UNIT 61 Engineering Thermodynamics Assignment 2

Assessment Title: Assignment 2: Second Law of Thermodynamics
Unit: 61 Outcome 1: Understand the parameters and characteristics of thermodynamic systems

Outcome/ Criteria	**Met X/✓**	**Assessor Feedback**
2.1 Apply the second law of thermodynamics to the operation of heat engines		
2.2 evaluate theoretical heat engine cycles		
2.3 evaluate the performance characteristics of spark ignition and compression ignition internal combustion engines		
2.4 discuss methods used to improve the efficiency of internal combustion engines		
M1 Identify and apply strategies to find appropriate solutions		
M2 Select/design and apply appropriate methods/ Techniques		
M3 Present and communicate appropriate findings		

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D1 Use critical reflection to evaluate own work and justify valid conclusions		
D2 Take responsibility for managing and organising activities		
D3 Demonstrate convergent/ lateral/ creative thinking		

Context

You are an Engineer working for an NGO who carry out emergency response work around the world. You are responsible for the generators, pumps and emergency lighting systems that work on a range of diesel and petrol internal combustion engines. The operation and maintenance of the systems is vital and you have been asked to complete some calculations and produced an instruction manual for operatives and technicians in the field.

Task 1 (2.1)

One of the simple single cylinder generators works on the following cycle.

The pressure, volume and temperature at the beginning of the compression of a constant volume cycle are 101 KN/m^2, 0.03m^3, and 18°C respectively. The maximum pressure of the cycle is 4.5MN/m^2. The volume ratio of the cycle is 9:1. The cycle is repeated 3000 times /min.

Determine for the cycle:

a. The pressure, volume and temperature at each of the cycle process points.
b. The thermal efficiency
c. The theoretical output in kilowatts
d. The Carnot efficiency

Take Cp=1.000kJ/kgK, Cv=0.718KJ/kgK

Task 2 (2.2)

You have been asked to produce a sort introduction to the internal combustion engine, therefore, it must cover all three types of internal combustion cycles, the diesel, Otto and duel combustion.
Describe the processes involved graphically on a PV diagram and annotate the diagram with the key processes, giving typical values for the Pressure and temperature.

Then evaluate their performance and identify typical commercial applications, including details of the cost power output and reliability.

Task 3 (2.3)

Describe how and internal combustion engine is tested and trialled to determine the performance of the engine. The engines you need to consider are; spark ignition petrol engines and compression ignition diesel engines.

Your answer must include a definition of the following

- Indicated and brake mean effective pressure
- Indicated and brake power.

Task 4 (2.4)

Discuss the methods used to improve the efficiency of internal combustion engines used in private and commercial vehicles.
Your answer should specifically deal with gas charging and exhaust gas recovery systems.
Your discussion must include the theoretical and technical basis for the improvements.

Extension Task 5 for higher grades

Describe the development and operation of the HCCI engine focusing on how it differs from normal internal combustion engine.
Critical evaluate the engine and its potential success in the current motor vehicle market reference must be made to the introduction of electrical vehicles.

Extension Tasks for higher grades

Task 6

A piston-cylinder device contains 50 kg of water at 150 kPa and 25°C. The cross sectional area of the piston is 0.1 m2. Heat is now transferred to the water, causing part of it to evaporate and expand. When the volume reaches 0.2 m^3 the piston reaches a linear spring whose spring constant is 100 kN/m. More heat is then supplied until the piston rises by an additional 20 cm.

a. Show the process on a P-v diagram.

b. Determine the final pressure and temperature in the cylinder.

c. Calculate the work done during the process.

General Advisory notes on Presentation of your work

- All assignments MUST be completed to the requirements as specified in the course handbook. Maths based sections may be hand written or word processed. Report sections must be word processed. Your work must be well structured, grammatically correct, spell-checked and proofread.
- Proper referencing using the Harvard system must be used where appropriate.
- Produce a suitable cover for your work. The font and size used should be consistent throughout. Do not use individual plastic wallets per page to present your work.
- Merit and distinction grading indicators and pointers to indicative evidence to achieve these are on following pages.

Merit descriptors	**Indicative characteristics -**	
In order to achieve a merit the learner must:	The learner's evidence shows elements of:	Evidence in context could be:
M1 Identify and apply strategies to find appropriate solutions	Relevant theories and techniques have been applied Effective judgments have been made Complex problems with more than one variable have been explored	Show theories and explain your solutions A solution for task 5 Detailed and annotated solutions showing clear thinking and methodology
M2 Select/design and apply appropriate methods/techniques	A range of methods and techniques has been applied Complex information/data have been synthesised and processed	Application of thermodynamic forces and mechanical forces to solve complex problems.
M3 Present and communicate appropriate findings	Appropriate structure and approach has been used A range of methods of presentation has been used Technical language accurately used	A cohesive report linking all the methods, tables of results, graphs, calculations Appropriate references for engineering examples (Task 2) and any research materials for extension tasks.

Distinction descriptors	**Indicative characteristics -**	
In order to achieve a distinction the learner must:	The learner's evidence shows:	
D1 Use critical reflection to evaluate own work and justify valid conclusions	• conclusions have been arrived at through synthesis of ideas • and have been justified the validity of results has been evaluated using defined criteria self-criticism of approach has taken place realistic improvements have been proposed against defined characteristics for success	Explain your methods for completing extended problems, including what research you had to conduct in order to complete the exercises
D2 Take responsibility for managing and organising activities	• autonomy/independence has been demonstrated substantial activities, • projects or investigations have been planned, managed and organised • activities have been managed • the unforeseen has been accommodated the importance of interdependence has been recognised and achieved	Research the methods to enable you to complete both extension tasks Completing the report in the requested timescale and showing evidence of planning and self-evaluation.
D3 Demonstrate convergent/lateral/ creative thinking	• ideas have been generated and decisions taken • self-evaluation has taken place • convergent and lateral thinking have been applied • problems have been solved • innovation and creative thought have been applied • receptiveness to new ideas is evident effective thinking has taken place in unfamiliar contexts.	Evaluate your methods and findings, and then discuss the suitability of these findings in an engineering environment and discuss alternative methods.