

WORK- ENERGY-POWER

Unit 10 & 11 Dr. John P. Cise,

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& New York Times , February 19, 2016 by Tom Voelk



INTRODUCTION: Efficiency = $X = \text{Work}_{\text{OUTPUT}} / \text{Work}_{\text{INPUT}}$
 $= W_{\text{OUT}} / W_{\text{IN}} = \text{Power}_{\text{OUTPUT}} / \text{Power}_{\text{INPUT}} = P_{\text{OUT}} / P_{\text{IN}}$
Thus: $X P_{\text{IN}} = P_{\text{OUT}} = W_{\text{OUT}} / t =$
 $[1/2 m V^2] / t = X P_{\text{IN}}$ eq. 1

Note the Work Output goes into useful Kinetic to the wheels. From the Lincoln.com site the weight of this 2016 Lincoln MKX is 4220 lb. The purpose of this application is to find the Efficiency (X) of this 2016 Lincoln MKX 2.7 liter 335 HP (= P_{IN}).

The 2016 MKX Aims Lincoln in the Right Direction

Ford is attempting to revive its Lincoln brand, and the new MKX is a big improvement from the previous model. Handsome, muscular and discreet, the crossover is spacious, quick and the interior has rich details. After years of indifference (and killing Mercury), [Ford](#) is putting serious effort into the Lincoln brand. The MKX begins at \$39,185, but the all-wheel-drive model I drove — lavished with all the major options — creeps up on \$62,000. Go with Black Label editions, and the price climbs further. Serious chutzpah for a brand re-establishing itself or delusional? Established players like the [Audi Q5](#), [BMW X3](#) and the big kahuna Lexus RX cost less. A 3.7-liter V6 is standard,

but **the 2.7-liter V6 with twin turbos is the way to go**, producing **335 horsepower** and 380 pound-feet of torque. And it uses standard grade gas. Lincoln is stingy, with the gears offering only 6 speeds where competitors get 8. Opinions vary on the push-button selector, but at least it's straightforward. All MKXs have adaptive suspension; all-wheel-drive models add adjustable dynamics, but the feature is buried in a menu. Torque rich, the turbo motor whispers **from 0 to 60 miles an hour in about six seconds**. Using the same tech used in noise-canceling headphones, the MKX is as hushed as it is powerful. The absence of road noise spotlights faint wind noise at higher speeds.

QUESTIONS: (a) Convert 335 HP to ft. lb./s.? (b) Find mass of this MKX in units of slugs?, (c) Find efficiency X of this Lincoln MKX 2.7 Liter engine? , (d) Comment on the efficiency you found?

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

ANSWERS: (a) $\sim 184,250 \text{ ft. lb./s.}$, (b) $\sim 131.9 \text{ slugs}$, (c) $\sim 46.2 \%$, (d) This efficiency computed is a bit higher than typical twin turbo engines. See explanation below: reason why this so called Ford EcoBoost engine is so efficient.

FURTHER COMMENT FROM AUTHOR: The simple explanation is that Ford's EcoBoost engine is a **combination of turbocharging and direct fuel injection that improves fuel economy** without sacrificing engine power. When Ford set out to improve the fuel economy of their cars and trucks, they knew customers wanted to have their cake and eat it too. **The most effective solution: Turbo + Direct Injection + Variable Camshafts. Ford engineers went all-in on this initiative resulting in the incredibly versatile, exceptionally strong EcoBoost turbocharged engines.**