# Spark Ignition Engine Lab

Student Name

Date

**Figure 1a.** Measuredtorque versus crankshaft speed for the spark ignition engine at fully open throttle.

[copy and paste your figure 1a here]

**Figure 1b.** Brake power and total power versus crankshaft speed for the spark ignition engine at full throttle. The markers indicate the experimental measurements. The black line represents the total theoretical power available, based on the Otto cycle using the air-standard model at the same conditions as those measured in the experiment.

[copy and paste your figure 1b here]

**Figure 1c.** Thermal efficiency versus crankshaft speed, comparing the measurements and theory. The theory is based on the Otto cycle using the air-standard model at the same conditions as those measured in the experiment.

[copy and paste your figure 1c here]

**Figure 1d.** Work rate terms in the energy balance of the engine versus crankshaft speed, as based on the experimental measurements.

[copy and paste your figure 1d here]

[copy and paste your figure 1e here]

**Figure 1e.** Mean effective pressure acting on the piston head versus crankshaft speed, as based on the experimental measurements.

Short-Answer Questions

**2a.** *State the value of the following energy ratios (in terms of a percentage) averaged over the entire range of engine speeds examined: , , and . Discuss how the frictional/inertial loss compares to the miscellaneous heat lost to the surroundings, and how this affects the overall thermal efficiency of the engine. [2–4 sentences]*

[insert your response here]

**2b.** *Write one sentence for each of the items below related to engine efficiency. [3 sentences total]*

*→  State the average mechanical efficiency of the engine (averaged over the range of crankshaft speeds measured), and compare this value with the typical mechanical efficiency of an electric motor having an equivalent power rating (1–2 hp).*

*→  Write a statement that compares the calculated thermal efficiency with that of an ideal Otto cycle, by quantifying the discrepancy () with a percentage, as follows*

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Description automatically generated*

*→  State three things that were neglected in the ideal model of the Otto cycle that might contribute to such a discrepancy.*

[insert your response here]

**2c.** *Based on your calculations for the mean effective pressure (MEP), estimate the average force acting on the piston head during the cycle when the engine is operating at 2600 RPM. State your answer in units of both N and lbs. Include this calculation in your Matlab code and have the code display the result to the screen. [1 sentence]*

[insert your response here]

**2d.** *Carbon dioxide (CO2), a greenhouse gas, is released into the environment from the exhaust of spark ignition engines. A diagram of the carbon lifecycle is shown below, illustrating how auto emissions tend to alter the natural balance by creating excessive carbon dioxide in the atmosphere. Spend some time to research (using the internet, textbooks, or other sources) solutions for reducing CO2 gas emissions from combustion engines. For example, some technologies can help increase engine efficiency, thereby reducing CO2 emissions. State one operation or hardware modification that could be implemented to improve the efficiency of a spark ignition engine, such as turbo- charging, inner cooling, split-fire spark plugs, variable valve timing, etc. Explain how this modification works to improve engine efficiency and describe some of the challenges associated with implementing this modification in practice. [4–6 sentences plus at least one reference]*

[insert your response here]