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E-mail: infomep@madeeasy.in
Contact: 9021300500

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PREFACE

B. Singh (Ex. IES)

It gives me great happiness to introduce the revised edition on Mechanical Engineering containing nearly 4400 MCQs which focuses in-depth understanding of subjects at basic and advanced level which has been segregated topic-wise to disseminate all kind of exposure to students in terms of quick learning and deep apt. The chapter wise segregation has been done to align with contemporary competitive examination pattern. Attempt has been made to bring out all kind of probable competitive questions for the aspirants preparing for ESE, GATE, PSU. The content of this book ensures threshold level of learning and wide range of practice questions which is very much essential to boost the exam time confidence level and ultimately to succeed in all prestigious engineer's examinations. It has been ensured from MADE EASY team to have broad coverage of subjects at chapter level.

Year by year number of competitors are increasing and the variety of questions asked in examination is widening, under such scenario this book will definitely help students to enhance their skills required to succeed in competitive exams like ESE, GATE, PSUs, State Engineering Services etc.

While preparing this book utmost care has been taken to cover all the chapters and variety of concepts which may be asked in the exams. The solutions and answers provided are upto the closest possible accuracy. The full efforts have been made by MADE EASY Team to provide error free solutions and explanations.

I have true desire to serve student community by way of providing good sources of study and quality guidance. I hope this book will be proved an important tool to succeed in competitive examinations. Any suggestions from the readers for the improvement of this book are most welcome.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group

CONTENTS

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UNIT 1

Thermodynamics

1. Basic Concepts

Q.1 The study of thermodynamics provides answer to the followings:
1. whether a process is feasible or not
2. to quantity the energy required for a process
3. rate or speed with which a process occurs
4. extent to which a reaction/process takes place

Which of the above statements are correct?
(a) 1, 2 and 3 (b) 1 and 2
(c) 1, 2 and 4 (d) 2, 3 and 4

Q.2 Consider the following statements:
1. Thermodynamic properties are the macroscopic coordinates significant only for systems existing in states of thermodynamic equilibrium.
2. Engineering thermodynamic studies about transfer and transformation of energy.
3. Engineering thermodynamics studies about storage, transfer and transformation of energy.

Which of the above is/are correct?
(a) 3 only (b) 1 and 3
(c) 2 only (d) 1 and 2

Q.3 An adiabatic boundary is one which
(a) prevents heat transfer
(b) permits heat transfer
(c) prevents work transfer
(d) permits work transfer

Q.4 Match the following **List-I** with **List-II**:

List-I
A. Centrifugal fan
B. Control volume
C. Intensive property
D. Microscopic property

List-II
1. Open system
2. Internal energy
3. Filling a tire at air station
4. Specific energy

Codes:

	A	B	C	D
(a)	4	2	1	3
(b)	1	4	3	2
(c)	1	3	4	2
(d)	3	1	2	4

Q.5 Match the following **List-I** (Thermometer) with **List-II** (Thermometric property):

List-I	**List-II**
A. Mercury-in-glass gas	**1.** Volume
B. Constant pressure gas	**2.** Length
C. Constant volume gas	**3.** EMF
D. Thermocouple	**4.** Pressure

Codes:

	A	B	C	D
(a)	4	3	2	1
(b)	2	4	1	3
(c)	1	3	2	4
(d)	2	1	4	3

Q.6 In a quasiequilibrium process, the pressure in a system
(a) remains constant
(b) varies with temperature
(c) is everywhere constant at an instant
(d) increase if volume increases

Q.7 Convert the following readings of pressure to kPa, assuming that the barometer reads 760 mm of Hg and match the **List-I** with **List-II**:

List-I	**List-II**
A. 50 cm Hg vacuum	**1.** 113 kPa
B. 80 cm Hg gauge	**2.** 34.68 kPa
C. 1.2 m of H_2O gauge	**3.** 208 kPa

Codes:

	A	B	C
(a)	1	3	2
(b)	1	2	3
(c)	2	3	1
(d)	3	1	2

Q.8 Match the **List-I** (Terms) with **List-II** (Description) and select the correct answer:

(c) Since $\left(\frac{\partial P}{\partial V}\right)_T$ can be either positive or negative, and $\left(\frac{\partial V}{\partial T}\right)_P^2$ must be positive, T must have a sign that is opposite to that of $\left(\frac{\partial P}{\partial V}\right)_T$.

(d) C_p is very equal to C_v for liquid water

Q.286 For a given volume of dry saturated steam Clapeyron's equation is given by

(a) $V_g - V_f = \frac{dT_s}{dp} \times \frac{T_s}{h_g - h_f}$

(b) $V_g - V_f = \frac{dp}{dT_s} \times \frac{T_s}{h_g - h_f}$

(c) $V_g - V_f = \frac{dp}{dT_s} \times \frac{h_g - h_f}{T_s}$

(d) $V_g - V_f = \frac{dT_s}{dp} \times \frac{h_g - h_f}{T_s}$

Q.287 For a single component two-phase mixture the number of independent variable properties are

(a) two (b) one

(c) zero (d) three

Q.288 On a P-V diagram of an ideal gas, suppose a reversible adiabatic line intersects a reversible isothermal line at point A. Then at point A, the slope of the reversible adiabatic line $\left(\frac{\partial P}{\partial V}\right)_S$ and the slope of the reversible isothermal line $\left(\frac{\partial P}{\partial V}\right)_T$ are related as

(a) $\left(\frac{\partial P}{\partial V}\right)_S = \left(\frac{\partial P}{\partial V}\right)_T$

(b) $\left(\frac{\partial P}{\partial V}\right)_S = \left[\left(\frac{\partial P}{\partial V}\right)_T\right]^\gamma$

(c) $\left(\frac{\partial P}{\partial V}\right)_S = \gamma\left(\frac{\partial P}{\partial V}\right)_T$

(d) $\left(\frac{\partial P}{\partial V}\right)_S = \frac{1}{\gamma}\left(\frac{\partial P}{\partial V}\right)_T$

Q.289 Which of the following identities can be most easily used to verify steam table data for superheated steam

(a) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$

(b) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(c) $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$

(d) $\left(\frac{\partial V}{\partial T}\right)_P = \left(\frac{\partial S}{\partial P}\right)_T$

Q.290 For a pure substance, the Maxwell's relation obtained from the fundamental property relation $du = Tds - Pdv$ is

(a) $\left(\frac{\partial T}{\partial v}\right)_s = -\left(\frac{\partial P}{\partial s}\right)_v$

(b) $\left(\frac{\partial p}{\partial T}\right)_v = \left(\frac{\partial s}{\partial v}\right)_T$

(c) $\left(\frac{\partial T}{\partial p}\right)_s = \left(\frac{\partial v}{\partial s}\right)_P$

(d) $\left(\frac{\partial v}{\partial T}\right)_P = -\left(\frac{\partial s}{\partial P}\right)_T$

[GATE Chemical Engg.-2007]

■■■■

Answers Thermodynamics

1.	(c)	2.	(b)	3.	(a)	4.	(c)	5.	(d)	6.	(c)	7.	(c)	8.	(a)
9.	(b)	10.	(a)	11.	(b)	12.	(c)	13.	(d)	14.	(b)	15.	(c)	16.	(d)
17.	(d)	18.	(b)	19.	(d)	20.	(d)	21.	(d)	22.	(b)	23.	(a)	24.	(d)
25.	(c)	26.	(b)	27.	(a)	28.	(b)	29.	(b)	30.	(d)	31.	(c)	32.	(a)
33.	(c)	34.	(d)	35.	(c)	36.	(a)	37.	(b)	38.	(c)	39.	(d)	40.	(b)
41.	(c)	42.	(d)	43.	(d)	44.	(d)	45.	(a)	46.	(a)	47.	(a)	48.	(a)
49.	(b)	50.	(a)	51.	(a)	52.	(d)	53.	(c)	54.	(b)	55.	(c)	56.	(b)
57.	(d)	58.	(d)	59.	(c)	60.	(c)	61.	(b)	62.	(c)	63.	(d)	64.	(a)
65.	(b)	66.	(a)	67.	(b)	68.	(b)	69.	(b)	70.	(a)	71.	(c)	72.	(a)
73.	(a)	74.	(c)	75.	(d)	76.	(c)	77.	(c)	78.	(c)	79.	(d)	80.	(b)
81.	(c)	82.	(d)	83.	(c)	84.	(a)	85.	(a)	86.	(b)	87.	(b)	88.	(b)
89.	(b)	90.	(a)	91.	(a)	92.	(c)	93.	(b)	94.	(d)	95.	(c)	96.	(d)
97.	(b)	98.	(b)	99.	(b)	100.	(c)	101.	(b)	102.	(d)	103.	(b)	104.	(b)
105.	(b)	106.	(c)	107.	(d)	108.	(b)	109.	(a)	110.	(c)	111.	(b)	112.	(b)
113.	(c)	114.	(d)	115.	(c)	116.	(c)	117.	(c)	118.	(c)	119.	(c)	120.	(a)
121.	(d)	122.	(c)	123.	(a)	124.	(c)	125.	(a)	126.	(d)	127.	(b)	128.	(b)
129.	(b)	130.	(b)	131.	(d)	132.	(d)	133.	(a)	134.	(b)	135.	(b)	136.	(b)
137.	(a)	138.	(b)	139.	(d)	140.	(b)	141.	(b)	142.	(d)	143.	(b)	144.	(c)
145.	(a)	146.	(c)	147.	(b)	148.	(d)	149.	(b)	150.	(c)	151.	(b)	152.	(b)
153.	(a)	154.	(b)	155.	(c)	156.	(c)	157.	(c)	158.	(d)	159.	(d)	160.	(c)
161.	(d)	162.	(d)	163.	(b)	164.	(d)	165.	(d)	166.	(c)	167.	(c)	168.	(a)
169.	(d)	170.	(b)	171.	(b)	172.	(c)	173.	(c)	174.	(b)	175.	(b)	176.	(a)
177.	(b)	178.	(b)	179.	(d)	180.	(a)	181.	(b)	182.	(a)	183.	(d)	184.	(d)
185.	(d)	186.	(a)	187.	(b)	188.	(c)	189.	(d)	190.	(b)	191.	(b)	192.	(d)
193.	(a)	194.	(c)	195.	(b)	196.	(b)	197.	(c)	198.	(c)	199.	(d)	200.	(b)
201.	(d)	202.	(d)	203.	(c)	204.	(d)	205.	(b)	206.	(a)	207.	(b)	208.	(b)
209.	(a)	210.	(b)	211.	(d)	212.	(d)	213.	(c)	214.	(c)	215.	(d)	216.	(b)
217.	(a)	218.	(d)	219.	(d)	220.	(a)	221.	(a)	222.	(d)	223.	(b)	224.	(c)
225.	(c)	226.	(b)	227.	(a)	228.	(a)	229.	(b)	230.	(b)	231.	(a)	232.	(b)
233.	(a)	234.	(d)	235.	(a)	236.	(b)	237.	(a)	238.	(a)	239.	(a)	240.	(b)
241.	(c)	242.	(d)	243.	(c)	244.	(b)	245.	(a)	246.	(a)	247.	(d)	248.	(b)
249.	(b)	250.	(c)	251.	(c)	252.	(a)	253.	(d)	254.	(b)	255.	(a)	256.	(a)
257.	(b)	258.	(c)	259.	(d)	260.	(a)	261.	(b)	262.	(c)	263.	(c)	264.	(b)
265.	(b)	266.	(d)	267.	(c)	268.	(c)	269.	(b)	270.	(b)	271.	(a)	272.	(b)
273.	(a)	274.	(b)	275.	(a)	276.	(d)	277.	(c)	278.	(a)	279.	(d)	280.	(a)
281.	(b)	282.	(c)	283.	(a)	284.	(a)	285.	(c)	286.	(d)	287.	(b)	288.	(c)
289.	(c)	290.	(a)												

Explanations

5. (d)

Mercury-in-glass	:	Length
Radiation	:	Black body radiation
Thermocouple	:	EMF
Constant volume gas	:	Pressure
Constant pressure gas	:	Volume

7. (c)

50 cm Hg vacuume:

$$P_{vacuum} = \rho gh$$
$$= 13.6 \times 10^3 \times 9.81 \times 50 \times 10^{-2}$$
$$= 66.70 \text{ kPa}$$
$$P_{abs} = P_{atm} - P_{vac}$$
$$= (760 - 500) \times 9.81 \times 13.6$$
$$= 34.68 \text{ kPa}$$

80 cm Hg gauge:

$$P_{abs} = P_{atm} + P_{guage}$$
$$= (760 + 800) \times 9.81 \times 13.6$$
$$= 208 \text{ kPa}$$

1.2 m of H_2O guage:

$$P_{abs} = P_{atm} + P_{guage}$$
$$= 101.325 + 1.2 \times 9.81 = 113 \text{ kPa}$$

8. (a)

Properties are the coordinates to describe the state of a system. They are state variables of the system. Any operation in which one or more of the properties of a system changes is called a change of state. The succession of states passes through during a change of state is called the path of the change of state is called a process. A thermodynamic cycle is defined as a series of state changes such that the final state is identical with the initial state.

17. (d)

A certain quantity of matter or a region in space upon which attention is focused in the analysis of a problem is called a system.

18. (b)

The concept of continuum loses validity when the mean free path of the molecules approaches the order of magnitude of the dimension of the vessel. So, in highly rarefied gases the concept of continuum loses its validity.

21. (d)

Thermodynamic cycle can be defined as a series of state changes such that the final and initial state is identical.

22. (b)

An isolated system is one in which there is no interaction of system with the surrounding.

for isolated system

$$\delta Q = 0$$
$$\delta W = 0$$

The first law gives

$$\delta Q = dU + \delta W$$
$$dU = 0$$
$$U = \text{constant}$$

The energy of isolated system is constant.

23. (a)

Since volume depends on mass hence it is extensive property.

24. (d)

Since heat transfer is the path function hence it is not the property of the system.

26. (b)

Open system: Both mass and energy transfer takes place

Closed system: No mass transfer, energy transfer may takes place

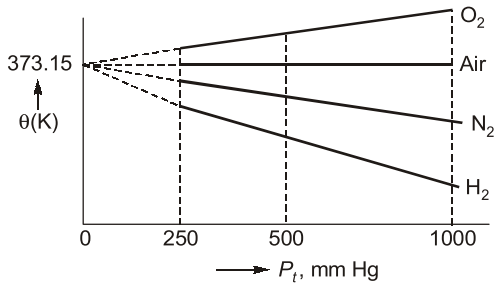
Isolated system:

Neither energy nor mass transfer takes place.

29. (b)

Specific enthalpy (enthalpy per unit mass) and pressure is intensive property.

35. (c)



UNIT 3

Heat and Mass Transfer

1. Basic Concepts of Heat Transfer

Q.1 Which of the following material has least thermal conductivity at room temperature?
(a) Human Skin (b) Urethane
(c) Wood (c) Brick

Q.2 A closed container filled with hot coffee in a plastic flask is in a room whose air and walls are at a fixed temperature. What are the possible modes of heat transfer process that contribute to cooling of coffee?
(a) convection and radiation
(b) radiation only
(c) conduction and radiation
(d) conduction, convection and radiation

Q.3 A satellite float in deep space with very high velocity. It will continuously lose heat by
(a) convection
(b) conduction and convection
(c) radiation
(d) radiation and convection **[IES-2012]**

Q.4 Consider the following statements pertaining to heat transfer processes:
1. Heat transfer is directly linked with the transport of medium itself, i.e., there is actual motion of heated particles during convection.
2. The material medium between the heat source and receiver is not affected during the process of heat transmission by radiation.
3. Heat transfer in liquids and gases is essentially due to radiation.
4. In gases and liquids, conduction is due to the collisions and diffusion of the molecules during their random motion.

Select the correct answer:
(a) 1, 2 and 4 (b) 2, 3 and 4
(c) 1, 3 and 4 (d) All of the above

Q.5 All the three modes of heat transfer are involved in
(a) melting of ice
(b) cooling of a small metal casting in a quenching bath
(c) heat flow through the walls of a refrigerator
(d) automobile engine equipped with a thermosyphon cooling system

Q.6 The essential condition for the transfer of heat from one body to another is
(a) both bodies must be in physical contact
(b) heat content of one body must be more than that of the other
(c) one of the bodies must have a high value of thermal conductivity
(d) there must exist a temperature difference between the bodies

Q.7 Consider the following statements:
1. The thermal conductivity of a material is it's ability to conduct heat.
2. The thermal conductivity can be defined as the rate of heat transfer through a unit thickness of the material per unit area.
3. In solids, heat conduction is due to lattice vibrational energy as well as energy transported via free flow of electrons.
4. Convection involves combined effect of conduction and fluid motion.

Which of the above statements are valid?
(a) 1 and 2 (b) 2, 3 and 4
(c) 1, 3 and 4 (d) 3 and 4

Q.8 Thermal conductivity of wood depends on
(a) moisture (b) density
(c) temperature (d) all of these

Q.9 Temperature of steam at around 540°C can be measured by
(a) thermometer (b) radiation pyrometer
(c) thermistor (d) thermocouple

Q.10 Cork is a good insulator because it has
(a) free electrons
(b) atoms colliding frequently
(c) low density
(d) porous body

Q.11 Thermal conductivity of water in general with rise in temperature
(a) increase
(b) decreases
(c) remains constant
(d) may increase or decrease depending on temperature [IES-2012]

Q.12 Thermal conductivity of air with rise in temperature
(a) increases
(b) remains constant
(c) decreases
(d) may increase or decrease depending on temperature

Q.13 Heat is mainly transferred by conduction, convection and radiation in
(a) insulated pipes carrying hot water
(b) refrigerator freezer coil
(c) boiler furnace
(d) condensation of steam in a condenser [IES-1998]

Q.14 Heat conduction in gases is due to
(a) electromagnetic waves
(b) motion of electrons
(c) mixing motion of the different layers of the gas
(d) elastic impact of molecules

Q.15 Heat transfer by molecular collision in
(a) conduction (b) convection
(c) radiation (d) scattering

Q.16 Arrangement of silver, air, aluminium and lead in order of increasing thermal conductivity at room temperature yields
(a) Air, Aluminium, Silver, Lead
(b) Air, Aluminium, Lead, Silver
(c) Lead, Air, Aluminium, Silver
(d) Air, Lead, Aluminium, Silver [DRDO-2008]

Q.17 Metals are good conductors of heat because of
(a) free electrons are present
(b) their atoms are relatively far apart
(c) their atoms collide frequently
(d) all of the above

Q.18 Choose the correct statement about thermal conductivity
(a) thermal conductivity for metals decreases with increase in temperature
(b) thermal conductivity for gases and insulating material decreases with increase in temperature
(c) thermal conductivity is not a function of temperature
(d) thermal conductivity increases with increase in temperature irrespective of material

Q.19 Cork is used as a good insulator
(a) it is flexible material and can be manufactured easily
(b) it is porous
(c) it can be powdered
(d) low value of thermal expansion

Q.20 In which one of the following materials, is the heat energy propagation minimum due to conduction heat transfer
(a) Lead (b) Copper
(c) Water (d) Air

Q.21 Consider the following materials:
1. Carbon 2. Mica
3. Bakelite 4. Fibre glass
Which of these materials are good conductors of heat, but bad conductors of electricity
(a) 1 only (b) 2 only
(c) 2 and 3 (d) 3 and 4 [UPSC JWM-2010]

Q.22 In which of the following material non-isotropic conductivity is exhibited
(a) Lead (b) Wood
(c) Copper (d) Brass

Q.23 Which one of the following have a highest thermal conductivity?
(a) Boiling water (b) Steam
(c) Solid ice (d) Rain water
[UP Irrigation-2007, UPSC JWM-2010]

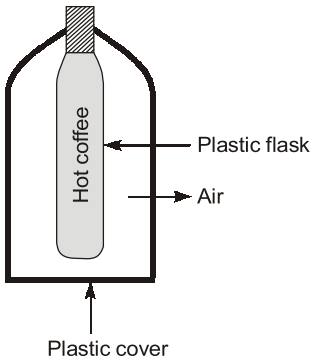
Q.24 Thermal diffusivity is
(a) a dimensionless parameter
(b) function of temperature
(c) a physical property of the material
(d) none of these

Explanations

1. (b)

Material	kW/m - K
Diamond	2300
Silver	429
Copper	401
Gold	317
Aluminium	237
Iron	80.2
Mercury (Liquid)	8.54
Glass	0.78
Brick	0.72
Water (Liquid)	0.607
Human Skin	0.97
Wood (Oak)	0.17
Helium (g)	0.152
Softrubber	0.13
Glass fibre	0.043
Air (g)	0.026
Urethane, rigid foam	0.026

2. (d)



Hot coffee is separated from its cooler surroundings by a plastic flask, an air space, and a plastic cover. So all modes of heat transfer.

4. (a)

Heat transfer in liquids and gases is essentially due to convection.

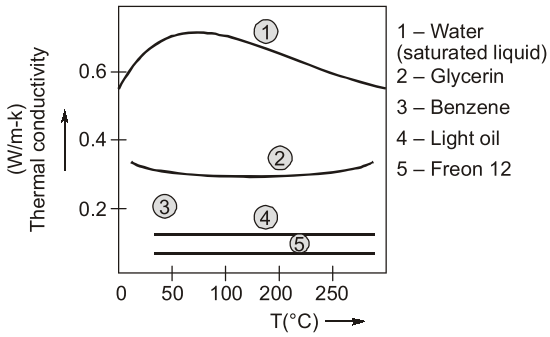
7. (c)

Thermal conductivity can be defined as the rate of heat transfer through a unit thickness of material per unit area per unit temperature difference.

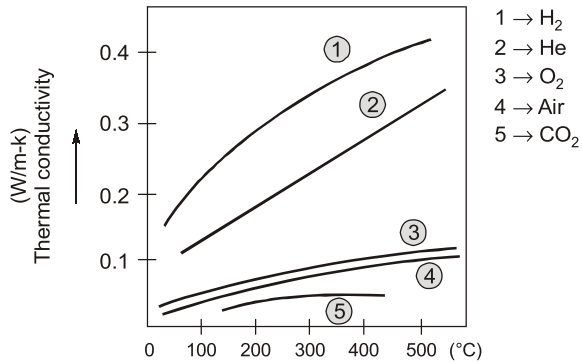
10. (d)

Thermal insulation materials have low thermal conductivity. As cork is a porous body, the trapped air in voids inhibits heat flow.

11. (d)



12. (a)



13. (c)

Because for radiation to be comparable the magnitude of temperature difference should be large enough, Convection & conduction is also predominant in boiler furnace.

16. (d)

According to their thermal conductivity
for Air, k = 0.022 W/mK
for Aluminium, k = 205 W/mK
for Silver, k = 407 W/mK
Hence correct sequence is
Air, Lead, Aluminium, Silver

18. (a)

Due to increase in lattice vibration the thermal conductivity of metals decreases with increase in temperature.

UNIT 5

Fluid Mechanics

1. Properties of Fluids

Q.1 What is the equivalent pressure head of mercury corresponding to 30 cm column of kerosene of relative density 0.8?
(a) 17.65 mm (b) 1.85 mm
(c) 18.5 mm (d) 1.5 cm

Q.2 What is dynamic viscosity in Pa·s for a liquid having relative density of 0.85 and kinematic viscosity of 2.5 centistoke?
(a) 2.225×10^{-3} (b) 2.125×10^{-3}
(c) 1.925×10^{-3} (d) 2×10^{-3}

Q.3 The space between two parallel plates kept 4 mm apart is filled with an oil of dynamic viscosity 0.2 Pa·s. What is the shear stress on the lower fixed plate, if the upper one is moved with a velocity of 1.6 m/s?
(a) 100 Pa (b) 90 Pa
(c) 80 Pa (d) 60 Pa

Q.4 The velocity distribution in a viscous flow over a plate is given by

$$u = 4y - y^2 \text{ for } y \le 2 \text{ m}$$

where, u = velocity in m/s at a point distant y from the plate. If the coefficient of dynamic viscosity is 1.5 Pa·s, what is the shear stress at y = 1.2 m?
(a) 1.4 Pa (b) 1.8 Pa
(c) 2 Pa (d) 2.4 Pa

Q.5 What is the pressure inside a soap bubble, over the atmospheric pressure if its diameter is 2 cm and the surface tension is 0.1 N/m?
(a) 0.4 N/m^2 (b) 4.0 N/m^2
(c) 40.0 N/m^2 (d) 400.0 N/m^2
[ESE : 2008]

Q.6 The gap between a horizontal shaft and a concentric sleeve is filled with viscous oil. The sleeve moves with a constant velocity of 1.5 m/s when a force of 1500 N is applied parallel to the axis of the shaft. If it was required to move the sleeve at a velocity of 2 m/s, what should have been the force?
(a) 1250 N (b) 1500 N
(c) 1750 N (d) 2000 N

Q.7 A perfect fluid is
(a) a real fluid
(b) the one which obeys perfect gas laws
(c) compressive and gaseous
(d) incompressible and frictionless

Q.8 The concept of continuum in fluid flow assumes that the characteristics length of the flow is
(a) smaller than the mean free path of the molecules.
(b) larger than the mean free path of the molecules.
(c) larger than the dimensions of the suspended particles.
(d) larger than the wavelength of sound in the medium.

Q.9 When a shear stress is applied to a substance, it is found to resist it by static deformation. the substance is
(a) liquid (b) solid
(c) gas (d) fluid

Q.10 The condition of 'no slip' at boundaries is applicable to
(a) flow of newtonian fluids only
(b) flow of ideal fluids only
(c) flow of all real fluids
(d) flow of non-newtonian fluids only

Q.11 Newton's law of viscosity for a fluid states that the shear stress is
(a) proportional to angular deformation
(b) proportional to rate of angular deformation
(c) inversely proportional to angular deformation
(d) inversely proportional to rate of angular deformation

Q.12 A real fluid is any fluid which
(a) has surface tension and is compressible
(b) has zero shear stress
(c) has constant viscosity and density
(d) has viscosity

241. (c)	242. (c)	243. (b)	244. (d)	245. (b)	246. (a)	247. (d)	248. (b)
249. (b)	250. (b)	251. (a)	252. (a)	253. (b)	254. (b)	255. (c)	256. (b)
257. (c)	258. (b)	259. (a)	260. (b)	261. (d)	262. (b)	263. (b)	264. (c)
265. (c)	266. (c)	267. (c)	268. (b)	269. (d)	270. (b)	271. (b)	272. (d)
273. (a)	274. (c)	275. (d)	276. (d)	277. (b)	278. (c)	279. (b)	280. (b)
281. (b)	282. (c)	283. (c)	284. (a)	285. (a)	286. (b)	287. (a)	288. (b)
289. (d)	290. (b)	291. (b)	292. (d)	293. (d)	294. (b)	295. (a)	296. (b)
297. (b)	298. (c)	299. (a)	300. (c)	301. (a)	302. (d)	303. (b)	304. (b)
305. (b)	306. (d)	307. (b)	308. (a)	309. (d)	310. (d)	311. (a)	312. (b)
313. (a)	314. (a)	315. (d)	316. (c)	317. (c)	318. (c)	319. (b)	320. (c)
321. (d)	322. (d)	323. (a)	324. (c)	325. (c)	326. (d)	327. (c)	328. (a)
329. (d)	330. (d)	331. (a)	332. (b)	333. (b)	334. (a)	335. (c)	336. (c)
337. (b)	338. (a)	339. (b)	340. (b)	341. (c)	342. (c)	343. (b)	344. (b)
345. (c)	346. (b)	347. (a)	348. (b)	349. (d)	350. (d)	351. (b)	352. (b)
353. (b)	354. (b)	355. (b)	356. (b)	357. (b)	358. (b)	359. (a)	360. (d)
361. (a)	362. (a)	363. (c)	364. (d)	365. (a)	366. (b)	367. (c)	368. (b)
369. (c)	370. (c)	371. (c)	372. (a)	373. (d)	374. (a)	375. (c)	376. (c)
377. (a)	378. (c)	379. (b)	380. (c)	381. (c)	382. (c)	383. (c)	

Explanations

1. (a)

$$\rho_k h_k = \rho_{Hg} h_{Hg}$$

$$\therefore \quad h_{Hg} = \frac{0.8}{13.6} \times 30$$

$$= 1.7647 \text{ cm} = 17.65 \text{ mm}$$

2. (b)

$$\nu = 2.5 \times 10^{-6} \text{ m}^2/\text{s}$$

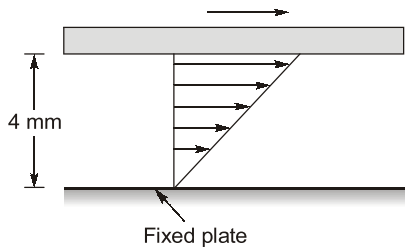
$$\rho = 850 \text{ kg/m}^3$$

$$\nu = \mu/\rho$$

or $$\mu = \rho\nu = 850 \times 2.5 \times 10^{-6} \text{ Pa·s}$$

$$= 2.125 \times 10^{-3} \text{ Pa·s}$$

3. (c)



$$\frac{du}{dy} = \frac{V}{h} = \frac{1.6}{4 \times 10^{-3}} = 400 \text{ s}^{-1}$$

$$\tau = \mu \frac{du}{dy} = 0.2 \times 400$$

$$= 80 \text{ Pa}$$

4. (d)

$$\tau = \mu \frac{du}{dy} = \mu(4 - 2y)$$

$$\tau\big|_{y=1.2} = 1.5\,(4 - 2 \times 1.2)$$

$$= 2.4 \text{ Pa}$$

5. (c)

$$\text{Pressure} = \frac{8\sigma}{d} = \frac{8 \times 0.1}{2 \times 10^{-2}}$$

$$= 0.4 \times 100 = \mathbf{40\ N/m^2}$$

UNIT 11

Production Engineering

1. Casting Processes

Q.1 Consider the following materials:
1. Sand
2. Plaster and Ceramic
3. Metal

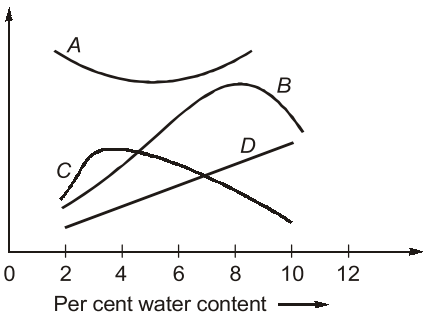
A mould can be made of
(a) 1 only (b) 1 and 3
(c) 1 and 2 (d) 1, 2 and 3

Q.2 The success of a casting process depends mainly on the following properties of the moulding sand:
1. Permeability 2. Strength
3. Deformation 4. Flowability
5. Refractoriness

Which of the these are valid?
(a) 1, 2, 3 and 4 (b) all of these
(c) 1, 2, 4 and 5 (d) 1 and 2

Q.3 Match the **List-I** with **List-II**:

List-I



List-II
1. Deformation
2. Flowability
3. Permeability
4. Refractioness
5. Strength

Codes:

	A	B	C	D
(a)	1	4	5	3
(b)	2	3	5	1
(c)	1	2	3	5
(d)	2	5	3	4

Q.4 The relative ability of the liquid metal to fill in the mould at a given temperature is knowns as
(a) Fluidity (b) Machinability
(c) Flowability (d) Viscosity

Q.5 Which of the following gating ratio represents pressurised gating systems?
(a) 1 : 1 : 2 (b) 1 : 2 : 1
(c) 1 : 2 : 3 (d) 1 : 3 : 3

Q.6 Which of the following methods increases turbulence in liquid metal flow in mould?
(a) Use of sprue base
(b) Use of tapered sprue
(c) An enlarged runner
(d) Providing sharp edges for sprue entrances, exit, runners and ingates

Q.7 If metal is freezing against a flat mould wall and heat flow is normal to mould surface, then how the thickness (x) of solid metal deposited related with time (t)?
(a) $x \alpha \sqrt{t}$ (b) $x \alpha t$
(c) $t \alpha \sqrt{x}$ (d) $x \alpha t^2$

Q.8 Three pieces being cast have the same volume but different shapes. One is sphere, one a cube, and the other a cylinder with a hight equal to its diameter. Which piece will solidify the fastest?
(a) Sphere (b) Cube
(c) Cylinder (d) Insufficient data

Q.9 Expendable moulds are destroyed to remove the casting when the process of solidification is over. Select the expendable moulds from the following lists:
1. Metal moulds 2. Sand moulds
3. Ceramic moulds 4. Plaster moulds
(a) 1 and 2 (b) 2 and 4
(c) 2, 3 and 4 (d) 2 and 3

Q.544 What will be the diameter of best size wire for the 20 mm ISO coarse thread of 2.5 mm pitch and 60° thread angle?

(a) 1.443 mm (b) 2.5 mm
(c) 2.886 mm (d) 5 mm

Q.545 The standard temperature adopted for metrology is

(a) 65°F (b) 68°C
(c) 67°F (d) 68°F

Answers Production Engineering

1.	(d)	2.	(b)	3.	(b)	4.	(a)	5.	(b)	6.	(d)	7.	(a)	8.	(b)
9.	(b)	10.	(a)	11.	(c)	12.	(b)	13.	(b)	14.	(b)	15.	(c)	16.	(b)
17.	(d)	18.	(d)	19.	(c)	20.	(a)	21.	(c)	22.	(a)	23.	(c)	24.	(a)
25.	(c)	26.	(d)	27.	(b)	28.	(b)	29.	(c)	30.	(c)	31.	(a)	32.	(a)
33.	(c)	34.	(c)	35.	(c)	36.	(b)	37.	(a)	38.	(b)	39.	(a)	40.	(a)
41.	(b)	42.	(a)	43.	(d)	44.	(d)	45.	(c)	46.	(d)	47.	(d)	48.	(b)
49.	(c)	50.	(c)	51.	(a)	52.	(a)	53.	(a)	54.	(c)	55.	(a)	56.	(a)
57.	(c)	58.	(a)	59.	(d)	60.	(b)	61.	(c)	62.	(b)	63.	(d)	64.	(c)
65.	(a)	66.	(c)	67.	(d)	68.	(d)	69.	(d)	70.	(b)	71.	(c)	72.	(c)
73.	(b)	74.	(d)	75.	(c)	76.	(d)	77.	(a)	78.	(c)	79.	(c)	80.	(d)
81.	(c)	82.	(c)	83.	(c)	84.	(d)	85.	(c)	86.	(a)	87.	(b)	88.	(d)
89.	(d)	90.	(d)	91.	(a)	92.	(d)	93.	(b)	94.	(c)	95.	(c)	96.	(b)
97.	(c)	98.	(b)	99.	(d)	100.	(d)	101.	(a)	102.	(a)	103.	(c)	104.	(b)
105.	(b)	106.	(a)	107.	(b)	108.	(b)	109.	(d)	110.	(c)	111.	(a)	112.	(c)
113.	(c)	114.	(b)	115.	(c)	116.	(a)	117.	(c)	118.	(d)	119.	(d)	120.	(c)
121.	(a)	122.	(b)	123.	(b)	124.	(b)	125.	(a)	126.	(b)	127.	(d)	128.	(a)
129.	(a)	130.	(a)	131.	(d)	132.	(d)	133.	(b)	134.	(a)	135.	(d)	136.	(b)
137.	(c)	138.	(c)	139.	(c)	140.	(c)	141.	(a)	142.	(a)	143.	(b)	144.	(d)
145.	(c)	146.	(a)	147.	(c)	148.	(d)	149.	(a)	150.	(a)	151.	(d)	152.	(c)
153.	(c)	154.	(a)	155.	(b)	156.	(d)	157.	(a)	158.	(b)	159.	(a)	160.	(b)
161.	(a)	162.	(c)	163.	(b)	164.	(b)	165.	(a)	166.	(b)	167.	(d)	168.	(c)
169.	(c)	170.	(b)	171.	(b)	172.	(b)	173.	(d)	174.	(d)	175.	(b)	176.	(b)
177.	(c)	178.	(a)	179.	(b)	180.	(d)	181.	(c)	182.	(c)	183.	(c)	184.	(c)
185.	(b)	186.	(a)	187.	(d)	188.	(a)	189.	(c)	190.	(c)	191.	(b)	192.	(b)
193.	(b)	194.	(c)	195.	(c)	196.	(c)	197.	(b)	198.	(d)	199.	(b)	200.	(b)
201.	(b)	202.	(c)	203.	(c)	204.	(d)	205.	(c)	206.	(b)	207.	(d)	208.	(b)
209.	(d)	210.	(c)	211.	(b)	212.	(c)	213.	(a)	214.	(d)	215.	(a)	216.	(d)
217.	(c)	218.	(c)	219.	(a)	220.	(a)	221.	(d)	222.	(a)	223.	(c)	224.	(b)
225.	(b)	226.	(b)	227.	(b)	228.	(a)	229.	(b)	230.	(c)	231.	(c)	232.	(d)
233.	(a)	234.	(d)	235.	(b)	236.	(b)	237.	(d)	238.	(c)	239.	(b)	240.	(a)
241.	(c)	242.	(a)	243.	(c)	244.	(c)	245.	(a)	246.	(b)	247.	(a)	248.	(b)

Explanations

1. (d)

Moulds can be classified on the basis of material i.e. green sand mould, plastic mould and metal mould.

2. (b)

Permeability: It is expressed as the gas flow rate through the specimen under a specified pressure difference across it.
Strength: It refers to compressive strength.
Deformation: It indicates the change in length of a standard specimen at the point of failure.
Flowability: It refers to the ability of the sand to flow around and over the pattern when the mould is rammed.
Refractioness: It measures the ability of the sand to remain solid as a function of temperature.

4. (a)

The optimum temperature after melting is decided by a property, called fluidity, of the metal. Fluidity refers to the relative ability of the liquid metal to fill in the mould at a given temperature. Fluidity is higher when viscosity is lower.

5. (b)

Gating ratio ≅ Sprue area: Runner area: Ingate area
If total ingate area is not greater than the area of sprue, gating systems are known as pressurised gating system.
Option (a), (c) and (d) represents unpressurized gating system.

6. (d)

Following are the suggested methods to reduce turbulence in liquid metal flow in mould:
(i) Keep the system filled by proper design of pouring basin and a tapered spure
(ii) Use a sprue base or well.
(iii) Reduce metal velocity by an enlarged runner.
(iv) Use a streamlined system by providing radius for sprue entrance and exit, runners and ingates.

8. (b)

$$\text{Solidification time } \alpha \frac{1}{(\text{Surface area})^2}$$

Shapes having highest surface area will solidify fastest.

$$V_{sphere} = 1 = \left(\frac{4}{3}\right)\pi r^3$$

$$r = \left(\frac{3}{4\pi}\right)^{1/3}$$

and $$4\pi r^2 = 4\pi\left(\frac{3}{4\pi}\right)^{2/3} = 4.84$$

$$V_{cube} = 1 = a^3,$$
$$A_{cube} = 6a^2 = 6$$
$$V_{cylinder} = \pi r^2 h = 2\pi r^3$$

i.e. $$r = \left(\frac{1}{2\pi}\right)^{1/3}$$

$$A_{cylinder} = 2\pi r^2 + 2\pi rh = 6\pi r^2$$
$$= 6\pi\left(\frac{1}{2\pi}\right)^{2/3} = 5.54$$

$\therefore \quad A_{cube} > A_{cylinder} > A_{sphere}$

11. (c)

Zinc and aluminium are best cast by die casting, because of their low melting points and better fluidity.

13. (b)

Centrifugal cast parts have sound mechanical properties because of elimination of impurities by centrifugal action in the process.

16. (b)

Aluminium and magnesium alloys have low density and due to rotating mould being used in the centrifugal casting these materials have tendency to get segregated, affecting the quality of casting.

24. (a)

Chills are placed around the core and it is used to achieve directional solidification.

UNIT 12

Industrial Engineering

1. Plant Layout

Q.1 Match the **List-I** (Layout types) with **List-II** (Layout characteristics):

List-I

A. Process layout
B. Product flow layout
C. Fixed position layout
D. Cellular layout

List-II

1. Inflexible to significant changes in product design.
2. Distinct part families and expanded worker training.
3. Low equipment utilization and high skill requirement.
4. Large work-in-process and increased material handling.

Codes:

	A	B	C	D
(a)	4	1	3	2
(b)	4	3	2	1
(c)	2	1	4	3
(d)	1	4	3	2

[GATE PI-2009]

Q.2 The layout of ship-building industry should be
(a) process layout
(b) group layout
(c) fixed location layout
(d) product layout **[IAS Pre-2003]**

Q.3 A cutter breaks while cutting gears and is removed by the operator. Which of the following represents this activity on the flow process chart?
(a) Delay-*D*
(b) Operation-*O*
(c) Operation cum transportation- 
(d) Inspection-  **[IAS Pre-2004]**

Q.4 Which of the following factors influences a plant layout?
1. Type of industry
2. Type of machines
3. Type of products
4. Volume of production

Select the correct answer using the code given below:
(a) 2 and 3 (b) 1, 2 and 3
(c) 1, 3 and 4 (d) 1 and 4
[IAS Pre-2005]

Q.5 Group technology is connected with
(a) process layout
(b) product layout
(c) hybrid layout
(d) fixed-position layout

Q.6 Hybrid layout is a combination of
(a) process and fixed-position layout
(b) process and product layout
(c) product and fixed-position layout
(d) none of the above

Q.7 Which of the following is not a advantage of cellular manufacturing system?
(a) Short throughput
(b) Better customer service
(c) High degree of material handling
(d) Better quality

Q.8 Suitability of process layout not applied for
(a) job-shop manufacturing
(b) frequent changes in product design
(c) low-volume, high variety manufacturing environment
(d) low variety, high-volume production system

Q.9 Which of the following is not an example of fixed position layout?
(a) Aircraft assembly
(b) Dam construction
(c) Automotive industry
(d) Railway wagon building

Q.10 Which of the following is not a performance related objective for a good facility plant layout?
(a) Better product quality
(b) Easy plant maintenance
(c) Minimum worker movement
(d) Minimum setup cost

Q.11 Vehicle manufacutring assembly line is an example of
(a) product layout
(b) process layout
(c) group layout
(d) fixed position layout **[GATE ME-2010]**

Q.12 Most of the large scale modern industry using automation adopt
(a) process layout (b) product layout
(c) group layout (d) fixed position layout

Q.13 Which is not the objective of plant layout?
(a) to make economical use of floor area
(b) to minimise material handling
(c) to keep the machine break down to minimum
(d) to maintain flexibility in arrangement of operations

Q.14 The plant location is affected to maximum extent by the single factor
(a) nearest to market
(b) proximity to raw materials
(c) cost of land and building
(d) low wages of labourers in the locality

Q.15 Which of the following aspects are true pretaining to product layout?
1. efficient flow of materials
2. most suited for mass production
3. requirement for greater space ara
4. high set up cost for the special purpose machines
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1, 2 and 4

Q.16 Which of the following layout technique not uses any standard symbols for specifying the activities?
(a) Operation process layout
(b) String diagram
(c) Flow process chart
(d) Flow diagram

Q.17 Which of the following is an analytical technique and widely used in a process type layout?
(a) Travel chart method
(b) String diagram
(c) Flow diagram
(d) Flow process chart

Q.18 Material handling is higher in case of
(a) process layout
(b) product layout
(c) group layout
(d) fixed position layout

Q.19 The production activity of the entire section may stop due to break down of the machine. Such a situation could arise in
(a) functional layout
(b) synthetic layout
(c) fixed position layout
(d) combination layout

Q.20 Match **List-I** (Type of production) with **List-II** (Type of layout) and select the correct answer using the codes given below the lists:

List-I (Equipments)
A. Ball bearings
B. Tools and gauges
C. Large boilers
D. Motor cycle assembly

List-II (Application)
1. Process layout
2. Product layout
3. Combination of product and process layout
4. Fixed position layout

Codes:

	A	B	C	D
(a)	1	3	4	2
(b)	3	1	4	2
(c)	1	2	4	3
(d)	3	1	2	4

[IES-1996]

Q.21 The type of layout suitable for use of the concept, principles and approaches of group technology is
(a) product layout
(b) job-shop layout
(c) fixed position layout
(d) cellular layout **[IES-1999]**

Q.22 Cellular manufacturing is suitable for
(a) a single product in large volumes
(b) one-off production of several varieties
(c) products with similar features made in batches
(d) large variety of products in large volumes
[GATE-2000]

Q.23 Which of the following can be considered to the advantages of product layout?
1. Reduced material handling
2. Greater flexibility
3. Lower capital investment
4. Better utilization of men and machines
(a) 1 and 3 (b) 2 and 3
(c) 1 and 4 (d) 2 and 4
[IAS Pre-1997]