

Power Engineering (315371)

MSBTE Diploma · K-Scheme · Model Question Paper — Set A

Time: 3 Hours**Max. Marks: 70****Instructions:**

1. All questions are compulsory.
2. Answer each next main question on a new page.
3. Illustrate your answers with neat sketches wherever necessary.
4. Figures to the right indicate full marks.
5. Assume suitable data, if necessary.
6. Use of non-programmable electronic pocket calculator is permissible.
7. Use of steam tables, refrigerant tables and psychrometric chart is permitted.
8. Mobile phone, pager and any other electronic communication devices are not permissible in the examination hall.

Q.1 Attempt any FIVE of the following:**10**

- a) Define one tonne of refrigeration (TR). State its value in kJ/min and in kW.
- b) Define dry bulb temperature and wet bulb temperature.
- c) Define brake power and mechanical efficiency of an I.C. engine.
- d) Define volumetric efficiency and free air delivery (FAD) of an air compressor.
- e) List the major pollutants regulated under BS-VI emission norms.
- f) Represent the Bell-Coleman cycle on p–v and T–s diagrams.
- g) State any four desirable properties of a refrigerant.

Q.2 Attempt any THREE of the following:**12**

- a) Explain with an indicator diagram the effect of intercooling in a two-stage reciprocating air compressor.
- b) Represent the following processes on a psychrometric chart: i) Sensible heating ii) Cooling and dehumidification iii) Heating and humidification iv) Evaporative cooling.
- c) State the need of a heat balance sheet for an I.C. engine. Draw its format and list the items to be measured to complete it.
- d) Compare vapour compression and vapour absorption refrigeration systems on any eight points.

Q.3 Attempt any THREE of the following:**12**

- a) Explain the Morse test used to determine the indicated power of a multi-cylinder petrol engine. State its limitations.
- b) Explain any four factors affecting human comfort in air conditioning.

- c) State the purpose of Exhaust Gas Recirculation (EGR). Explain the EGR system with a neat sketch.
- d) Compare reciprocating and centrifugal compressors on the basis of: i) pressure range ii) mechanical efficiency iii) capacity control iv) applications.

Q.4 Attempt any THREE of the following:

12

- a) Explain with a neat sketch the construction and working of a single-stage single-acting reciprocating air compressor.
- b) List the factors affecting efficient management of a compressed air system. Suggest any two measures to reduce air leakage.
- c) Prepare a checklist of energy saving opportunities for the air-conditioning system of a computer laboratory in your institute.
- d) Explain the terms sub-cooling and superheating. State their effect on the performance of a vapour compression cycle with a p-h diagram.
- e) A single-stage reciprocating air compressor takes in 3.5 m³/min of air at 1 bar and 27 °C and delivers it at 6 bar. The law of compression is $pV^{1.3} = C$. Neglecting clearance, calculate the indicated power required and the isothermal efficiency of the compressor.

Q.5 Attempt any TWO of the following:

12

- a) An ammonia refrigerator works between 30 °C and -15 °C. The vapour is dry saturated at the end of compression and there is no under-cooling of the liquid. The refrigerant flow rate is 4 kg/min. Calculate (i) COP of the cycle, (ii) refrigerating capacity in TR, (iii) power required to drive the compressor. Use the following properties of ammonia:

Temperature (°C)	Liquid heat h_f (kJ/kg)	Latent heat h_{fg} (kJ/kg)	Liquid entropy s_f (kJ/kg·K)
30	322.63	1144.59	1.2017
-15	112.33	1312.73	0.4566

- b) Using the psychrometric chart, find the following properties of air at 35 °C DBT and 55 % relative humidity: (i) dew point temperature, (ii) wet bulb temperature, (iii) specific humidity, (iv) enthalpy, (v) specific volume. Show the state point and the properties on a sketch of the chart.

- c) A test on a single-cylinder four-stroke oil engine gave the following results:
bore = 20 cm, stroke = 28 cm, speed = 400 rpm, indicated mean effective pressure = 6.5 bar, net brake load ($W - S$) = 600 N, brake drum diameter = 1.2 m, rope diameter = 2 cm, duration of trial = 1 hour, fuel consumed = 4.2 kg, calorific value = 43,000 kJ/kg, cooling water = 9 kg/min with temperature rise of 20 °C, air consumed = 180 kg/h, exhaust gas temperature = 320 °C, room temperature = 27 °C, specific heat of exhaust gas = 1.1 kJ/kg·K, specific heat of water = 4.187 kJ/kg·K. Determine (i) IP, BP and mechanical efficiency, (ii) BSFC and indicated thermal efficiency, (iii) draw the heat balance sheet on minute basis and in percentage.

Q.6 Attempt any TWO of the following:

12

- a) Explain with a neat sketch the construction and working of a storage-type water cooler. Write its typical specifications.
- b) A Morse test was carried out on a four-cylinder, four-stroke petrol engine at constant speed. The fuel consumption was 7.2 kg/h and the calorific value of the fuel is 44,000 kJ/kg. The results were:
BP with all cylinders working = 22.5 kW
BP with cylinder No. 1 cut off = 15.9 kW
BP with cylinder No. 2 cut off = 16.0 kW
BP with cylinder No. 3 cut off = 15.8 kW
BP with cylinder No. 4 cut off = 16.1 kW
Determine (i) indicated power of the engine, (ii) mechanical efficiency, (iii) brake and indicated thermal efficiencies.
- c) Explain the construction and working of a split air conditioner with a neat sketch. State any two advantages of a split AC over a window AC.

Note: This is a **model question paper prepared by Ananda Technologies** only for practice and exam preparation, based on the pattern of previous MSBTE question papers and the K-scheme syllabus. It is **not an official MSBTE paper**, and it does **not** mean that these questions will come in the exam. Answers follow standard textbook points; marks shown are indicative. Free for students — anandatechnologies.in