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MECHANICAL ENGINEERING

Internal Combustion Engine

Duration : 1:00 hr.   **Maximum Marks : 50**

Read the following instructions carefully

1. This question paper contains **30** objective questions. **Q.1-10** carry one mark each and **Q.11-30** carry two marks each.

2. Answer all the questions.

3. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked **A**, **B**, **C**, **D**) using HB pencil against the question number. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely using a good soft eraser.

4. There will be **NEGATIVE** marking. For each wrong answer **1/3rd** of the full marks of the question will be deducted. More than one answer marked against a question will be deemed as an incorrect response and will be negatively marked.

5. Write your name & Roll No. at the specified locations on the right half of the **ORS**.

6. No charts or tables will be provided in the examination hall.

7. Choose the **Closest** numerical answer among the choices given.

8. If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that questions.

9. If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Q. No. 1 to Q. No. 10 carry 1 mark each

Q.1 A good CI engine fuel should have
(a) high self ignition temperature
(b) short ignition lag
(c) long ignition lag
(d) short ignition lag and high self ignition temperature

Q.2 Stoichiometric air-fuel ratio of alcohol when compared to gasoline is
(a) higher
(b) equal
(c) lower
(d) higher or lower depends on type of engine

Q.3 Disadvantage of hydrogen as an alternative fuel in IC engines is:
(a) Large vehicle range for a given fuel tank capacity
(b) High NO_x emissions
(c) Difficult to refuel and the possibility of detonation
(d) Very difficult to store

Q.4 The process of breaking up of a liquid into fine droplets by spraying is called
(a) atomisation
(b) injection
(c) ionisation
(d) vaporisation

Q.5 Pour point of fuel oil is the
(a) temperature at which if flows easily
(b) it catches fire without external aid
(c) temperature at which it solidifies or congeals
(d) indicated by 90% distillation temperature

Q.6 In SI engines, for higher thermal efficiency
(a) compression ratio should be high
(b) long flame travel distance
(c) surface to volume ratio should be high
(d) heat liberation during combustion should be maximum

Q.7 An ideal air standard Otto cycle has a compression ratio of 10. Assuming γ = 1.4, the thermal efficiency of the Otto cycle is
(a) 60.18%
(b) 71.2%
(c) 49.1%
(d) 56.2%

Q.8 The air standard diesel cycle is less efficient than the Otto cycle for the
(a) Same compression ratio and heat rejection
(b) Same pressure and heat rejection
(c) Same rpm and cylinder dimensions
(d) Same pressure and compression ratio

Q.9 The crank radius of a single-cylinder IC engine is 50 mm and the diameter of the cylinder is 90 mm. The swept volume of the cylinder is
(a) 176.71 cm³
(b) 636.172 cm³
(c) 520.34 cm³
(d) 821.6 cm³

Q.10 In a SI engine working on the ideal Otto cycle, the compression ratio is 7.5 and mechanical efficiency is 85%. The work output per cycle is $19.5 \times 10^5 \, V_c$ Joule where V_c is clearance volume, in m³. The brake mean effective pressure is
(a) 1.50 bar
(b) 0.75 bar
(c) 2.55 bar
(d) 3.20 bar

Q. No. 11 to Q. No. 30 carry 2 marks each

Q.11 What is the fuel consumption per cycle per cylinder for a 6-cylinder, 4-stroke CI engine having brake specific fuel consumption of 250 gm per kW-hr and developing 90 kW at 2500 rpm?
(a) 0.004 gm
(b) 0.04 gm
(c) 0.005 gm
(d) 0.05 gm

Q.12 Consider the following statements about supercharging:
1. Supercharging reduces knocking in CI engines.
2. Supercharging at high altitudes is essential.
3. Supercharging results in fuel economy.
4. There can be limited supercharging in SI engines because of detonation.
Which of the above statements are correct?
(a) 1, 2 and 3
(b) 1, 2 and 4
(c) 2, 3 and 4
(d) 1, 3 and 4

Q.13 An engine produces 12 kW brake power while working with a brake thermal efficiency of 28%. The calorific value of the fuel used is 40,000 kJ/kg. The fuel consumption is
(a) 1.07 kg/hr
(b) 1.51 kg/hr
(c) 5.20 kg/hr
(d) 3.85 kg/hr

Q.14 In a Morse test for a 2-cylinder, 2-stroke SI engine, the brake power was 10 kW whereas the brake power of individual cylinder with spark cut-off were 4.75 kW and 4 kW respectively. The mechanical efficiency of the engine is

(a) 90%   (b) 80%

(c) 88.88%   (d) 78.65%

Q.15 A turbocharged four-stroke direct injection diesel engine has a displacement volume of 0.0259 m³. The engine has an output of 950 kW at 2200 rpm. The mean effective pressure is

(a) 2 kPa   (b) 1 kPa

(c) 2 MPa   (d) 1 MPa

Q.16 An SI engine develops indicated power of 50 kW at full load. Its brake thermal efficiency is 30% and brake specific fuel consumption is 0.286 kg/kWhr. At 70% of load, it has a mechanical efficiency of 80%. Assuming constant frictional losses, what is the brake power?

(a) 32.50 kW   (b) 42.55 kW

(c) 35.75 kW   (d) 50 kW

Q.17 A 2L IC engine working on ideal diesel cycle has cut off ratio and compression ratio 1.9 and 18 respectively. Compression process begins at 40°C and 99 kPa. If the engine produces 57.4 kW of power, what should be its rated rpm?

(a) 2200.128

(b) 2966.66

(c) 2733.33

(d) 3333.33

Q.18 An oil engine working on dual engine cycle takes air at 1.0 bar and 16°C. The maximum cycle pressure is 60 bar. The compression ratio is 14 : 1. The heat addition at constant pressure is equal to heat addition at constant volume. What is the air standard efficiency of the cycle?

(a) 64.4%

(b) 74.6%

(c) 78.1%

(d) 82.5%

Q.19 What is the volume of air required for complete combustion of methane per kg of fuel? The air is supplied at 1.01 bar and 22°C. Assume air contains 79% N_2 and 21% O_2 by volume.

(a) 11.01 m³/kg of fuel

(b) 13.81 m³/kg of fuel

(c) 12.41 m³/kg of fuel

(d) 14.38 m³/kg of fuel

Q.20 An IC engine is operating on the cycle shown below.
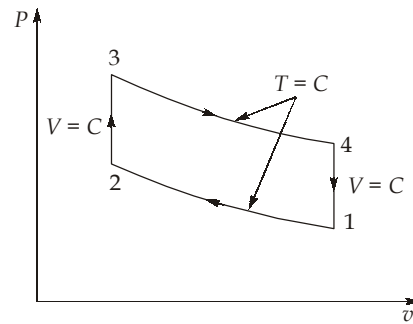
The cycle takes in air at 1 bar and 300 K. The air is compressed isothermally and then heated at constant volume so that the pressure rises to 15 bar and temperature to 700 K. The air expands isothermally to its initial volume and rejects the cycle. What is the mean effective pressure?

(a) 2.94 bar   (b) 3.48 bar

(c) 3.21 bar   (d) 3.91 bar

Q.21 A four cylinder 4 stroke engine is tested and following data are obtained.

Brake power = 50 kW. Air fuel ratio = 10 : 1, Calorific value = 34 MJ/m³, Compression ratio = 10 : 1, Volumetric efficiency = 70%, indicated thermal efficiency = 35% and mechanical efficiency = 80%. Total volume of the engine is 2000 cc. The speed of engine is approximately,

(a) 3500 rpm   (b) 2500 rpm

(c) 4500 rpm   (d) 1500 rpm

Q.22 A single cylinder 4-stroke diesel engine having an expansion ratio and cut-off ratio as 15 and 1.5 respectively is working with a fuel with a calorific value of 42 MJ/kg. If the relative efficiency is 40% and the brake power is 30 kW, the mass flow rate of fuel is (Take γ = 1.4)

(a) 5.6 kg/h   (b) 6.3 kg/h

(c) 9.4 kg/h   (d) 7.9 kg/h

Q.23 A 4-stroke diesel engine has following data. Cylinder bore = 20 cm, stroke length is 30 cm, brake torque = 300 N-m at engine speed of 500 rpm. Length of indicator diagram is 60 mm and area is 500 sq-mm. The indicator spring rating is 1.4 mm for a pressure of 10 N/cm². The mechanical efficiency of the engine is

(a) 41.56%   (b) 67.165%

(c) 72.90%   (d) 59.12%

Q.24 The clearance volume of diesel cycle is 30 cm^3. The compression ratio is 20. The volume of gas when the piston has completed 30% of the compression stroke will be
(a) 259 cm^3 (b) 429 cm^3
(c) 469 cm^3 (d) 399 cm^3

Q.25 The following data is given for an oil engine working on ideal diesel cycle:
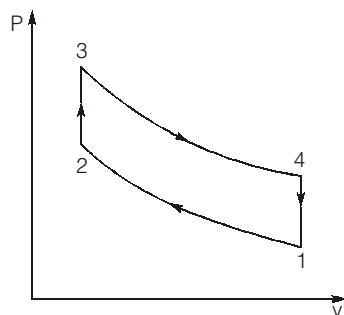
Compression ratio = 20

Inlet pressure and temperature are 1 bar and 67°C respectively. Heat addition at constant pressure take place up to 10% of the stroke.

What will be the temperature at the end of the heat addition?
(a) 1521 K   (b) 2141 K
(c) 1730 K   (d) 2560 K

Q.26 In the figure shown, the efficiency of the Otto cycle is given by

1. $1 - \dfrac{T_1}{T_2}$ 2. $1 - \left(\dfrac{1}{r}\right)^{\gamma-1}$

3. $1 - \dfrac{T_4 - T_1}{T_3 - T_2}$ 4. $\dfrac{1}{1 + \dfrac{HR}{WD}}$

Where, r = compression ratio, g = ratio of specific heats, HR = heat rejected, WD = work done
Which of the above expressions are correct?
(a) 1 only   (b) 2 only
(c) 2 & 3 only   (d) All of these

Q.27 In an IC engine working with Nitrogen gas on an ideal Otto cycle, the minimum enclosed volume is 12.5% of the volume at the beginning of suction. If the heat addition to the engine is 150 kW, the work produced by the engine is
(a) 130.2 hP   (b) 150.10 hP
(c) 100.2 hP   (d) 95.20 hP

Q.28 Statement (I): The air standard efficiency of the diesel cycle decreases as the load is increased.
Statement (II): With increase of load, cut-off ratio decreases.
(a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.29 Statement (I): The CI engine is found to be more efficient than an SI engine.
Statement (II): Because of higher compression ratio, the maximum value of thermal efficiency that can be obtained is higher as compared to SI engine.
(a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.30 Statement (I): The compression ratio for SI engine is limited between 6 to 10.
Statement (II): Upper limit of compression ratio is limited by weight increase of the SI engine.
(a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

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