasoline**) engines are more than 20 % more efficient than traditional gasoline engines which are about 15 – 20 % efficient. Thus, making plug-in hybrid cars > 40 % efficient. Thus,  $X = P_{OUT}/P_{IN}$  or  $P_{OUT} = X P_{IN}$ . The power output goes into useful kinetic energy ( $1/2mv^2$ ) per unit time.  $P_{OUT} = W_{OUT} / t =$

$$X P_{IN} = [ \frac{1}{2} m V^2 ] / t$$

**QUESTIONS:** (a) Find mass of this car? (b) Convert 400 mph to ft. lb./s.? (c) Find efficiency X of this Volvo plug-in hybrid?

**HINTS:** weight = mass X gravity,  $g = 32 \text{ ft./s.}^2$ ,  
1 HP = 550 ft. lb./s. , 60 mph = 88 ft./s.

The XC90 is a breakout machine, and this **plug-in hybrid version** (**has 400 horsepower**) and a ride that is controlled, comfortable and quiet. VOLVO'S XC90 is a breakout machine, filling garages all over the world and the Swedish automaker's trophy case with awards. The folks in Gothenburg desperately needed this hit. For the uninitiated, here is a spotter's guide to XC90s: **A T5 badge on the liftgate means the rig runs with a turbocharged 4-cylinder, and a T6 gets turbo and supercharging.** But a sharp eye is needed for the subject of my attention this week, the T8. This rare bird is a plug-in hybrid using the two-liter engine from the T6 (detuned by 3 horsepower for some reason) and an electric motor that turns the rear wheels. **Total horsepower is 400. A large lithium-ion battery fills the cavity vacated by the drive shaft, giving the T8 a 14-mile pure electric range.** The T8 is the desirable XC90, being more powerful and efficient than the T5 and T6. Sadly — and your wallet knew this was coming — it costs about \$18,000 more than the T6 model. Ouch. Added equipment (the eight-speed transmissions controller is Orrefors crystal) and a \$4,600 federal tax credit relieve some of that sting. The Inscription model tested will drain your checking account of \$84,005, though prices start at \$69,095. Even at this premium, the take rate is 1 in 5. BMW and Porsche offer plug-in hybrid sport utility vehicles, too, but they don't have Volvo's trump card — a third row. It's useful, too. The T8's smart packaging means passenger and cargo space remain the same as the T6. Remember, this is the country that gave us Ikea. **A hybrid?** Yes. A snail? Nope. Volvo says its (**0-to-60 acceleration is 5.3 seconds**), a claim easily believed. The T8 doesn't sound like a V8. Pushed hard, the sonic quality is that of a hurried **Toyota Corolla**. Advantage goes to BMW and Porsche there. Like all XC90s, the ride is controlled, comfortable and quiet. **The T8 defaults to a hybrid dynamic where the gas engine kicks in at 15 to 20 miles an hour.** Drivers can select modes like pure electric drive, or force gas operation to save electric power for later. A full charge at home takes as little as four hours on standard 110 current. Take additional power at work (I know I do) and gas consumption goes way down. Starting with a full battery and a heavy right foot, I saw about 30 miles per gallon on my 75-mile mixed-driving loop. **The government rates this powertrain at 53 MPGe, miles per gallon equivalent, or 25 m.p.g. gasoline-only** using specified premium fuel. The luxurious XC90 proves the understated Swedes have their swagger back. The price tag is large and the engine sounds small but everything else about the XC90 T8 is targeted to steal buyers away from the traditional luxury brands.

**ANSWERS:** (a) 137.3 slugs, (b) 220,000 ft./lb./s., (c)  $X = 0.456$  or 45.6 %

**AUTHORS COMMENT:** This Volvo plug-in hybrid being both electric and gasoline (kicks in 15-20 mph) is very efficient. Our computed efficiency of 45.6% is validated by the government rated 53 mph equivalent.