Homework 2

Question 1: For the following engines:

2 cylinder, 4-cycle; 2 cylinder 2-cycle; 3 cylinder, 4-cycle;
4 cylinder, 4-cycle; 6 cylinder, 4-cycle; 8 cylinder 4-cycle;

(a). Determine the average firing interval.
(b). Identify those engines with an uneven power strokes.
(c). Identify those engine with power strokes that overlap. Assuming engines of equal power were available for each of the engine types determine the order of relative size of flywheel required for each engine. (i.e. From largest flywheel to smallest flywheel).
(d). For a 5cylinder, 4 cycle engine, determine the crank angle degrees when intake and exhaust valves would open and close for any 3 of the five cylinders. Assume that a crank angle of 0 degrees corresponds with the piston 1 at TDC at the beginning of the intake stroke. Assume that intake valve opens 15º before TDC and closes 45º after BDC; and that exhaust valve closes 15º after TDC and opens 45º before BDC. The firing order of the engine is 1,5,2,4,3

Question 2:
(a). Is the minor diameter (Measured parallel to the piston pin) and the major diameter (measured perpendicular to the piston pin) of a piston the same when the piston is cold? If not, explain the reasons for this difference.
(b) If the exhaust valve clearance is too small, would this cause the valve to prematurely fail? If this is the case, give two different reasons this could cause valve failure.
(c). After an engine is dismantled the following observations were made on only one of the four engine cylinders (other 3 appeared to have no damage). (1). The front top and back bottom edges of the piston were badly worn in a plane parallel to the crankshaft. Give potential causes for this uneven wear and explain how the wear occurred.

Question 3: The stoichiometric A/F ratio for gasoline engines is 15.05 for complete combustion, producing carbon dioxide and water.
(a). If the A/F ratio was decreased to 12, would the air/fuel mixture be considered a rich or a lean mixture, and would complete combustion occur.
(b). Name two additional combustion products that may be produced under these conditions.
(c). An engine is tested with the following A/F ratios, (10, 15, 20, 25, 50, and 75). It was found that the engine would run satisfactorily at A/F ratios above 25. Is this a SI engine or diesel engine? Explain your answer.
(d). When would you use a high cetane fuel in a gasoline engine? Explain your answer.

Question 4: The point's T10 , T20 , and T90 refer, respectively to the temperatures on the fuel distillation curve at which 10, 50 and 90 % of the fuel has been distilled.
(a). Why is it important that the T10 temperature is not too high? What would the effect of increasing the T10 temperature be on starting an engine in cold weather?
(b). Engines' warm time up depends on the T50 temperature of the fuel. For gasoline would the T50 temperature be increased or decreased during winter. Explain your reasoning.
(c). A fuel is found to cause dilution of the crankcase oil. Which of the three distillation temperature points are associated with this phenomenon How does the fuel enter the crankcase?
(d). Gasoline volatility is adjusted by petroleum refiners to suit the season. Give one reason why the volatility of gasoline is increased in winter, and a second reason why the volatility is lower in summer.

Question 5: The ignition delay of a fuel after the self-ignition temperature is reached, has important effects on the speed of the flame front, rate of combustion and rate of pressure rise in the engine cylinder.
(a). Why would you tend to use a fuel with a relatively long ignition delay in a spark ignition engine?
(b). What would be the effect of using fuel with a long ignition delay in a diesel engine?

Question 6 A diesel engine accelerating under varying loads. The fuel used is cetane $C_{16}H_{34}$

Note: Atomic Mass of Carbon (C) =12, Hydrogen (H) =1 Nitrogen (N) =14, Oxygen (O) =16. Assume for each molecule of oxygen (O_2) in air there are 3.76 molecules of Nitrogen (N_2)

$C_{16}H_{34}$ + ??[O_2 + 3.76N_2] $\Rightarrow$??$C0_2$ + ??H_20+ ??C0 + ??0_2 + ??N_2

a). Determine the Stoichiometric combustion equation and Stoichiometric Air/Fuel ratio.

b) Determine actual combustion equation at a Fuel Equivalence Ratio of 0.85 and the actual Air/Fuel ratio

c). If the engine fuel consumption is 45.2 kg/hr, determine the mass of carbon dioxide produced per hour.

Question 7 Blended fuels are sometimes used in engines. A blend containing 20% Butanol (by volume), in 80% gasoline can be used for automobiles. Given the following information:

	Chemical Formula	Density
Butanol	$C_4H_{10}O$	0.780 kg/L
Gasoline (Octane)	C_8H_{18}	0.740 kg/L

Note: For every mole of an oxygen molecule in air, there are 3.76 moles of nitrogen molecules.

a). Determine the composite fuel molecule $C_{xc}H_{yc}0_{zc}$ which can be used to represent blended fuel.

b). Show the balanced Stoichiometric combustion equation for the composite molecule.

c). Calculate the Stoichiometric air to fuel ratio for the fuel blend.

Question 7

a). A gasoline engine is required to start at an ambient temperature of 0^o C. The maximum A/F ratio in the vapor phase, (Mass air / Mass of vaporized fuel) that the engine will start is 20:1. At 0^o C only 20% of the fuel mixed with the air will vaporize.

(i)Calculate the actual A/F ratio (Mass Air/Total Mass of Fuel) that is required for starting.

(ii) If the air to fuel ratio is less than that calculated above will the engine start? Justify your answer!!!!

b). A gasoline engine is required to start at an ambient temperature of 10^o C. The minimum A/F ratio in the vapor phase, (Mass air / Mass of vaporized fuel) that the engine will start is 8:1. At 10^o C only 40% of the fuel mixed with the air will vaporize.

(i) Calculate the lowest actual A/F ratio (Mass Air/Total Mass of Fuel) that engine will start before "flooding."

(ii) If the air to fuel ratio is less than that calculated above will the engine start? Justify your answer!!!!

c). What characteristic of a gasoline fuel is measured by the octane number.

d). What characteristic of a diesel fuel is measured by the cetane number.