BYJU'S EXAM PREP

AE/JE Foundation

Mechanical Engineering

IC Engine & Powerplant

Top 100
Most Expected Questions

1. Steam enters a turbine at 30 bar, 300 °C (u = 2750 kJ/kg, h = 2993 kJ/kg) and exits the condenser as saturated liquid at 15 kPa (u = 225 kJ/kg. h = 226 kJ/kg). Heat loss to the surrounding is 50kJ/kg of steam flowing through the turbine. Neglecting changes in kinetic energy and potential energy, the work output of the turbine (in kJ/kg of steam) is _____

A. 2600 B. 2620

C. 2717 D. 2537

Ans. C

Sol. Enthalpy of saturated liquid at exit from the condenser = h_4 = 226 kJ/kg

Enthalpy of steam at exit from the turbine= $h_2 = h_4 + Q_{rej}$ = (226 + 50) = 276 kJ/kg

Enthalpy of steam at entry into the turbine = h_1 = 2993 kJ/kg

Work output of the turbine = $h_2 - h_1$ = (2993 - 276) = 2717 kJ/kg

2. For minimum work in a reciprocating compressor, the compression process should be _____

A. adiabatic B. isothermal

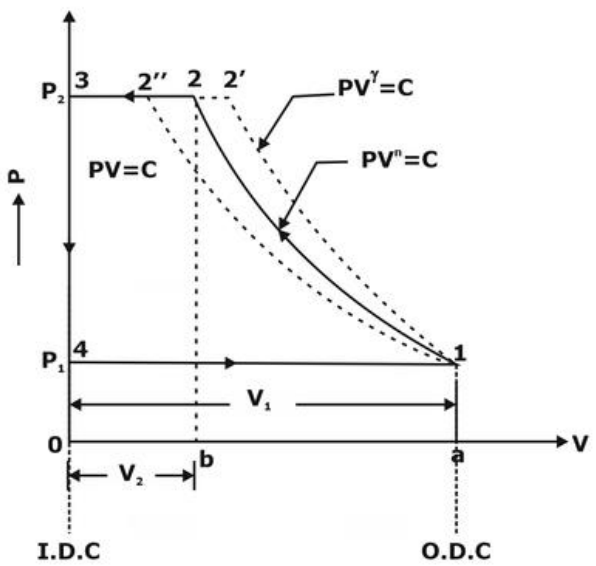
C. isochoric D. isobar

Ans. B

Sol.

- In reciprocating compressor,

  Compression work will be minmum when the process isothermal compression.



3. For a gas turbine working on Brayton cycle, if T_1 is the temperature at inlet of compressor, T_4 is exit temperature of turbine, then work ratio (R_w) is represented by

A. $\gamma_w = 1 - T_1/T_4$ B. $\gamma_w = 1 + T_1/T_4$

C. $\gamma_w = 1 + T_4/T_1$ D. $\gamma_w = 1 - T_4/T_1$

Ans. A

Sol.

$$\gamma_w = \frac{W_{net}}{W_T} = \frac{W_T - W_C}{W_T} = 1 - \frac{W_C}{W_T}$$

$$\gamma_w = 1 - \frac{C_p(T_2 - T_1)}{C_p(T_3 - T_4)} = 1 - \frac{T_1\left(\frac{T_2}{T_1} - 1\right)}{T_4\left(\frac{T_3}{T_4} - 1\right)}$$

For ideal brayton cycle, $\frac{T_2}{T_1} = \frac{T_3}{T_4} \Rightarrow \frac{T_2}{T_3} = \frac{T_1}{T_4}$

$$\gamma_w = 1 - \frac{T_1}{T_4} = 1 - \frac{T_2}{T_3}$$

4. In a gas turbine plant operating on Brayton cycle, select the incorrect statement regarding the effect of reheating

A. No change is compressor input is required

B. The work output of turbine increases

C. Efficiency of the cycle increases

D. Both mean temperature of heat addition and mean temperature of heat rejection increases

Ans. C

Sol. During reheating in the Brayton cycle:

1. Cycle efficiency decreases.

2. Both mean temperature of heat addition and mean temperature of heat rejection increases.

3. No change is compressor input is required

5. Which of the following is a boiler accessory?

A. Safety Valve

B. Pressure Gauge

C. feed pump

D. fusible plug

Ans. C

Sol. Boiler Mountings-These are the equipment in absence of which power-plant will not work.

Accessory- These are the equipment in absence of which power-plant will not work efficiently.

Feed pump is an accessory, rest options are boiler mountings

6. In the fuel mixture of iso octane and n-heptane, the % of n-heptane by volume is 40. The octane no. of fuel is

A. 40

B. 60

C. 24

D. 100

Ans. B

Sol. The octane no. of a fuel is the % of iso octane by volume in a mixture of iso octane and n-heptane which produces the same knock intensity as the given fuel.

% of iso octane = 100-40 =60%

Octane no. = 60

7. Rotary compressors are used in those cases where

A. High discharge rate at low pressure is required

B. Low discharge rate at high pressure is required

C. Low discharge rate at low pressure is required

D. None of the above

Ans. A

Sol. * Rotary compressors are used in those cases where High discharge rate at low pressure is required.

* Rotary-screw compressors are generally used to supply compressed air for larger industrial applications. They are best applied in applications that have a continuous air demand such as food packaging plants and automated manufacturing systems.

8. An engine has a swept volume of 100 cm^3 and a clearance volume of 20 cm^3. The mechanical efficiency is 0.8 and volumetric efficiency is 0.75. The volume taken in per stroke will be

A. 80 cm^3

B. 75 cm^3

C. 60 cm^3

D. 25 cm^3

Ans. B

Sol. Given,

Swept volume V_s = 100 cm^3

Clearance volume V_C = 20 cm^3

Mechanical efficiency =0.8

Volumetric efficiency = 0.75

Volumetric efficiency = Actual intake volume/Swept volume

Actual intake volume = Volumetric efficiency × Swept volume

Actual intake volume = 100 x 0.75 cm^3= 75 cm^3

9. Rankine cycle consists of _____.

A. Two isentropic processes & two constant volume processes

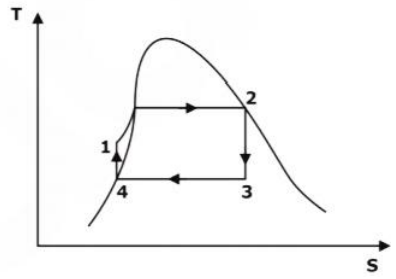
B. Two isentropic processes & two constant pressure processes

C. Two isothermal processes & two constant volume processes

D. Two isentropic processes and two constant temperature processes

Ans. B

Sol. **Rankine Cycle:** The Rankine cycle or Rankine Vapor Cycle is the process widely used by power plants such as coal-fired power plants or nuclear reactors.



1–2 → Constant pressure heat addition

2–3 → Reversible adiabatic expansion

3–4 → Constant pressure heat rejection

4–1 → Reversible adiabatic compression

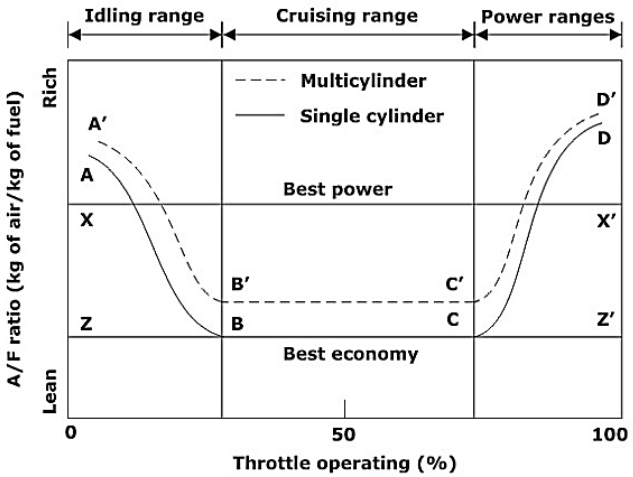
10. Which of the following mixture / ratio requires during idling condition in petrol engine _____?

A. Rich mixture
B. Lean Mixture
C. Stoichiometric ratio
D. None of the above

Ans. A

Sol.

- An idling engine is one which operates at no load and with nearly closed throttle.
- The final mixture of fuel and air is diluted by the exhaust gases. Thus, to sustain combustion it is necessary to provide more fuel thus making the air-fuel mixture rich.



11. Which type of boilers are called drum-less boilers _____?

A. Natural circulation boilers
B. Fire tube boilers
C. Once through boiler
D. Forced circulation boiler

Ans. C

Sol.

- In Once through boilers, water enters the bottom of the tubes and completely transforms into steam as it passes through the tubes and reaches at the top.
- Thus, these boilers do not need a steam drum and hence often referred as drum-less boilers.
- These operate at a pressure above of 221.2 bar (supercritical pressure).

12. For same maximum pressure and heat input, correct relation for air standard efficiencies is _____.

A. $\eta_{otto} > \eta_{diesel} > \eta_{dual}$
B. $\eta_{otto} < \eta_{diesel} < \eta_{dual}$
C. $\eta_{otto} < \eta_{dual} < \eta_{diesel}$
D. $\eta_{otto} > \eta_{dual} > \eta_{diesel}$

Ans. C

Sol. For the same maximum pressure and heat input, the order of efficiency is as follows:

$\eta_{otto} < \eta_{dual} < \eta_{diesel}$

13. Match the following:

List-I

A. Boiler
B. turbine
C. Condenser
D. pump

List-II

1) reversible adiabatic expansion of steam
2) constant pressure heat addition
3) reversible adiabatic compression
4) constant pressure heat rejection

A. A-2 B-1 C-4 D-3
B. A-3 B-1 C-4 D-2
C. A-2 B-4 C-1 D-3
D. A-1 B-2 C-4 D-3

Ans. A

Sol.

A. Boiler= 2) constant pressure heat addition
B. turbine =1) reversible adiabatic expansion of steam
C. Condenser= 4) constant pressure heat rejection
D. pump = 3) reversible adiabatic compression

14. Which of the following represents correct relationship between mean effective pressure of Carnot cycle and Stirling cycle for same swept volume_____?

A. $(mep)_{Carnot} > (mep)_{Stirling}$
B. $(mep)_{Stirling} > (mep)_{Carnot}$
C. $(mep)_{Carnot} = (mep)_{Stirling}$
D. None of the above

Ans. B

Sol.

Mean effective pressure = $\frac{\text{Work done}}{\text{Swept volume}}$

Since work output of Carnot is less than that of Stirling, so for same swept volume mean effective pressure of Stirling is more than Carnot.

15. Degree of reaction in a turbine is the ratio of _____.

A. Enthalpy drop in fixed blade to total enthalpy drop
B. Enthalpy drop in moving blade to total enthalpy drop
C. Enthalpy drop in fixed blade to enthalpy drop in moving blade
D. Enthalpy drop in moving blade to enthalpy drop in fixed blade

Ans. B

Sol.

- Degree of reaction in a turbine is the ratio of enthalpy drop in moving blade to total enthalpy drop.
- Degree of reaction (R)= $\frac{Enthalpy\ drop\ in\ rotor}{Enthalpy\ drop\ in\ stage}$

16. Which one of the following modifications of the simple ideal Rankine cycle increases the thermal efficiency and reduces the moisture content of the steam at the turbine outlet?

A. Decreasing the condenser pressure.

B. Increasing the boiler pressure.

C. Decreasing the boiler pressure.

D. Increasing the turbine inlet temperature.

Ans. D

Sol. Due to increase of the turbine inlet temperature, quality of the stream at outlet of the turbine improves. Which increases the thermal efficiency and reduces the moisture content of the steam at the turbine outlet.

17. The cycle generally used for gas turbines is:

A. Otto cycle

B. Brayton cycle

C. Carnot cycle

D. Dual cycle

Ans. B

Sol. The Brayton cycle is a thermodynamic cycle named after George Bailey Brayton that describes the workings of a constant pressure heat engine. The original Brayton engines used a piston compressor and piston expander, but more modern gas turbine engines and airbreathing jet engines also follow the Brayton cycle

18. The cycle in which heat is supplied at constant volume and rejected at constant pressure is known as

A. Dual combustion cycle

B. Diesel cycle

C. Atkinson cycle

D. Rankine cycle

Ans. C

Sol. In case of **diesel cycle,** heat addition taken place at constant pressure and heat rejection taken place at constant volume.

In case of **Rankine cycle,** heat addition and heat rejection taken place at constant pressure.

In case of **dual combustion,** heat addition taken place at constant volume and constant pressure and heat rejection taken place at constant volume.

19. Throttling is_____.

A. irreversible adiabatic process

B. Reversible isenthalpic process

C. irreversible isenthalpic process

D. isentropic process

Ans. C

Sol.

During throttling process, enthalpy remains const. Thus isenthalpic

Throttling results in decrease in pressure and increase in entropy.

$h_1 = h_2$

$\Delta S > 0$

20. If a reheater is added to a Rankine Cycle then usually

A. The net-work increases but the efficiency may increase or decrease.

B. The net-work & efficiency decrease

C. The net-work remains same & efficiency increases

D. Net-work increases & efficiency remains same

Ans. A

Sol.

- Reheat Rankine Cycle is employed when high pressure turbine are used and dryness fraction at outlet of turbine will reduce below acceptable limit (88% usually).
- To avoid this condition the steam is partially expanded in high pressure turbine and then reheated to same initial temperature.
- Further it is expanded in low pressure turbine which increases the net work output but increase the dryness fraction, the efficiency may increase or decrease.

21. For CI engines, fuels most preferred are _____.

A. Paraffins

B. Napthalene

C. Aromatics

D. Olefins

Ans. A

Sol.

- For C.I. engines fuel most preferred are paraffins and for S.I. engines fuel most preferred are aromatics.
- The paraffins is more preferred due to its high antiknocking tendency.

22. An engine is required 150 kW brake power. The mechanical efficiency of the engine is 75%. The frictional power is

A. 150 kW

B. 200 kW

C. 50 kW

D. 25 kW

Ans. C

Sol. Frictional power (FP) is

FP = IP – BP

$$\eta_{mech} = \frac{BP}{IP}$$

$$IP = \frac{150}{0.75} = 200 \text{ kW}$$

FP = 200 – 150 =50kW

23. Ideal regenerative rankine cycle_____.

A. Increases efficiency

B. Increases work output

C. Increases the heat supplied

D. does not affect efficiency

Ans. A

Sol.

- Feedwater is preheated so as to decrease the fuel consumption which increases efficiency.

24. The volumetric analysis of dry products of combustion_____.

A. Bomb calorimeter
B. Viscosity meter
C. Orsat apparatus
D. Calorimeter

Ans. C

Sol.

- Volumetric analysis of dry product is done by with the help of Orsat apparatus.
- Analysis of fossil fuel gas is done by Orsat apparatus.

25. Nozzle efficiency is described as.....

A. Isentropic heat drop/useful heat drop
B. useful heat drop/isentropic heat drop
C. saturation temperature/supersaturation temperature
D. supersaturation temperature/saturation temperature

Ans. B

Sol. Nozzle efficiency is defined as the ratio of actual heat drop to isentropic heat drop

$$\eta_N = \frac{\text{actual heat drop}}{\text{isentropic heat drop}} = \frac{\Delta h}{\Delta h_s}$$

$$\eta_N = \frac{V_2^2 - V_1^2}{V_{2s}^2 - V_1^2} \qquad \text{(if velocity at the inlet is zero)}$$

$$\eta_N = \frac{V_2^2}{V_{2s}^2}$$

26. A single cylinder four stroke spark ignition engine has mechanical efficiency of 75%. If frictional power is estimated to be 20 KW. Find the brake power of engine in KW ___?

A. 80 KW
B. 40 KW
C. 60 KW
D. 30 KW

Ans. C

Sol. Given,

Mechanical efficiency = 75%

Frictional power = 20 KW

$$\text{Mechanical efficiency} = \frac{\text{Brake power}}{\text{Indicated power}}$$

$$0.75 = \frac{BP}{IP}$$

Frictional Power = IP – BP = 20 KW

IP – 0.75IP = 20 KW

0.25IP = 20 KW

IP = 80 KW

27. Which of the following factors does NOT contribute towards detonation in an engine?

A. Engine overheating
B. High compression ratio
C. Stoichiometric fuel mixture
D. Wrong position of spark plug

Ans. C

Sol.

Following Factors causes detonation in Engine

- Engine overheating
- Compression ratio is high
- Wrong position of spark plug
- Use of lean mixture in fuel

28. Which of the following statement is TRUE for work output of an ideal Otto cycle?

A. Increases with an increase in adiabatic index.
B. Increases with an increase in compression ratio.
C. Increases with an increase in pressure ratio
D. All option are correct

Ans. D

Sol.

All points describe the basic characteristics of OTTO CYCLE.

The four processes that make up the Otto cycle are

(1) isentropic compression,

(2) constant volume heat addition,

(3) Isentropic expansion

(4) constant volume heat rejection

$$\eta = \frac{W_{net}}{\text{heat supplied}} = 1 - \frac{1}{r^{\gamma-1}}$$

from the expression,

as specific heat ratio γ increases, work output will increase.

as compression ratio,r increases, work output will increase.

$$p_{mep} = \frac{W_{net}}{V_s}$$

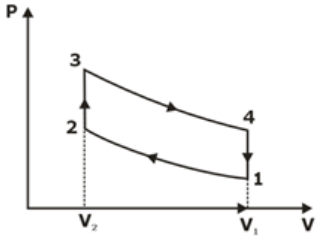
as the pressure ratio r_p increases, mean effective pressure will increase and so the work output will increase

29. The minimum and maximum volumes in an air standard otto cycle are 100cc and 800cc. Thermal efficiency of the cycle approximately will be

A. 57%
B. 37%
C. 67%
D. 46%

Ans. A

Sol. Given



V_1 = 100cc = V_C

V_2 = 800cc = $V_S + V_C$

⇒ Compression ratio(r)

$$= \frac{V_s + V_c}{V_c} = \frac{V_1}{V_2} = \frac{800}{100}$$

r = 8

$$\eta = 1 - \frac{1}{r^{\gamma-1}} \Rightarrow 1 - \frac{1}{8^{0.4}} = 0.564$$

η = 56.4%

30. A calorically perfect gas (specific heat at constant pressure 1000 J/kg.K) enters and leaves a gas turbine with the same velocity. The temperatures of the gas at turbine entry and exit are 1100 K and 400 K, respectively. The power produced is 4.6 MW and heat escapes at the rate of 300 kJ/s through the turbine casing. The mass flow rate of the gas (in kg/s) through the turbine is

A. 6.14 B. 7.00

C. 7.50 D. 8.00

Ans. B

Sol. Given that,

$C_p = 1000$ J/kgK

$T_1 = 1100K$, P= 4.6MW

$T_2 = 400K$, $Q_L = 300kJ/s$

$\dot{E}_{in} = \dot{E}_{out}$

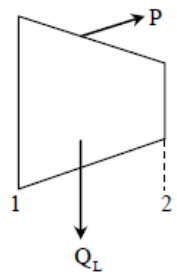
$$h_1 + \frac{V_1^2}{2} + gz_1 = h_2 + \frac{V_2^2}{2} + gz_2 + Q_L + P$$

$\therefore V_1 = V_2, Z_1 = Z_2$

So, $h_1 - h_2 = Q_L + P$

$$\dot{m} = \frac{(300 \times 10^3) + (4.6 \times 10^6)}{1000 \times (1100 - 400)}$$

$\dot{m} = 7kg/sec$



31. Which of the following methods are used to increase efficiency of a Brayton cycle?

A. Regeneration
B. Increasing pressure ratio
C. Heat exchanger
D. All of the mentioned

Ans. D

Sol.

- A heat exchanger that acts as a counter-flow energy recovery device positioned within the supply and exhaust air streams of an air handling system, in order to recover the waste heat.

32. Consider an Otto Cycle:

Match List I with List II and select the correct answer using the code givenbelow the Lists:

List 1	List 2
A. Most Efficient Working fluid	1. Polyatomic gas
B. Detonation	2. Monatomic gas
C. Octane Reading	3. Auto ignition
	4. Knock Resistance

A. A-2, B-3, C-4
B. A-2, B-4, C-3
C. A-1, B-3, C-4
D. A-1, B-4, C-3

Ans. A

Sol.

- Efficiency of otto cycle increased with adiabatic exponent (γ). Monatomic gas has maximum γ.
- Premature ignition/Auto ignition of fuel leads to noise called engine knock or detonation.
- Octane reading implies the knock resistance of the fuel.

33. Direct system of cooling air is one in which

A. cooling water flows by gravity
B. hot water is continuously cooled and circulated
C. hot water is simply discharged
D. water is allowed to evaporate in the cylinder jacket

Ans. C

Sol.

Direct system of cooling air is one in which hot water is simply discharged.

With direct cooling, ambient air is taken in to cooled hot water discharge.

34. A gas turbine operating on Brayton cycle has the maximum temperature of 1200 k and the minimum temperature of 300 k . the cycle efficiency for the maximum work capacity will be

A. 75%
B. 60%
C. 50%
D. 25%

Ans. C

Sol. The Maximum net work is obtained when the pressure ration is equal to the square root of maximum theoretical pressure ratio.

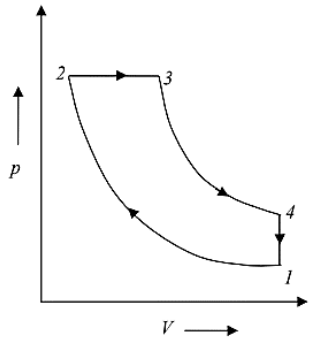
$$r_p = \sqrt{r_{pmax}}$$

$$so\ \eta_{max\ net\ work} = 1 - \sqrt{\frac{T_{min}}{T_{max}}}$$

$$= 1 - \sqrt{\frac{300}{1200}}$$

$$= 1 - \frac{1}{2} = 50\%$$

35. Shown below is the P-V diagram of a diesel cycle. Which of the following represents the cut-off ratio?



A. $\frac{V_3}{V_1}$

B. $\frac{V_2}{V_1}$

C. $\frac{V_3}{V_2}$

D. $\frac{V_2}{V_3}$

Ans. C

Sol. The cutoff ratio of the diesel cycle is given by :

$$\rho = \frac{V_3}{V_2}$$

36. Select the correct statement for 50% reaction stage in a steam turbine _____.

A. The rotor blade is symmetric.

B. The stator blade is symmetric.

C. The absolute inlet flow angle is equal to absolute exit flow angle.

D. The absolute exit flow angle is equal to inlet angle of rotor blade.

Ans. D

Sol. In Parsons Reaction Turbine (50% reaction):

$$\alpha_1 = \beta_2\ and\ \alpha_2 = \beta_1$$

and $V_1 = V_{r2}\ \ and\ V_{r1} = V_2$

37. The main purpose of fan in a liquid cooling system is to

A. disperse engine fumes

B. pump cold air over the hot water

C. cool the external surface of the engine

D. a belt driven water impeller

Ans. B

Sol. The main purpose of fan in a liquid cooling system is to pump cold air over the hot water for higher coefficient of convection.

38. For an air-standard Diesel cycle,

A. heat addition is at constant pressure and heat rejection is at constant pressure

B. heat addition is at constant volume and heat rejection is at constant pressure

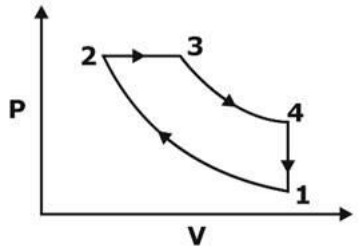
C. heat addition is at constant volume and heat rejection is at constant volume

D. heat addition is at constant pressure and heat rejection is at constant volume

Ans. D

Sol.

Air standard diesel cycle



Process 1-2: Isentropic compression

Process 2-3: Constant pressure heat addition

Process 3-4: Isentropic expansion

Process 4-1: Constant volume heat rejection.

39. Which of the following factors aids in increasing detonation in SI engine?

1) Increase in spark advance

2) Higher speed

3) Increased air-fuel ratio on the far side of stoichiometric strength

4) Higher compression ratio.

Select the exact answer from below options:

A. 1 and 3

B. 2 and 4

C. 1, 2, & 4

D. 1 and 4

Ans. D

Sol. Detonation in the S.I. engines is augmented by increasing spark advance and Increase in compression ratio. The increased speed and lean mixtures do not have much influence.

40. What is the main purpose of supercharging of the engine?

A. To increase the power output of the engine.

B. Volumetric Efficiency of the engine increases.

C. Brake Power per unit mass increases

D. All of the above

Ans. D

Sol. Supercharging is a process in which an air compressor is used to increase the pressure or density of air supplied to an internal combustion engine.

Due to supercharging of IC Engines

- Power output of the engine increases.
- Volumetric efficiency of the engine increases.
- Brake power per unit mass increases

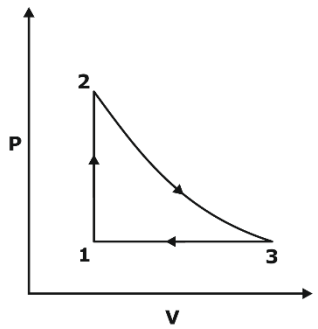
41. Lenoir cycle consists of constant ----------heat addition and constant ---------- heat rejection.

A. volume, pressure
B. pressure, volume
C. temperature, pressure
D. temperature, volume

Ans. A

Sol.

- Lenoir cycle consists of constant volume heat addition (process 1 to 2) and constant pressure heat rejection (process 3 to 1) and isentropic expansion (process 2 to 3).
- The Lenoir cycle is an idealized thermodynamic cycle often used to model a pulse-jet engine.



42. Which of the following statement is/are true.

(a) Generally, the chemical delay is larger than physical delay.
(b) At high temperatures, the physical delay is smaller than chemical delay.
(c) Ignition lag in SI engine is equivalent to chemical delay.
(d) All of above

A. a, b
B. b, c
C. a, c
D. d

Ans. C

Sol.

- The physical delay is the time between the beginning of injection and attainment of chemical reaction conditions.
- During chemical delay reactions starts slowly and then accelerates.Hence generally chemical delay is more but as temperature increases chemical reactions are faster and hence physical delay are larger than chemical delay.

43. In case of Rankine cycle, Heat rate is given is given by _____. (where, η is the efficiency of Rankine cycle).

A. η
B. η^2
C. $1/\eta^2$
D. $1/\eta$

Ans. D

Sol.

$$Heat\ rate = \frac{Heat\ supplied\ in\ kW}{Power\ in\ kW}$$

$$= \frac{\dot{m}_s \times Heat\ supplied}{\dot{m}_s \times Net\ work}$$

$$= \frac{Heat\ supplied}{Net\ work} = \frac{1}{\eta}$$

44. An example of a water tube boiler is a:

A. Locomotive boiler
B. Lancashire boiler
C. Babcock-Wilcox boiler
D. Cochran boiler

Ans. C

Sol. If water passes through the tubes and hot gases surround the tubes, then it is called a water tube boiler. Eg. Babcock and Wilcox boiler.

45. Which of the following relation holds when a diesel cycle and an otto cycle have the same efficiency and same compression ratio (r), the cutoff ratio of diesel cycle is (r_c). (Specific heat ratio = γ)

A. $\gamma(r-1)+r_c^{\gamma}+1=0$
B. $\gamma(r_c-1)+r^{\gamma}+1=0$
C. $\gamma(r_c-1)-r_c^{\gamma}+1=0$
D. $\gamma(r_c-1)+r_c^{\gamma}-1=0$

Ans. C

Sol.

$$\eta_{otto} = 1-\frac{1}{r^{\gamma-1}},\quad \eta_{Diesel} = 1-\frac{1}{r^{\gamma-1}}\left(\frac{r_c^{\gamma}-1}{\gamma(r_c-1)}\right)$$

$$\eta_{otto} = \eta_{diesel}$$

$$\frac{r_c^{\gamma}-1}{\gamma(r_c-1)} = 1$$

$$\gamma(r_c-1)-r_c^{\gamma}+1=0$$

46. Which one of the following safety device is used to protect the boiler when the water level falls below a minimum level?

A. Safety valve
B. Water level indicator
C. Fusible plug
D. Blow off cock

Ans. C

Sol.

- Fusible plug is a small device installed in small horizontal fire tube boilers between furnace and boiler water drum for protection of boiler while lower water level in drum.
- When water level reduces lower than predefined level, the higher temperature of the steam melts the lead of fusible plug so water from the drum fall in to the furnace and shell of boiler, wetting the fire tube and disrupting combustion in the furnace and thus preventing any damage to the boiler.

47. In Brayton Cycle, the work ratio is 0.65. What is the back work ratio of this Brayton Cycle?

A. 2.53 B. 0.65

C. 0.35 D. 1.53

Ans. C

Sol.

For a Brayton Cycle:

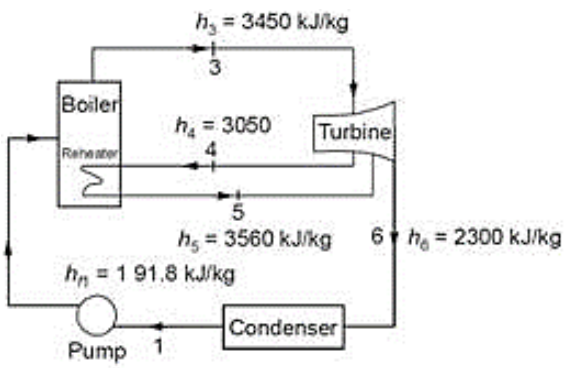
Work ratio (r_w)+ Back work ratio (r_{bw}) = 1

Therefore:

r_{bw}= 1 −r_w = 1 – 0.65 = 0.35

48. A steam power plant operates on a theoretical reheat cycle as shown below. Steam enters high pressure turbine at 150 bar and 550 °C (h_3 = 3450 kJ/kg) and expands upto 40 bar (h_4 = 3050 kJ/kg). It is reheated at constant pressure of 40 bar to 550 °C (h_5 = 3560 kJ/kg) and expands through the low pressure turbine to a condenser at 0.1 bar (h_6 = 2300 kJ/kg). Also given, h_{f1} (at 0.1 bar) = 191.8 kJ/kg.

Thermal efficiency (in %) and steam rate (kg/kWh) of the plant neglecting pump work respectively are:



A. 44.05 and 4.34 B. 48.10 and 5.12

C. 42.10 and 3.10 D. 44.05 and 2.17

Ans. D

Sol. Given,

enthalpy at 150 bar and 550 °C (h_3) = 3450 kJ/kg

enthalpy of steam after expansion in high pressure turbine to 40 bar (h_4)= 3050 kJ/kg

enthalpy at 40 bar and 550 °C (h_5)= 3560 kJ/kg

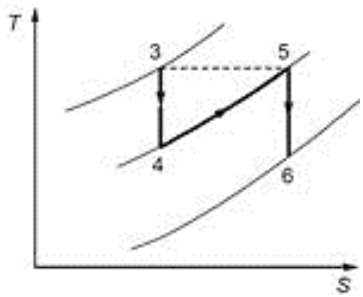
enthalpy of steam after expansion in low pressure turbine to 0.1 bar (h_6) = 2300 kJ/kg

$$Q_s = (h_3 - h_{f1}) + (h_5 - h_4)$$

$$= (3450 - 191.8) + (3560 - 3050)$$

$$= 3768.2 \text{ kJ/kg}$$

$$W = (h_3 - h_4) + (h_5 - h_6)$$



$$= (3450 - 3050) + (3560 - 2300)$$

$$= 1660 \text{ kJ/kg}$$

$$\eta_{cycle} = \frac{W}{Q_s} = \frac{1660}{3768.2} = 44.05\%$$

$$\text{Steam rate} = \frac{3600}{W}$$

$$= \frac{3600}{1660}$$

$$= 2.17 \text{ kg/kWh}$$

49. The clearance ratio of a 4- stroke single cylinder I.C. engine is 10 % of swept volume. The compression ratio of the engine is _____.

A. 9 B. 10

C. 11 D. 12

Ans. C

Sol.

Given: $V_c = 0.10\ V_s$

Compression ratio is given by:

$$r_k = \frac{V_s + V_c}{V_c}$$

$$r_k = \frac{V_s + 0.10V_s}{0.10V_s} = 11$$

50. In a centrifugal compressor as fluid moves through impeller, there is_____?

A. Increase in pressure and decrease in velocity.

B. Increase in both pressure and velocity.

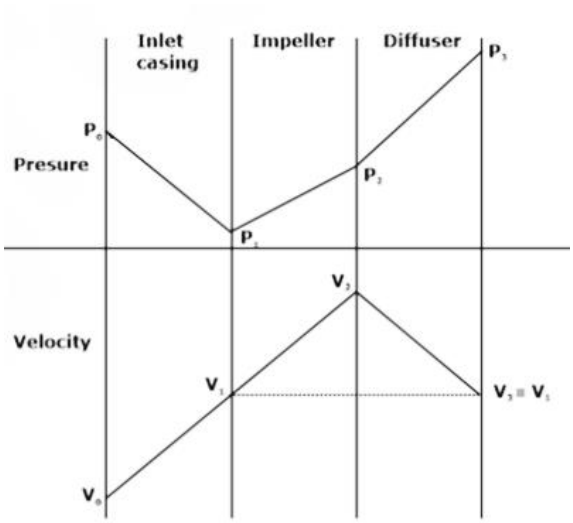
C. Decrease in pressure and increase in velocity.

D. Decrease in both pressure and velocity.

Ans. B

Sol. In a centrifugal compressor as fluid moves through impeller, there is increase in both pressure and velocity.

Variation of pressure and velocity is shown below.



51. Which of these gases attains the lowest thermal efficiency for the same compression ratio in an otto cycle ?

A. Any of the gases
B. Diatonic gases
C. Monoatomic gases
D. Triatomic gases

Ans. D

Sol.

efficiency of otto cycle =

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$

ratio of specific heat

for Monoatomic $\gamma = 1.67$

for Tri-atomic $\gamma = 1.33$

for Di-atomic $\gamma = 1.4$

as γ increases, efficiency of cycle increases.

so the maximum efficiency will occur for monoatomic gas

and minimum maximum efficiency will occur for triatomic gas

52. In a dual cycle, compression ratio and expansion ratio are 15 and 10 respectively. Find cut off ratio for given cycle.

A. $\frac{2}{3}$
B. $\frac{3}{2}$
C. $\frac{4}{3}$
D. $\frac{3}{4}$

Ans. B

Sol. Given,

Compression ratio (r) = 15,

Expansion ratio (r_e) = 10,

$$\text{cutoff ratio} = \frac{\text{compression ratio}}{\text{expansion ratio}} = \frac{15}{10} = \frac{3}{2} = 1.5$$

53. The peak load on a power plant is 40 MW and a group of four loads having maximum demand of 15 MW, 12 MW, 18 MW and 5 MW respectively are connected to the plant. The capacity of the plant is 60 MW. What is diversity factor of the plant?

A. 1.5 B. 1.25

C. 0.8 D. 0.75

Ans. B

Sol.

- Diversity factor is the ratio of the sum of the individual maximum demands of the various subdivisions of a system to the maximum demand of the whole system under consideration.
- Usually diversity is more than one.
- $$Diversity\ factor = \frac{15+12+18+5}{40} = \frac{50}{40} = 1.25$$

54. In a three stage compressor, if the pressure at the entry of first and third stage are 1 bar and 16 bar, then the delivery pressure at the third stage will be

A. 1 bar B. 16 bar

C. 64 bar D. 256 bar

Ans. C

Sol. Given,

P_1 = 1bar , P_3 = 16bar

P_4 = ?

In a multi stage compressor

$$\frac{P_2}{P_1} = \frac{P_3}{P_2} = \frac{P_4}{P_3}$$

$$So, taking\ \frac{P_2}{P_1} = \frac{P_3}{P_2}$$

$$(P_2)^2 = 1\times16$$

$$P_2 = 4$$

$$Now\ taking\ \frac{P_3}{P_2} = \frac{P_4}{P_3}$$

$$P_4 = \frac{(P_3)^2}{P_2}$$

$$P_4 = \frac{256}{4} = 64\ bar$$

Hence, the correct answer is option (C).

55. For an air standard cycle, power at crank shaft is 9.6 MJ/Kg. If the Calorific value of the fuel is 42000 KJ/Kg and indicated thermal efficiency of engine is 30%. then mechanical efficiency of the engine is

A. 81% B. 71.47%

C. 82.33% D. 76.19%

Ans. D

Sol.

Given η_{ith} = 30%, BP = 9.6 MJ/Kg

CV_{fuel} = 42000 KJ/Kg = 42 MJ/Kg

$$\eta_{ith} = \frac{IP}{m_f \times CV} \Rightarrow 0.3 = \frac{IP}{1 \times 42}$$

IP = 12.6 MJ/Kg

Mechanical efficiency,

$$\eta_m = \frac{BP}{IP} = \frac{9.6}{12.6}$$

$\eta_M = 0.7619 \Rightarrow \eta_M = 76.19\%$

56. The following are the results of a Morse test conducted on a four-cylinder, four-stroke petrol engine at a common constant speed in all cases:

The brake power of the engine when all the cylinders are firing is 80 kW. The brake power of the engine when each cylinder is cut-off in turn is 55 kW, 55.5 kW, 54.5 kW and 55 kW, respectively.

The mechanical efficiency of the engine when all the cylinders are firing will be

A. 90% B. 85%

C. 80% D. 75%

Ans. C

Sol.

$$B.P._{All\ cylinder\ working} = 80\ kW$$

$$I.P._{1st\ cylinder\ working} = 80 - 55\ kW$$

$$I.P._{2nd\ cylinder\ working} = 80 - 55.5\ kW$$

$$I.P._{3rd\ cylinder\ working} = 80 - 54.5\ kW$$

$$I.P._{4th\ cylinder\ working} = 80 - 55kW$$

$$\eta_m = \frac{B.P}{I.P} = 80\%\ Ans$$

57. In reciprocating compressors, clearance is provided

a- To improve the volumetric efficiency of compressor

b- To accommodate valves

c- To account for thermal expansion due to temperature variation

d- To reduce power consumption of the compressor

A. (a), (b) & (c) B. (b) & (c)

C. (a), (b), (c) & (d) D. (b) & (d)

Ans. B

Sol.

Clearance volume or bumping clearance is the space between the top of the piston and the cylinder head of an air compressor. This clearance is an important aspect of the compressors and should be as less as practically possible to improve the volumetric efficiency of the compressor. The clearance volume should not be too less or too more. Moreover, it affects the efficiency of the machinery and thus should be checked at regular intervals of time.

58. After a test on four cylinder, two stroke gasoline engine following observations were made:

Area of the positive loop of the indicator diagram = 5.75 cm^2

Area of negative loop of the indicator diagram = 0.25 cm^2

Length of indicator diagram = 55 cm

Spring constant = 3.5 bar/cm

What will be the indicated mean effective pressure (in bar) of the engine?

A. 0.35 B. 5.5

C. 3.5 D. 4.2

Ans. A

Sol. Given,

Area of the positive loop of the indicator diagram = 5.75 cm^2

Area of negative loop of the indicator diagram = 0.25 cm^2

Net area of diagram = 5.75 - 0.25 = 5.5cm^2

$$P_{imep} = \frac{\text{Area of diagram}}{\text{length of diagram}} \times \text{spring constant}$$

$$P_{imep} = \frac{5.5}{55} \times 3.5 = 0.35 \text{ bar}$$

59. Economizer used in power plants is used to heat _____.

A. flue gases B. intake air

C. steam D. feed water

Ans. D

Sol.

- A common application of economizers in steam power plants is to capture the waste heat from boiler stack gases (flue gas) and transfer it to the boiler feed water. This raises the temperature of the boiler feed water, lowering the needed energy input, in turn reducing the firing rates needed for the rated boiler output.

60. A diesel engine has a compression ratio of 21 and cut-off takes place at 8% of the stroke. What is the cut – off ratio ?

A. 1.2 B. 2.2

C. 1.6 D. 2.6

Ans. D

Sol.

Given:

compression ratio, $r_k = 21$

cut off takes place = 8% of(V_1 - V_2)

$$r_c - 1 = \frac{\% p}{100}\left(r_k - 1\right)$$

$$r_c - 1 = \frac{8}{100}(21 - 1)$$

$r_c = 2.6$

61. Which of the following is correct regarding the pressure inside the cylinder during exhaust stroke?

A. equal to the atmospheric pressure

B. less than the atmospheric pressure

C. more than the atmospheric pressure

D. None of the above

Ans. C

Sol. During exhaust piston moves BDC to TDC inside cylinder, forcing all the remaining burnt air/fuel (exhaust) out. Again, depending on how restrictive the exhaust valves, ports, mufflers, etc are, the cylinder pressure in the cylinder will be somewhat higher than atmospheric.

How high the cylinder pressure is during the exhaust stroke determines how hard the engine must work to expel the burnt exhaust.

62. Which of the following parameter remain constant during Morse test of the IC engine?

A. Friction power

B. Load on the dynamometer

C. Break power

D. Indicated power

Ans. A

Sol. The Morse test is used to obtain the Indicated Power (IP) of a Multi-cylinder Engine. In it the load on the dynamometer is adjusted so as maintain constant speed and so frictional power (FP). FP is independent of load and proportional to engine speed.

63. The thermal efficiency of air standard diesel cycle with increasing cut off ratio keeping other parameters constant

A. Increases

B. Decreases

C. Remain constant

D. none of the above

Ans. B

Sol. The thermal efficiency of diesel cycle is given by

$$\eta_{diesel} = 1 - \frac{1}{r^{\gamma-1}}\left\{\frac{\alpha^{\gamma}-1}{\gamma(\alpha-1)}\right\}$$

Where,

r = compression ratio,

γ = specific heat ratio,

α = cut- off ratio

It is clear that as α increases the η_{diesel} decreases.

64. Which of the following statement is INCORRECT about excess value of 'Valve overlap Period'_____?

1) Burnt gases will be sucked into cylinder.

2) It may allow Fresh Charge to escape through exhaust value.

A. Only 1 B. Only 2

C. Both 1 & 2 D. None of the above

Ans. D

Sol.

o In 4 stroke SI Engine, there is a period where both inlet valve and exhaust valves are open. This period is called Valve overlap Period.

o This period should not be excessive otherwise the burnt gases will be sucked into cylinder or it may allow fresh charge to escape through exhaust valve.

65. Find the maximum work obtainable per kg of air in ideal brayton cycle working between temperature limits of 127°C and 1327°C. (Take C_p = 1 kJ/kg/K)

A. 100 kJ/kg B. 200 kJ/kg

C. 300 kJ/kg D. 400 kJ/kg

Ans. D

Sol.

Given: T_{max} = 627°C =1327 + 273 = 1600 K

T_{min} = 127°C = 127 + 273 = 400 K

C_p = 1 KJ/kg-K

Maximum work obtainable is given by:

$$W_{max} = mC_p\left(\sqrt{T_{max}} - \sqrt{T_{min}}\right)^2$$

$$W_{max} = 1 \times 1 \times \left(\sqrt{1600} - \sqrt{400}\right)^2$$

W_{max}= $(40-20)^2$ = 400 kJ/kg

66. The ratio of the actual vacuum to the ideal vacuum in a condenser is called

A. condenser efficiency B. vacuum efficiency

C. nozzle efficiency D. boiler efficiency

Ans. B

Sol.

Due to the presence of air inside the condenser, the actual pressure inside will not be equal to the pressure corresponding to steam temperature inside the condenser. The air will exert its own partial pressure and thus lower the partial pressure of the seatm during condensation. To judge the effect of air leakage,we defined a term vacuum efficiency. The ratio of the actual vacuum to the ideal vacuum in a condenser is called vacuum

efficiency.

$$\eta_{vacuum} = \frac{Actual\ vacuum\ in\ the\ condenser}{Ideal\ vaccum\ in\ condenser\ when\ no\ air\ is\ present}$$

67. Stirling Cycle has _____.

A. Two isentropic and two isochoric processes

B. Two isentropic and two isobaric processes

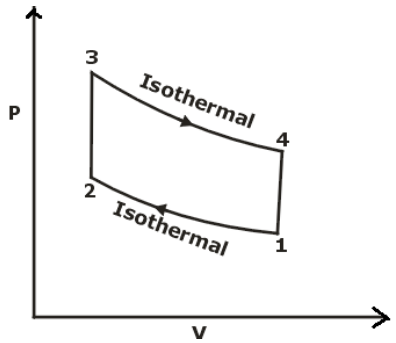
C. Two isothermal and two isochoric processes

D. Two isothermal and two isobaric processes

Ans. C

Sol.

Stirling cycle:



Stirling Cycle has Two isothermal and two isochoric processes.

Process 1-2: Isothermal compression

Process 2-3: Isochoric head addition

Process 3-4: Isothermal expansion

Process 3-4: Isochoric head rejection.

68. A gas turbine working on Brayton cycle has a back work ratio of 0.35 and net output is 250 kJ. If compressor efficiency of 90%, then find the work output by the turbine _____?

A. 384 kJ

B. 250 kJ

C. 384.6 kJ

D. 220 kJ

Ans. C

Sol. Given:

Back work ratio: r_{bw}= 0.35

Back work ratio is given by:

$$r_{bw} = \frac{W_C}{W_T}$$

$0.35 = W_C/W_T$ ..... (1)

$W_{net} = W_T - W_C$ ..... (2)

$250 = W_T - 0.35\ W_T$

$0.65\ W_T = 250$

$W_T = 384.6$ kJ

69. If the enthalpy drop in the moving blades and fixed blades of a steam turbine is 10 kJ/kg and 15 kJ/kg respectively then what is the degree of reaction?

A. 67% B. 60%

C. 40% D. 33%

Ans. C

Sol. Given,

ΔH_{moving}= 10 kJ/kg,

ΔH_{fixed}= 15 kJ/kg

$$Degree\ of\ reaction = \frac{Enthalpy\ drop\ across\ moving\ blades}{Total\ Enthalpy\ drops}$$

$$= \frac{10}{10+15}$$

$$= 0.4 = 40\%$$

70. If m is the ratio of maximum and minimum temperature of Brayton cycle, then the efficiency corresponding to the maximum work done is given by the relation _____.

A. $\eta = 1 + \frac{1}{\sqrt{m}}$ B. $\eta = 1 - \frac{1}{\sqrt{m}}$

C. $\eta = 1 - \sqrt{m}$ D. $\eta = 1 + \sqrt{m}$

Ans. B

Sol.

Given: $m = \sqrt{\frac{T_{max}}{T_{min}}}$

For maximum work done, cycle efficiency is:

$$\eta = 1 - \sqrt{\frac{T_{min}}{T_{max}}} = 1 - \frac{1}{\sqrt{m}}$$

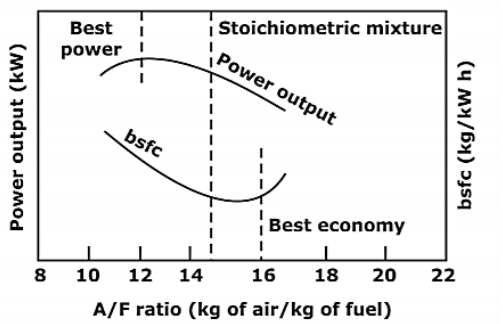
71. For maximum power generation the air fuel ratio for a petrol engine is

A. 16:1 B. 12:1

C. 15:1 D. 20:1

Ans. B

Sol. power characteristics curve of fuel



From the above figure, we can see that for maximum power output, Air to fuel ratio is to be 12:1

72. The intermediate pressure which produces minimum work also results in

A. equal discharge temperatures

B. equal work for two stages

C. equal pressure ratios in two stages

D. all of the mentioned

Ans. D

Sol. These are the results when we consider minimum work of compression

1. equal discharge temperature
2. equal pressure ratio in each stages
3. same amount of work is required in each stage of compression
4. intermediate pressure is the square root of the product of the inlet and delivery pressure

73. In an air standard cycle, indicated power is 80 KW and mechanical efficiency is 85%. Then the frictional power will be

A. 68 kW

B. 12 kW

C. 14 kW

D. 15 kW

Ans. B

Sol.

Given η_M = 85%, IP = 80 KW

$$\eta_M = \frac{BP}{IP} \Rightarrow 0.85 = \frac{BP}{80} \Rightarrow BP = 68\ KW$$

IP = BP + FP ⇒ FP = IP – BP

= 80 – 68

FP = 12 kW

74. In SI engines for higher thermal efficiency _____.

A. compression ratio should be high

B. heat liberation during combustion should be maximum

C. surface to volume ratio should be high

D. long flame travel distance

Ans. A

Sol. Thermal efficiency of SI engine:

$$\eta = 1 - \frac{1}{r^{\gamma-1}}$$

Where r is the compression ratio. As 'r' increases efficiency increases.

75. Cetane number of alpha methyl naphthalene is assigned the value of :

A. 0

B. 15

C. 55

D. 100

Ans. A

Sol.

- *n-hexadecane*(also called cetane, n-$C_{16}H_{34}$), which has very good ignition quality, was assigned the cetane number of 100;
- *1-methylnaphthalene*, which has a poor ignition quality, was assigned a cetane number of zero.

76. an air standard otto cycle having compression ratio 8. It is compressed isentropically to a pressure 18.3bar and 690K. if the pressure and temperature at the beginning of compression is 1bar and 300K, then the efficiency of the cycle is

A. 47.5% B. 63.2%

C. 44.77% D. 56.52%

Ans. D

Sol. given,

P_1 = 1bar, P_2 = 18.3 bar

T_1 = 300K T_2 = 690K

$$\eta = 1 - \frac{1}{r^{\gamma-1}} = 1 - \frac{T_1}{T_2}$$

$$\eta = 1 - \frac{300}{690}$$

$$\eta = 0.5652 = 56.52\%$$

77. What is the effect of regeneration on mean temperature of heat addition in Brayton cycle?

A. mean temperature of heat addition decreases because of regeneration

B. mean temperature of heat addition increases because of regeneration

C. mean temperature of heat addition is not affected by use of regenerator

D. none of the above

Ans. B

Sol. Due to Regeneration, heat addition process (inlet to combustion chamber)starts at a temperature higher than the earlier whereas the exit temperature of the combustion chamber remains constant so the mean temperature(average) of heat addition increases.

78. Two special cases are formed in a dual cycle corresponding to the zero pressure ratio and zero cutoff ratio. These two cases give rise to which cycle?

1) Otto cycle

2) Diesel cycle

3) Atkinson cycle

4) Lenoir cycle

The correct statements are

A. 1&2 B. 1&3&4

C. 2&3 D. 1, 2 &4

Ans. A

Sol. In dual cycle if cut off ratio is zero, we get Otto cycle and if explosion or pressure ratio is zero then we get diesel cycle.

79. A gas turbine power plant operates on the Brayton cycle between T_{min} = 300 K and T_{max} = 1200 K. The ratio of maximum cycle efficiency of Brayton cycle to the efficiency of Carnot cycle, operating between the same two temperatures is _____.

A. 0.33 B. 0.45

C. 0.67 D. 75

Ans. C

Sol. Maximum efficiency of Brayton cycle is given by:

$$(\eta_{max})_{Brayton} = 1 - \sqrt{\frac{T_{min}}{T_{max}}}$$

$$(\eta_{max})_{Brayton} = 1 - \sqrt{\frac{300}{1200}} = 0.5$$

Efficiency of Carnot cycle is given by:

$$\eta_{Carnot} = 1 - \frac{T_{min}}{T_{max}} = 1 - \frac{300}{1200} = 0.75$$

$$\frac{(\eta_{max})_{Brayton}}{\eta_{Carnot}} = \frac{0.50}{0.75} = 0.67$$

80. Which of the following statements regarding a Rankine cycle with reheating is/are TRUE_____?

(i) Increase in thermal efficiency always

(ii) Decrease in thermal efficiency always

(iii) Drier steam at the turbine exit

A. Only (i) & (iii) B. Only (ii) & (iii)

C. Only (i) D. Only (iii)

Ans. D

Sol. A Rankine cycle when subjected to reheating,

⇒ Steam quality at exit of steam turbine increases.

⇒ Efficiency of Rankine cycle may increase or decrease, it depends on the reheating pressure.

81. The 'work ratio' increases with

A. increase in turbine inlet pressure

B. decrease in compressor inlet temperature

C. decrease in pressure ratio of the cycle

D. all of the mentioned

Ans. D

Sol.

$$Work\ Ratio = \frac{W_{net}}{W_T} = \frac{W_T - W_C}{W_T} = 1 - \frac{W_C}{W_T}$$

$$Work\ Ratio = 1 - \frac{C_p(T_2 - T_1)}{C_p(T_3 - T_4)} = 1 - \frac{T_1}{T_4}$$

$$Work\ Ratio = 1 - \frac{T_1}{T_3} \times \frac{T_3}{T_4}$$

$$Work\ Ratio = 1 - \frac{T_1}{T_3} \times \left(r_p\right)^{\frac{\gamma - 1}{\gamma}}$$

Thus the 'work ratio' increases when the turbine inlet pressure increases, the compressor inlet temperature decreases, the pressure ratio of the cycle decreases.

82. Willian's line for the steam engine is a straight line relationship between _____.

A. the steam consumption per hour & indicated power

B. the steam consumption per hour & brake power

C. the steam consumption per hour & efficiency

D. the steam consumption per hour & pressure of steam

Ans. B

Sol. **Willian's Line method:**

- It is the method estimating the friction power of compression ignition (C.I.) engines.
- Willian's line for the steam engine is a straight line relationship between the fuel consumption per hour (on vertical axis) and brake power (on horizontal axis).
- Here, it is asked for steam engine, therefore replace fuel by steam because steam fulfills the same purpose as fuel in C.I. engines.

83. The self-ignition temperature of diesel is _____ as compared to that of petrol.

A. is higher

B. is lower

C. is same

D. cannot be determined

Ans. B

Sol.

* Self Ignition Temperature(SIT) is the lowest temperature at which a diesel/Petrol will ignite itself without the presence of a spark or flame.

*SIT of diesel is 210^0C

* SIT of petrol is (240^0C - 280^0C)

84. For a single cylinder four-stroke oil engine, indicated power is 15 kW. calorific value of fuel is 40000 kJ/kg and fuel consumed is 0.001 kg/s. What will be the indicated thermal efficiency?

A. 62.5%

B. 40%

C. 75%

D. 37.5%

Ans. D

Sol.

Given,

Indicated Power (IP) = 15 kW

Calorific value of fuel (C_v) = 40000 kJ/kg

Mass of fuel used (m_f) = 0.001 kg/s

$$\eta_{ith} = \frac{IP}{m_f \times C_v} = \frac{15}{0.001 \times 40000} = 0.375 = 37.5\%$$

85. A steam plant has the boiler efficiency of 90%, turbine efficiency (mechanical) of 94%, generator efficiency of 98 % and cycle efficiency of 40%. If 8 % of the generated power is used to run the auxiliaries, the overall plant efficiency is

A. 34%
B. 31%
C. 45%
D. 25%.

Ans. B

Sol.

$\eta_{overall} = \eta_{boiler} \times \eta_{turbine} \times \eta_{generator} \times \eta_{auxillary} \times \eta_{cycle}$

$\eta_{overall} = 0.90 \times 0.94 \times 0.98 \times 0.92 \times 0.40 = 30.5\ \% \approx 31\ \%$

86. Which of the following boiler accessories utilizes the waste heat of flue gases to heat the feed water?

A. Water preheater
B. Economiser
C. Feed heater
D. super heater

Ans. B

Sol. Economizer is the device used to pre heat the water before entering into the boiler. basically it is a heat exchanger.

Super heater is used to superheat the steam at constant pressure.

87. In thermal power plants, the deaerator is used mainly to_____

A. remove air from condenser.
B. increase feed water temperature
C. reduce steam pressure
D. remove dissolved gases from feed water,

Ans. D

Sol.

- The purpose of a deaerator is to reduce dissolved gases, particularly oxygen, to a low level and improve a plant's thermal efficiency by raising the water temperature.
- In addition, deaerators provide feedwater storage and proper suction conditions for boiler feedwater pumps.

88. The compression ratio in a diesel engine is 25 and cutoff takes place at 20% of the stroke. What is the cutoff ratio?

A. 3
B. 2.8
C. 2.4
D. 5.8

Ans. D

Sol.

Compression ratio = V_1/V_2 = 25

Cutoff ratio = V_3/V_2

Given,

$V_3 - V_2 = 0.2 \times (V_1 - V_2)$

Dividing by V_2

$V_3/V_2 = 1 + 0.2 \times 24 = 1 + 4.8 = 5.8$

89. For the same compression ratio, the efficiency of an air standard otto cycle is:

A. More than the efficiency of an air standard diesel cycle

B. Less than the efficiency of an air standard diesel cycle

C. Equal to the efficiency of an air standard diesel cycle

D. None of these

Ans. A

Sol. The efficiency of a standard otto cycle is more than the efficiency of an air standard diesel cycle for the same compression ratio.

90. Given a four stroke diesel engine with compression ratio 16 and cut off ratio 2.5 . Find the percentage of stroke at which cut off occur. Take γ=1.4

A. 5% B. 10%

C. 15% D. 20%

Ans. B

Sol.

Given, compression ratio:

r=16 and cut off ratio (ρ) =2.5

Let, cut off takes place at %S of stroke.

$$\rho - 1 = \frac{\%S}{100}(r-1)$$

$$2.5 - 1 = \frac{\%S}{100} \times (16-1)$$

% S= 10%

91. The cycle efficiency of diesel cycle depends upon

A. only on temperature limits

B. only on pressure limits

C. Onnly on volume compression ratio

D. on cut-off ratio and volume compression ratio.

Ans. D

Sol. The cycle effieciency of diesel cycle depends on cut-off ratio and volume compression ratio.

So the correct option is (d).

92. A large diesel engine runs on a 4 stroke cycle at 2000 rpm. The engine has a displacement of 25 litre and a brake mean effective pressure of 0.6 MN/m^2. It consumes 0.018 Kg/s of fuel (calorific value = 42000 kJ/Kg).

Determine the brake power.

A. 250KW
B. 225KW
C. 275KW
D. None of the above

Ans. A

Sol. N=2000 rpm

$$V_s = 25\ litre\ = 0.025\ m^3$$

$$\dot{V}_s = V_s \times \frac{N}{60 \times 2}$$

$$\dot{V}_s = 0.025 \times \frac{2000}{60 \times 2}\ =\ 0.4167\ m^3/s$$

$$B.P. = b_{mep} \times \dot{V}_s = 0.6 \times 0.4167 = 250kW$$

93. An SI engine, working on ideal Otto cycle, has a compression ratio of 8. If the ratio of specific heats is 1.45, then the air standard efficiency of the engine is _____.

A. 61%
B. 66%
C. 71%
D. 63%

Ans. A

Sol. Efficiency of Otto cycle:

$$\eta_{otto} = 1 - \frac{1}{r^{\gamma-1}} = 1 - \frac{1}{8^{1.45-1}} = 0.6077$$

94. The equipment installed in power plants to reduce air pollution due to smoke is

A. Induced draft fans
B. De-super heaters
C. Electrostatic precipitators
D. Re-heaters

Ans. C

Sol. Electrostatic Precipitators(ESPs) are used in coal based power plant to separate flyash from flue gases in order to reduce air pollution.

95. In a steam condenser the partial pressure of Steam and Air are 0.06 bar and 0.007 bar respectively, the condensed pressure is.

A. 0.067 bar
B. 0.06 bar
C. 0.053 bar
D. 0.007 bar

Ans. A

Sol. Given,

The partial pressure of steam = 0.06 bar

The partial pressure of air = 0.007

Condenser Pressure = $P_s + P_a$

= 0.06 + 0.007 = 0.067 bar

96. The most common advantage of liquid cooling system is_____.

A. Simplicity of engine design

B. Uniform cooling

C. Dependence on water supply

D. Improve power to weight ratio

Ans. B

Sol.

- The most common advantage of liquid cooling system is uniform cooling compare to air cooled system. As water is more denser than air.

97. In dynamic compressor, rise in pressure is achieved _____?

A. Completely in Rotor

B. Completely in diffuser

C. By decreasing volume

D. Partly in rotor and partly in diffuser

Ans. D

Sol. • In dynamic compressors the rise in pressure is achieved by the dynamic action of gas.

• In turbo compressors, the kinetic energy imparted to the gas by the rotation of rotor is changed into pressure energy, partly in rotor and rest in a diffuser.

98. The knocking tendency in compression ignition engines increases with_____.

A. Increase of coolant water temperature

B. Increase of temperature of inlet air

C. Decrease of compression ratio

D. Increase of compression ratio

Ans. C

Sol.

- Decreases of compression ratio reduces temperature and increases delay period, which increases knocking tendency in CI engine.

99. A 4-storke otto cycle having mean effective pressure of 1MPa and the displacement of the engine is 5 litre. If the engine is operated at 4000 rpm, then power output of the engine is

A. 333.33 KW

B. 166.66 KW

C. 150 KW

D. 200 KW

Ans. B

Sol.

Given 4 stroke cycle ⇒ No of working strokes per minute = N/2

P_{mep} = 1 MPa V_S = 5 litre = 5 × 10^{-3} m^3

N = 4000 rpm

$$\text{Power} = P_{mep} \times V_S \times \frac{N}{2 \times 60} \text{ Watt}$$

$$= 1 \times 10^6 \times 5 \times 10^{-3} \times \frac{4000}{2 \times 60}$$

Power = 166.66 KW

100. A thermal electric power plant produces 5000 MW of power. If the coal releases 70 x 10^5 kJ/sec of energy, then what is the rate at which heat is rejected from the power plant?

A. 4805.6 MW
B. 2024.5 MW
C. 2000 MW
D. 1905 MW

Ans. C

Sol.

Energy released by coal $= 70 \times 10^5$ kJ/sec $= 7000$ MW

Heat released from Powerplant $= 7000 - 5000 = 2000$ MW

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