BTSC JE MECHANICAL ENGINEERING Sample Paper

Q101. A closed thermodynamic system is one in which
(a) there is no energy or mass transfer across the boundary
(b) there is no mass transfer, but energy transfer exists
(c) there is no energy transfer, but mass transfer exists
(d) both energy and mass transfer take place across the boundary, but the mass transfer is controlled by valves

Q102. Which one of the following thermodynamic processes approximates the steaming of food in a pressure cooker?
(a) isenthalpic
(b) isobaric
(c) isochoric
(d) isothermal

Q103. For a simple closed system of constant composition, the difference between the net heat and work interactions is identifiable as the change in
(a) Enthalpy
(b) Entropy
(c) Flow energy
(d) Internal energy

Q104. A closed system undergoes a process 1-2 for which the values of Q_{1-2} and W_{1-2} are + 20kJ and + 50kJ, respectively. If the system is returned to state 1 and Q_{2-1} is –10kJ, what is the value of the work W_{2-1} ?
(a) +20 kJ
(b) -40 kJ
(c) -80 kJ
(d) +40 kJ

Q105. Consider the following statements:
A real gas obeys perfect gas law at very
1. high temperatures
2. high pressures
3. low pressures
Which of these statements is/are correct?
(a) 1 only
(b) 1 and 3
(c) 2 only
(d) 3 only

Q106. At critical point the enthalpy of vaporization is
(a) dependent on temperature only
(b) maximum
(c) minimum
(d) zero

Q107. An engine working on Carnot cycle rejects 40% of absorbed heat from the source, while the sink temperature is maintained at 27°c, then the source temperature is
(a) 750°C
(b) 477°C
(c) 203°C
(d) 67.5°C

Q108. The irreversibility is defined as the difference of the maximum useful work and actual work: $I = W_{useful} - W_{actual}$. How can this be alternatively expressed?
(a) $I = T_0\ (\Delta S_{system} + \Delta S_{surrounding})$
(b) $I = T_0\ (\Delta S_{System} - \Delta S_{surrounding})$
(c) $I = T_0\ (\sqrt{\Delta S_{system}} + \sqrt{\Delta S_{surrounding}})$
(d) $I = T_0\ (\sqrt{\Delta S_{system}} - \sqrt{\Delta S_{Surroundings}})$

Q109. The thermodynamic parameters are
1. Temperature
2. Specific volume
3. Pressure
4. Enthalpy
5. Entropy
The Clapeyron Equation of state provides relationship between:
(a) 1 and 2
(b) 2, 3 and 4
(c) 3, 4 and 5
(d) 1, 2, 3 and 4

Q110. Which one of the following represents the condensation of a mixture of saturated liquid and saturated vapour on the enthalpy-entropy diagram?
(a) A horizontal line
(b) an inclined line of constant slope
(c) A vertical line
(d) A curved line

Q111. An oil of specific gravity 0.9 has viscosity of 0.28 stokes at 38°C. What will be its viscosity in Ns/m^2?
(a) 0.2520
(b) 0.0311
(c) 0.0252
(d) 0.0206

Q112. What is the pressure difference between inside and outside of a droplet of water?
(a) $\frac{2\sigma}{d}$
(b) $\frac{4\sigma}{d}$
(c) $\frac{8\sigma}{d}$
(d) $\frac{12\sigma}{d}$
Where σ is surface tension and d is the diameter of the droplet.

Q113. Resultant pressure of the liquid in case of an immersed body acts through which one of the following?
(a) Centre of gravity
(b) Centre of pressure
(c) Metacentre
(d) Centre of buoyancy

Q114. A house-top water tank is made of flat plates and is full to the brim. Its height is twice that of any side. The ratio of total thrust force on the bottom of the tank to that on any side will be:
(a) 4
(b) 2
(c) 1
(d) 0.5

Q115. Consider the following statements:
1. The increase in metacentric height
2. Increases stability
3. Decreases stability
4. Increases comfort for passengers in a ship
5. Decreases comfort for passengers in a ship
Which of the above statements are correct?
(a) 1 and 3
(b) 1 and 4
(c) 2 and 3
(d) 2 and 4

Q116. A streamline is a line
(a) which is along path of the particle
(b) which is always parallel to the main direction of flow
(c) along which there is no flow
(d) on which tangent drawn at any point gives the direction of velocity

Q117. The loss of head due to sudden enlargement is attributed to
(a) Viscosity of fluid
(b) Generation of heat
(c) Roughness of pipe
(d) Production and dissipation of turbulent energy

Q118. Match **List-I** (Phenomena) with **List-II** (Causes) and select the correct answer using the codes given below the lists:

List-I
A. Shock wave
B. Flow separation
C. Capillary rise
D. Cavitation

List-II
1. Surface tension
2. Vapour pressure
3. Compressibility
4. Adverse pressure gradient

Codes:

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

Q119. In reaction turbines, the draft tube is used
(a) for the safety of the turbine
(b) to convert the kinetic energy of flow by a gradual expansion of the flow cross-section
(c) to destroy the undesirable eddies
(d) for none of the above purposes

Q120. Hydraulic ram is a pump which works on the principle of
(a) water hammer
(b) centrifugal action
(c) reciprocating action
(d) hydraulic press

Q121. What are the forces that influence the problem of fluid statics?
(a) Gravity and viscous forces
(b) Gravity and pressure forces
(c) Viscous and surface tension forces
(d) Gravity and surface tension forces

Q122. The vertical component of force on a curved surface submerged in a static liquid is equal to the
(a) weight of liquid column above the CG of the curved surface
(b) weight of liquid above the curved surface
(c) product of pressure at CG, multiplied by the area of the curved surface
(d) product of pressure at CG, multiplied by the projected area of the curved surface

Q123. Which one of the following is the condition for stable equilibrium of a floating body ?
(a) The metacenter coincides with the centre of gravity.
(b) The metacenter is below the centre of gravity.
(c) The metacenter is above the centre of gravity.
(d) The centre of buoyancy is below the centre of gravity.

Q124. The flow in a pipe whose valve is being opened or closed gradually is an example of
(a) steady flow
(b) nonsteady flow
(c) steady uniform flow
(d) steady nonuniform flow

Q125. Which one of the following is measured by a rotameter?
(a) Velocity of fluids
(b) Discharge of fluids
(c) Viscosity of fluids
(d) Rotational speed of solid shafts

Q126. In flow through a pipe, the transition from laminar to turbulent flow does not depend on
(a) density of fluid
(b) length of pipe
(c) diameter of pipe
(d) velocity of the fluid

Q127. For laminar flow through a pipe, the discharge varies
(a) linearly as the diameter
(b) Inversely as the square of diameter
(c) as the inverse of viscosity
(d) inversely as the pressure gradient

Q128. The boundary layer thickness at a given distance from the leading edge of a flat plat is
(a) More for lighter fluid
(b) More for dense fluid
(c) Less for lighter fluid
(d) None of the above

Q129. Euler number is defined as the ratio of inertia force to
(a) viscous force
(b) elastic force
(c) pressure force
(d) gravity force

Q130. Match **List-I** (Dimensionless number) with **List-II** (Definition as the ratio of) and select the correct answer using the codes given below the lists:

List -I
A. Reynolds number
B Froude number
C. Weber number
D. Mach Number

List-II
1. Inertia force and elastic force
2. Inertia force and surface tension force
3. Inertia force and gravity force
4. Inertia force and viscous force

Codes

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

Q131. In a long cylindrical rod of radius R and a surface heat flux of q_0, the uniform internal heat generation rate is
(a) $2\ q_0/R$
(b) $2\ q_0$
(c) q_0/R
(d) $\frac{2\ q_0}{R^2}$

Q132. A wall of thickness 0.6 m has a normal area 1.5 m^2 and is made up of material of thermal conductivity 0.4 W/mK. The temperatures on the two sides are 800°C and 100°C. What is the thermal resistance of the wall?

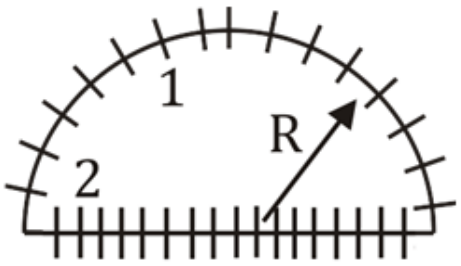
(a) 1 W/K
(b) 1.8 W/K
(c) 1 K/W
(d) 1.8 K/W

Q133. Consider the following statements: An increase in pin fin effectiveness is caused by high value of
1. Convective coefficient
2. Thermal conductivity
3. Sectional area
4. Circumference
Which of the above statements are correct?
(a) 1 and 3
(b) 1 and 4
(c) 2 and 3
(d) 2 and 4

Q134. Which one of the following non-dimensional numbers is used for transition from laminar to turbulent flow in free convection?
(a) Reynolds number
(b) Grashoff number
(c) Peclet number
(d) Rayleigh number

Q135. Fraction of radiative energy leaving one surface that strikes the other surface is called
(a) Radiative flux
(b) Emissive power of the first surface
(c) View factor
(d) Reradiation flux

Q136. A hemispherical surface 1 lies over a horizontal plane surface 2 such that convex portion of the hemisphere is facing sky. What is the value of the geometrical shape factor F_{12}?



(a) 1/4
(b) 1/2
(c) 3/4
(d) 1/8

Q137. The fouling factor in heat exchanger is defined as
(a) $R_f = U_{dirty} - U_{clean}$
(b) $R_f = \frac{1}{U_{dirty}} - \frac{1}{U_{clean}}$
(c) $\frac{1}{R_f} = \frac{1}{U_{dirty}} - \frac{1}{U_{clean}}$
(d) $\frac{1}{R_f} = U_{dirty} - U_{clean}$

Q138. When a liquid flow through a tube with sub-cooled or saturated boiling, what is the process known?
(a) Pool boiling
(b) Bulk boiling
(c) Convection boiling
(d) Forced convection boiling

Q139. In a boiler, the air preheater is invariably located between:
(a) Forced draft fan and chimney
(b) Forced draft fan and furnace
(c) Economizer and feed pump
(d) Condenser and feed pump

Q140. The turbomachine used to circulate refrigerant in large refrigeration plant is
(a) A centrifugal compressor
(b) A radial turbine
(c) An axial compressor
(d) An axial turbine

Q141. Consider the following features for a gas turbine plant:
1. Intercooling
2. Regeneration
3. Reheat
Which of the above features in a simple gas turbine cycle increases the work ratio?
(a) 1, 2 and 3
(b) Only 1 and 2
(c) Only 2 and 3
(d) Only 1 and 3

Q142. The propulsive efficiency of a turbo-jet aircraft approaches 100% when the thrust approaches
(a) maximum
(b) 50% of the maximum
(c) 25% of the maximum
(d) zero

Q143. A refrigerating machine working on reversed Carnot cycle takes out 2 kW per minute of heat from the system while between temperature limits of 300 K and 200 K. COP and power consumed by the cycle will be respectively.
(a) 1 and 1 kW
(b) 1 and 2 kW
(c) 2 and 1 kW
(d) 2 and 2 kW

Q144. Match **list I** with **list II** and select the correct answer using the codes given below the lists:

List – I	**List – II**
A. Bell Coleman refrigeration	1. Compressor
B. Vapour compression refrigeration	2. Generator
C. Absorption refrigeration	3. Flash chamber
D. Jet refrigeration	4. Expansion cylinder

codes

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

Q145. What is an azeotrope?
(a) A non-halogenic refrigerant
(b) A refrigerant dissolved in alcohol
(c) A mixture of refrigerants without phase separation
(d) An eco-friendly refrigerant

Q146. Air at 35°C DBT and 25°C dew point temperature passes through the water shower whose temperature is maintained at 20°C. What is the process involved?
(a) cooling and humidification
(b) sensible cooling
(c) cooling and dehumidification
(d) heating and humidification

Q147. For an air-conditioned space, RTH = 100 kW, RSHF = 0.75, volume flow rate = 100 m^3/min, and indoor design specific humidity is 0.01 kg/kg of dry air. What is the specific humidity of the supply air?
(a) 0.010
(b) 0.0075
(c) 0.005
(d) 0.0025

Q148. In an air-standard Diesel cycle; r is the compression ratio, ρ is the fuel cut-off ratio and γ is the adiabatic index $\left(\frac{C_p}{C_V}\right)$. Its air standard efficiency is given by

(a) $\eta = 1 - \left\{\frac{1}{\gamma.r^{\gamma-1}}.\frac{(\rho^{\gamma}-1)}{(\rho-1)}\right\}$

(b) $\eta = 1 - \left\{\frac{1}{\gamma.r^{\gamma-1}}.\frac{(\rho^{\gamma-1}-1)}{(\rho-1)}\right\}$

(c) $\eta = 1 - \left\{\frac{1}{\gamma.r^{\gamma-1}}.\frac{(\rho^{\gamma-1})}{(\rho-1)}\right\}$

(d) $\eta = 1 - \left\{\frac{1}{\gamma.r^{\gamma}}.\frac{(\rho^{\gamma-1}-1)}{(\rho-1)}\right\}$

Q149. A Carnot engine receives 100 kJ of heat at 600 K. Heat is rejected at 300 K. The displacement volume is 0.2 m^3. The mean effective pressure is

(a) 2 bar

(b) 2.5 bar

(c) 3 bar

(d) 3.5 bar

Q150. Piston compression rings are made of which one of the following?

(a) Cast iron

(b) Bronze

(c) Aluminium

(d) White metal

Q151. Which law of motion (of newton) gives the measures of force?

(a) Newton's first law

(b) Newton's second law

(c) Newton's third law

(d) none of these

Q152. When a body slides down an inclined surface, the acceleration (f) of the body is given by:

(a) f = g

(b) f = g sinθ

(c) f = g cosθ

(d) f =g tanθ

Q153. The friction between objects that are stationary is called:

(a) static friction

(b) rolling friction

(c) kinematic friction

(d) dynamic friction

Q154. The direction of frictional force acting on a body which can slide on a fixed surface is:
(a) in the direction of motion
(b) normal to the direction of motion
(c) unpredictable
(d) opposite to the direction of motion

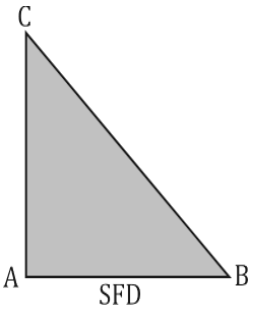
Q155. A copper rod of 2 cm diameter is completely encased in a steel tube of inner diameter 2 cm and outer diameter 4 cm. Under an axial load, the stress in the steel tube is 100 N/mm^2. If $E_s = 2\ E_c$, then the stress in the copper rod is
(a) 50 N/mm^2
(b) 33.33 N/mm^2
(c) 100 N/mm^2
(d) 300 N/mm^2

Q156. A tension member of square cross-section of side 10 mm and Young's modulus E is to be replaced by another member of square cross-section of same length but Young's modulus E/2. The side of the new square cross-section, required to maintain the same elongation under the same load, is nearly
(a) 14 mm
(b) 17 mm
(c) 8 mm
(d) 5 mm

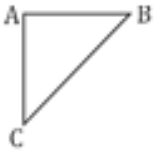
Q157. The state of stress at a point when completely specified enables one to determine the
1. maximum shearing stress at the point
2. Stress components on any arbitrary plane containing that point
Which of the above is/are correct?
(a) 1 only
(b) 2 only
(c) both 1 and 2
(d) Neither 1 nor 2

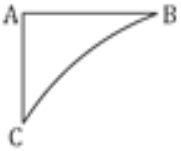
Q158. In an internally pressurized thick cylinder, the hoop stress
1. Remains constant but the radial stress varies parabolically
2. Varies parabolically but the radial stress remains constant
Which of the above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

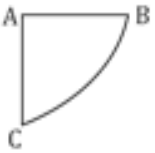
Q159. The shearing force diagram for a beam is shown in the figure below.

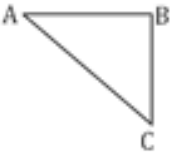


The bending moment diagram is represented by which one of the following?

(a) 

(b) 

(c) 

(d) 

Q160. The property of a material which allows it to be drawn into a smaller section is called
(a) plasticity
(b) ductility
(c) elasticity
(d) malleability

Q161. Coriolis component of acceleration depends on
1. Angular velocity of the link
2. Acceleration of the slider
3. angular acceleration of the link
Which of the above is/are correct?
(a) 1 only
(b) 2 only
(c) 1 and 3
(d) 2 and 3

Q162. In a crank and slotted lever quick return motion mechanism, the distance between the fixed centres is 200 mm. the lengths of the driving crank and the slotted bar are 100 mm and 500 mm, respectively. The length of the cutting stroke is.
(a) 100 mm
(b) 300 mm
(c) 500 mm
(d) 700 mm

Q163. Which of the following are associated with Ackerman steering mechanism used in automobiles?
1. Has both sliding and turning pairs
2. Less friction and hence long life
3. Mechanically correct in all positions
4. Mechanically not accurate except in three positions
5. Has only turning pairs
6. Controls movement of two front wheels
(a) 2, 4, 5 and 6
(b) 1, 2, 3 and 6
(c) 2, 3, 5 and 6
(d) 1, 2, 3 and 5

Q164. In a circular arc cam with a roller follower, acceleration of the follower depends on
1. Cam speed and location of centre of circular arc
2. Roller diameter and radius of circular arc
Which of the above is /are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Q165. A slider moves with uniform velocity 'v' on a revolving link of length 'l' with angular velocity 'ω'. The Coriolis acceleration component of point on the slider relative to a coincident point on the link is equal to
(a) ωv parallel to the link
(b) 2ωv perpendicular to the link
(c) ωv perpendicular to the link
(d) 2ωv parallel to the link

Q166. For a slider crank mechanism, the velocity and acceleration of the piston at inner dead centre will be

(a) 0 and 0
(b) 0 and $\omega^2 r$
(c) 0 and < ω^2r
(d) 0 and > ω^2r
Where 'ω' is angular velocity of the crank and 'r' its radius

Q167. The crank radius of a slider crank mechanism is 10 cm. If the crank radius is increased to 12 cm, the stroke length will increase by
(a) 10%
(b) 20%
(c) 12%
(d) 5%

Q168. Partial balancing in locomotives results in
(a) hammer blow, variation of tractive effort, swaying couple
(b) least wear
(c) most smooth
(d) better performance of engine

Q169. Centrifugal governors are preferred to the inertia type governors because an inertia governor
(a) has less controlling force
(b) is highly sensitive and more prone to hunting
(c) poses problems in the balancing of inertia forces
(d) has high initial and maintenance cost

Q170. Which one of the following is a gravity-controlled type governor?
(a) Hartnell governor
(b) Hartung governor
(c) Watt governor
(d) Pickering governor

Q171. According to Lami's theorem
(a) three forces acting at a point will be in equilibrium
(b) three forces acting at a point can be represented by a triangle, each side being proportional to force
(c) if three forces acting upon a particle are represented in magnitude and direction by the sides of a triangle, taken in order, they will be in equilibrium
(d) if three forces acting at a point are in equilibrium, each force is proportional to the sine of the angle between the other two

Q172. Two coplanar couples having equal and opposite moments
(a) balance each other
(b) cannot balance each other.
(c) are equivalent
(d) produce a moment of couple

Q173. A framed structure is perfect if it contains members equal to
(a) $2n - 3$
(b) $n - 1$
(c) $2n - 1$
(d) $n - 2$
When, n = number of joints in a frame

Q174. At what height from the base of a pillar must the end of a rope of given length (l) be fixed so that a man standing on the ground and pulling it at the other end with given force may have the greatest tendency to make the pillar overturn
(a) $l/2$
(b) $2l/3$
(c) $l/\sqrt{2}$
(d) ¾

Q175. Which is the false statement about true stress-strain method?
(a) It does not exist
(b) It is more sensitive to changes in both metallurgical and mechanical conditions
(c) It gives a more accurate picture of the ductility
(d) It can be correlated with stress-strain values in other tests like torsion, impact, combined stress tests etc.

Q176. In a tensile test on mild steel specimen, the breaking stress as compared to ultimate tensile stress is
(a) more
(b) less
(c) same
(d) more/less depending on composition

Q177. If a part is constrained to move and heated, it will develop
(a) principal stress
(b) tensile stress
(c) compressive stress
(d) shear stress

Q178. Which of the following materials is most elastic?
(a) rubber
(b) plastic
(c) brass
(d) steel

Q179. The value of Poisson's ratio for steel is between
(a) 0.01 to 0.1
(b) 0.23 to 0.27
(c) 0.25 to 0.33
(d) 0.4 to 0.6

Q180. The buckling load for a given material depends on
(a) slenderness ratio and area of cross-section
(b) Poisson's ratio and modulus of elasticity
(c) slenderness ratio, modulus of elasticity
(d) slenderness ratio, area of cross-section and modulus of elasticity

Q181. A cantilever of length 1.2 m carries a concentrated load of 12 kN at the free end. The beam is of rectangular cross section with breadth equal to half the depth. The maximum stress due to bending is not to exceed 100 N/mm^2. The minimum depth of the beam should be
(a) 120 mm
(b) 60 mm
(c) 75 mm
(d) 240 mm

Q182. Line imperfection in a crystal is called
(a) Miller defect
(b) Frenkel defect
(c) Schottky defect
(d) Edge dislocation

Q183. Which of the following phase of steel is NOT present in Iron-Carbon phase diagram?
(a) Ferrite
(b) Cementite
(c) Austenite
(d) Martensite

Q184. During tensile testing it has been observed that for same material the deformation is fully recoverable and time-independent, but does not obey hook's law. The material is
(a) Elastomer
(b) Rubber
(c) Polymer
(d) Aluminium alloy

Q185. Structure of common glass is
(a) Amorphous
(b) Partially crystalline
(c) Fully crystalline
(d) None of the above

Q186. Which one of the following casting processes is best suited to make bigger size hollow symmetrical pipes?
(a) Die casting
(b) Investment casting
(c) Shell moulding
(d) Centrifugal casting

Q187. Small amount of carbonaceous material sprinkled on the inner surface of mould cavity is called
(a) Backing sand
(b) Facing sand
(c) Green sand
(d) Dry sand

Q188. Which one of the following statements is correct?
(a) In extrusion process, thicker walls can be obtained by increasing the forming pressure
(b) Extrusion is an ideal process for obtaining rods from metal having poor density
(c) As compared to roll forming, extruding speed is high
(d) impact extrusion is quite similar to Hooker's process including the flow of metal being in the same direction.

Q189. Which one of the following processes is the wiredrawing process?
(a) Compressive
(b) Tensile
(c) Shear
(d) Hydrostatic stress

Q190. Which one of the following metal forming processes is not a high energy rate forming processes?
(a) Electro-magnetic
(b) Roll-forming
(c) Explosive forming
(d) Electro-hydraulic forming

Q191. Which one of the following is the correct statements?
(a) Extrusion is used for the manufacture of seamless tubes
(b) Extrusion is used for reducing the diameter of round bars and tubes by rotating dies which open and close rapidly on the work
(c) Extrusion is used to improve fatigue resistance of the metal by setting up compressive stresses on its surface
(d) Extrusion comprises pressing the metal inside a chamber to force it out by high pressure through an orifice which is shaped to provide the desired form of the finished part

Q192. Which metal forming process is used for manufacture of long steel wire?
(a) Deep drawing
(b) forging
(c) Drawing
(d) Extrusion

Q193. The advantage of the welding process is
(a) It relieves the joint from residual stresses
(b) it helps in checking of distortion of work piece
(c) Large number of metals and alloys, both similar and/or dissimilar can be joined
(d) heat produced during the welding does not produce metallurgical changes.

Q194. Tool life is affected mainly with
(a) Feed
(b) Depth of cut
(c) Coolant
(d) Cutting speed

Q195. Flank wear occurs on the
(a) Relief face of the tool
(b) Rake face
(c) Nose of the tool
(d) cutting edge

Q196. Some high speed steels have Cobalt (Co) added to them in amounts ranging from 2% to 15%, since this element improves the
(a) Cutting efficiency, especially at high temperature
(b) Depth hardening ability of the HSS tool
(c) Red hardness of the HSS tool
(d) Grain structure of the HSS tool

Q197. The relationship between the shear angle ϕ, the friction angle β and cutting rake angle α is given as
(a) $2\beta + \phi - \alpha = C$
(b) $2\phi + \beta - \alpha = C$
(c) $2\alpha + \beta - \phi = C$
(d) $\phi + 2\beta - \alpha = C$

Q198. In relation to the peripherical or surface speeds of the grinding wheel and that of the workpiece in cylindrical grinding of alloy steel workpieces, the grinding wheel speed is
(a) less than the speed of the workpiece
(b) Same as the speed of the workpiece
(c) Double the speed of the workpiece
(d) 65 to 75 times the speed of the workpiece

Q199. Constituents of ceramics are oxides of different materials, which are
(a) cold mixed to make ceramic pallets
(b) ground, sintered and palleted to make ready ceramics
(c) Ground, washed with acid, heated and cooled
(d) Ground, sintered, palleted and after calcining cooled in oxygen

Q200. Interference fit joints are provided for
(a) assembling bush bearing in housing
(b) mounting heavy duty gears on shafts
(c) mounting pulley on shafts
(d) assembly of flywheels on shaft

SOLUTIONS

S101. Ans.(b)
Sol. A closed system consists of fixed amount of mass and no mass can cross its boundary but energy in the from of heat and work can cross the system boundary. This means that the total mass within the system remains constant, and there's no exchange of mass with the surroundings.

S102. Ans.(c)
Sol. Volume of pressure cooker is always constant. Hence, it is isochoric process.
An isochoric process, also known as an isovolumetric or constant volume process, is a thermodynamic process where the volume of a system remains constant throughout the entire process. In other words, the system undergoes changes in pressure and temperature while keeping its volume fixed.

S103. Ans.(d)

Sol. The First Law describes how energy is conserved within a closed system. It explains that the change in the internal energy of a system is equal to the heat added to the system minus the work done by the system. This principle allows for the accounting of energy changes within a system as heat is added or removed and work is done.

$\delta Q = dU + \delta W$

$\delta Q - \delta W = dU$

S104. Ans.(b)

Sol. For process 1 -2

$U_1 + Q = U_2 + W$

$U_1 - U_2 = W - Q = 50 - 20 = 30\ kJ$

For process 2 – 1

$U_2 + Q = U_1 + W$

$Q + U_2 - U_1 = W$

$-10 - 30 = W$

$W = -40\ kJ$

S105. Ans.(b)

Sol. A real gas is a gas that does not strictly obey the ideal gas law under all conditions of temperature and pressure. Unlike an ideal gas, a real gas has its molecules or atoms interacting with each other, which can cause deviations from ideal behavior.

A real gas starts behaving as ideal gas at low pressure and high temperature.

S106. Ans.(d)

Sol. At critical point, enthalpy of vaporization is zero.

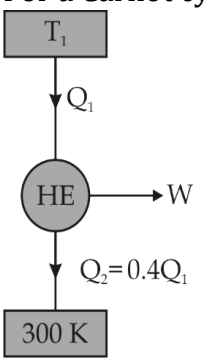
Enthalpy of vaporization, which is the energy required to change a substance from liquid to vapor at its boiling point, becomes zero at the critical point because there is no distinction between liquid and vapor phases.

S107. Ans.(b)

Sol. Sink temperature: $T_2 = 27°C$ = 27 + 273 = 300K

It is given that engine rejects 40% of absorbed heat from the source

For a Carnot cycle engine



$\frac{Q_1}{T_1} = \frac{Q_2}{T_2}$

$\frac{Q_1}{T_1} = \frac{0.4\,Q_1}{300}$

$\Rightarrow T_1 = \frac{300}{0.4} = 750$ K

$= 477°C$

S108. Ans.(a)

Sol. The irreversibility of a system refers to the inability to reverse a process or a change that has occurred within the system back to its original state without some net effect on the system and its surroundings.

Irreversibility,

$I = T_0\,(\Delta S)_{universe}$

$= T_0\,(\Delta S_{system} + \Delta S_{surrounding})$

S109. Ans.(d)

Sol. The Clapeyron equation is $\left(\frac{dp}{dT}\right)_{Sat} = \frac{h_{fg}}{T.V_{fg}}$

It enables us to determine the enthalpy of vaporization h_{fg} at a given temperature by simply measuring the slope of saturation curve on a p-T diagram and the specific volume of saturated liquid and saturated vapour at given temperature.

S110. Ans.(b)

Sol. The Mollier diagram, also known as the h-s diagram or enthalpy-entropy diagram, is a graphical representation used in thermodynamics to visualize and analyze the properties of substances, particularly steam or moist air.

For Mollier diagram, condensation takes place at constant pressure which is along vertically inclined.

S111. Ans.(c)

Sol. Dynamic viscosity,

$\mu = \rho v = (0.9 \times 1000) \times (0.28 \times 10^{-4})$

$=0.0252$ Ns/m^2

S112. Ans.(b)

Sol. Pressure difference between inside and outside of a droplet of water = $\frac{4\sigma}{d}$

$\because$ Bursting force = $p \times \frac{\pi d^2}{4}$

Resisting force = $\sigma \times \pi\, d$

Bursting force= Resisting force

$p \times \frac{\pi d^2}{4} = \sigma \times \pi d$

or $p = \frac{4\sigma}{d}$

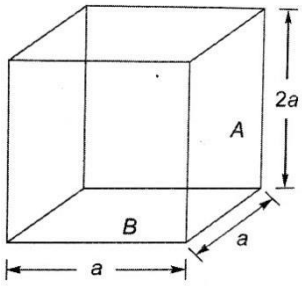
S113. Ans.(b)

Sol. The point of application of resultant pressure is called as centre of pressure. The center of pressure is a point within a fluid, like a liquid or gas, through which the total force due to fluid pressure acts when the fluid is in contact with a solid surface or an object immersed in it.

The center of buoyancy is the point within a submerged or floating body where the force of buoyancy acts. Buoyancy is the upward force exerted by a fluid on an object submerged in or floating on it, and it is equal to the weight of the fluid displaced by the object.

S114. Ans.(c)

Sol.



$\frac{F_B}{F_A} = \frac{\rho g h_b \times area}{\rho g h_a \times area}$

$\frac{F_B}{F_A} = \frac{\rho g(2a) \times a^2}{\rho g(a) \times 2a^2} = 1$

S115. Ans.(b)

Sol. Time period of oscillations is inversely proportional to meta centric height. Thus, more the GM less will be time period, and body regains its position in less time. So more stable.

The metacentric height (GM) is a critical measurement used to determine the stability of a floating vessel, particularly ships and boats, in response to small disturbances or tilting.

It represents the distance between the metacenter (M) and the center of gravity (G) of a floating body when it's tilted slightly from its equilibrium position. The metacenter is the intersection point of the lines of action of the buoyant force on the tilted and untilted positions of the vessel.

S116. Ans.(d)

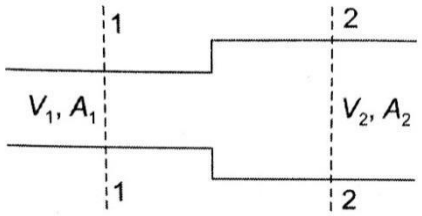
Sol. A stream line is a line on which tangent drawn at any point gives the direction of velocity.

Streamlines in fluid dynamics are imaginary curves that represent the path followed by a fluid particle as it moves through the flow. They show the direction a particle would travel at any given point within the fluid.

S117. Ans.(d)

Sol. The loss of head due to sudden enlargement in a fluid flow system is primarily attributed to the production and dissipation of turbulent energy.

Loss of head due to sudden enlargement is $\frac{(V_1-V_2)^2}{2g}$



S118. Ans.(c)

Sol. Shock wave : compressibility
Flow separation : adverse pressure gradient
Capillary rise : surface tension
Cavitation : vapour pressure

S119. Ans.(b)

Sol. The draft tube has two purposes as follows:
It permits a negative or suction head to be established at the runner exist, thus making it possible to install the turbine above the tail race level without loss of head.
It converts a large proportion of velocity energy rejected from the runner into useful pressure energy. i.e. acts as a recuperator of pressure energy.

S120. Ans.(a)

Sol. A hydraulic ram is a type of water pump that operates using the energy of flowing water to pump a portion of that water to a higher elevation than its source. It works based on the principles of fluid dynamics and uses the energy of water hammer, which is the pressure surge resulting from the sudden interruption of a fluid's flow.

S121. Ans.(b)

Sol. Gravity and pressure forces influence the problem of fluid statics.
Gravity force acts on the fluid's mass and causes it to exert pressure vertically downwards. The weight of the fluid contributes to the pressure at any given depth.

Pressure forces arise due to the pressure difference within the fluid. Pressure increases with depth in a fluid, creating a force perpendicular to any surface within the fluid.

Surface tension for liquids, especially at interfaces, molecules exhibit cohesive forces leading to surface tension. This force acts tangentially to the surface, minimizing the surface area of the liquid.

S122. Ans.(b)

Sol. Vertical component of a curved surface is equal to the weight of the liquid contained in that portion extending vertically above the curved surface up to the free surface of the liquid.

S123. Ans.(c)

Sol. The metacenter is above the centre of gravity. For stable equilibrium, the metacentric height (GM) must be positive. This means that the metacenter should be above the center of gravity of the floating body. When the body tilts slightly, the center of buoyancy shifts, causing a restoring torque that returns the body to its original position.

A lower center of gravity adds to stability. Placing more weight lower in the body helps in keeping the center of gravity below the metacenter

S124. Ans.(b)

Sol. As the fluid velocity and flow will change with time the flow will be nonsteady. Nonsteady flow refers to the movement of fluids where the velocity, pressure, and other flow properties change with respect to time at a particular point in the flow field.

Steady uniform flow describes a fluid motion that remains constant over time and does not change from one point to another within the flow field.

S125. Ans.(b)

Sol. A rotameter is a device used to measure the flow rate of a fluid in a closed conduit. It consists of a tapered tube, typically made of glass or plastic, through which the fluid flows vertically upward. Inside the tube, there's a float, often shaped like a ball or a cone, which moves freely based on the fluid flow.

The principle behind a rotameter is based on the variable area flow measurement. The cross-sectional area through which the fluid passes changes along the length of the tapered tube. As the area decreases, the fluid velocity increases, causing the float to rise to a certain height where equilibrium is achieved.

S126. Ans.(b)

Sol. Transitional flow depends upon Reynolds number

$Re = \frac{\rho VD}{\mu}$

∴Renolds number depends on density of fluid, velocity of fluid, viscosity of fluid and diameter of pipe

S127. Ans.(c)

Sol. For laminar flow through a pipe, the discharge (volumetric flow rate) is directly proportional to the pressure gradient and the fourth power of the pipe radius, and inversely proportional to the viscosity of the fluid.

Discharge(Q) $= \frac{\pi D^4}{128\mu}\left(\frac{\partial P}{dx}\right)$

$\therefore Q \propto \frac{1}{\mu}$

S128. Ans.(a)

Sol. $\delta = \frac{5x}{\sqrt{R_{ex}}} \Rightarrow \delta = \frac{5x}{\sqrt{\frac{\rho Ux}{\mu}}}$

$\therefore \delta \propto \frac{1}{\sqrt{\rho}}$

Boundary layer thickness is more for lighter fluid.

S129. Ans.(c)

Sol.

Euler number:

$$E = \left(\frac{Inertia\ force}{Pressure\ force}\right)^{\frac{1}{2}} = \frac{V}{\sqrt{\frac{p}{\rho}}}$$

Weber number:

$$W = \left(\frac{Inertia\ force}{Surface\ tension}\right)^{\frac{1}{2}} = \frac{V}{\sqrt{\frac{\sigma}{\rho L}}}$$

Mach number:

$$M = \left(\frac{Inertia\ force}{Elastic\ force}\right) = \frac{V}{\sqrt{\frac{K}{\rho}}}$$

S130. Ans.(b)

Sol. Inertia-viscous force ratio → Reynold number

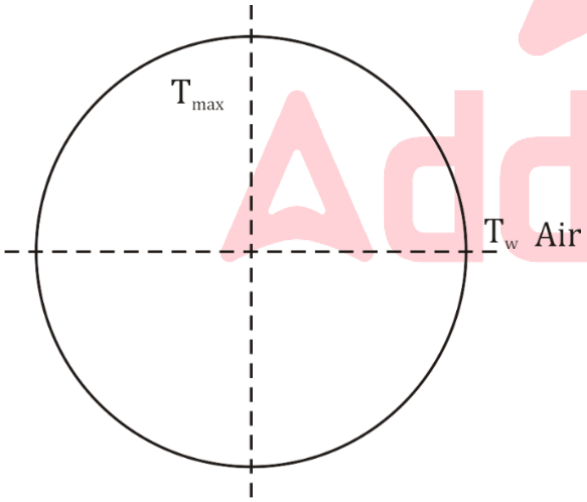
Inertia-gravity force ratio → Froude number

Inertia-surface tension ratio → Weber number

Inertia-elastic force ratio → Mach number

S131. Ans.(a)

Sol.



$$T_w = \frac{qR}{2h} + T_f$$

$$T_w - T_f = \frac{q.R}{2h}$$

Surface heat flux

$$q = h.(T_w - T_f)$$

$$q_0 = h.\frac{q.R}{2h}$$

$$q = \frac{2q_0}{R}$$

S132. Ans.(c)

Sol. Thermal resistance of the wall,

$R_{th} = \frac{kA}{l}$

$= \frac{0.4\times1.5}{0.6} = 1$ K/W

S133. Ans.(d)

Sol.

$\in_{fin} = \sqrt{\frac{kP}{hA}}$

$\in \propto K^{1/2}$

$\in \propto P^{1/2}$

Thus, fin effectiveness will increase if thermal conductivity and circumference increases.

S134. Ans.(d)

Sol. Rayleigh number is used to determine whether the flow is laminar or turbulent in natural convection.

$Ra < 10^8$ Laminar

$10^8 < Ra < 10^{10}$ Transaction

$Ra > 10^{10}$ Turbulent

S135. Ans.(c)

Sol. The view factor is the fraction of radiative energy that diffused from one surface element and strikes the other surface directly.

S136. Ans.(b)

Sol. $F_{22} = 0; F_{21} = 1$

$f_{12} = \left(\frac{A_2}{A_1}\right) F_{21} = \frac{1}{2}$

$F_{12} = \frac{1}{2}$

S137. Ans.(b)

Sol. The resistance due to fouling = R_f

$\therefore \frac{1}{U_{dirty}} = \frac{1}{U_{clean}} + \frac{1}{1/R_f}$

$\therefore R_f = \frac{1}{U_{dirty}} - \frac{1}{U_{clean}}$

S138. Ans.(d)

Sol. Forced Convection Boiling: This refers to a situation where the fluid motion is induced by external means. This type of boiling occurs in water tube boilers involving forced convection. Forced convection boiling is the process that occurs when a liquid flows through a tube with sub-cooled or saturated boiling. It is characterized by the forced flow of the fluid and the transfer of heat from the liquid to the tube wall.

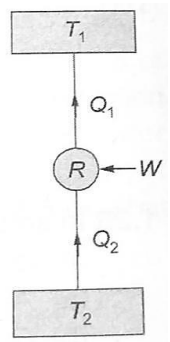
Pool Boiling: In this case the liquid above the hot surface is essentially stagnant and its motion near the surface is due to free convection.
Sub-Cooled or Local Boiling: In this case the liquid temperature is below the saturation temperature and bubbles are formed in the vicinity of heat surface.
Saturated Boiling: Here, the liquid temperature exceeds the saturation temperature.

S139. Ans.(b)
Sol. In a boiler, the air preheater is invariably located between Forced draft fan and furnace.
An air preheater is a device used in industrial and power generation processes to increase the temperature of air supplied to a furnace or boiler. Its main purpose is to improve the efficiency of the combustion process by recovering heat from the flue gas before it is exhausted.
S140. Ans.(a)
Sol. A centrifugal compressor is used to circulate refrigerant in large refrigeration plant. Large amount of vapour refrigerant at low pressure is required to handle in large refrigerant plant. Also unlike reciprocating compressor, centrifugal compressor are steady-flow device hence subjected to less vibration and noise.

S141. Ans.(d)
Sol. Work ratio $= \frac{net\ work}{positive\ work} = \frac{W_T - W_C}{W_T}$
Intercooling in a gas turbine plant refers to a process that involves cooling the air between compressor stages in a gas turbine cycle. Gas turbines work by compressing incoming air, mixing it with fuel, combusting the mixture, and then expanding the hot gases through a turbine to produce power. Intercooling is a method used to improve the efficiency of this process.
Reheat in gas turbines is a technique used to improve the overall efficiency and power output of the turbine. In a typical gas turbine setup, the basic operation involves compressing incoming air, mixing it with fuel to combust, and then expanding the hot gases through a turbine to generate power. Reheat is introduced to optimize this process.

S142. Ans.(d)
Sol. Propulsive efficiency is maximum when jet velocity (C_j) = forward velocity of aircraft (C_a)
Now thrust power = $(C_j - C_a)C_a = 0$
i.e. at maximum efficiency thrust power is zero.

S143. Ans.(c)
Sol. Given data



$Q_2 = 2\ kW \quad T_1 = 300\ K$

$T_2 = 200$ K

$COP = \frac{T_2}{T_1 - T_2}$

$= \frac{200}{300-200} = 2$

Also,

$COP = \frac{Q_2}{W}$

$\therefore 2 = \frac{2}{W}$

$or, W = \frac{2}{2} = 1$ kW per minute

S144. Ans.(d)

Sol.

1. Bell Coleman refrigeration: Expansion cylinder
2. Vapour compression refrigeration: compressor
3. Absorption refrigeration: Generator
4. Jet Refrigeration: Flash chamber

S145. Ans.(c)

Sol. Azeotrope is a mixture of refrigerants without phase separation.

Azeotropic refrigerant mixtures are blends of two or more refrigerants that exhibit characteristics different from their individual components. Azeotropic refrigerants form mixtures where the liquid and vapor phases have the same composition, causing them to evaporate or condense at a constant temperature. This property makes them useful in refrigeration cycles as they enable consistent temperature changes during phase transitions.

S146. Ans.(c)

Sol. As the temperature of water shower is less than dew point temperature hence, water vapour starts condensing. Thus, process involved is cooling and dehumidification.

S147. Ans.(c)

Sol.

$RSHF = \frac{RSH}{RTH}$

$\therefore RSH = 0.75 \times 100 = 75\ kW$

$RLH = 100 - 75 = 25$ kW

RLH = 50 cmm $(w_1 - w_2)$

$W_2 = 0.005$ kg/kg of dry air

S148. Ans.(a)

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

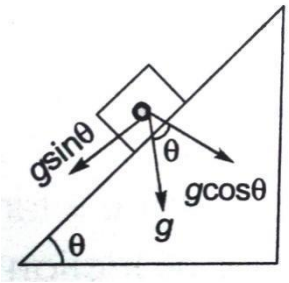
η of diesel engine increases as the load on the engine decreases and at limiting condition becomes to Otto. With increase in load, cut off ratio increases.

S149. Ans.(b)
Sol.
$\eta = 1 - \frac{T_1}{T_2} = 1 - \frac{300}{600} = 0.5$
$W = \eta Q_S = 0.5 \times 100 = 50\ kJ$
m.e.p. $= \frac{W}{V_S} = \frac{50}{0.2}$
= 250 kPa = 2.5 bar

S150. Ans.(a)
Sol. Since grey cast iron has properties of self lubrication and damping of small vibrations they are widely used for machine base, engine frames, drainage pipes, elevator and industrial furnace counter weights, pump housings cylinder and piston rings of IC engines, flywheel etc.

S151. Ans.(b)
Sol. Newton's second law of motion gives the measure of force.
First law : In an inertial reference frame, an object either remains at rest or continues to move at a constant velocity, unless acted upon by a net force.
Second law : In an inertial reference frame, the vector sum of forces F on an object is equal to the mass m of that object multiplied by the acceleration a of the object i.e.
F – m a
Third law : When one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body.

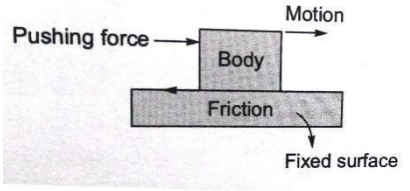
S152. Ans.(b)
Sol.
f = g sinθ



S153. Ans.(a)
Sol. Static friction is the force that prevents two surfaces from sliding against each other when they're at rest relative to each other. When an object is sitting on a surface or when two surfaces are in contact but not moving relative to each other, static friction comes into play.

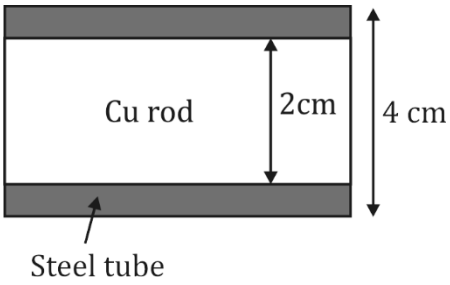
The magnitude of static friction can vary and depends on the nature of the surfaces in contact and the force pressing them together.
Friction force (f) = $\mu \times$ N

S154. Ans.(d)
Sol.



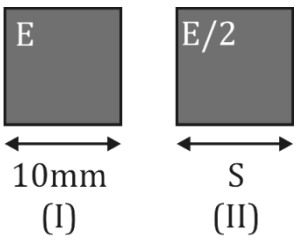
The direction of frictional force acting on a body which can slide on a fixed surface is opposite to the direction of motion (figure)

S155. Ans.(a)
Sol.



Given,
σ_s = 100 MPa
$E_s = 2E_c$
$\delta_s = \delta_c$
$\frac{P_s L_s}{A_s E_s} = \frac{P_c L_c}{A_c E_c}$
$\frac{\sigma_s}{E_s} = \frac{\sigma_C}{E_c}$ [$\because L_S = L_C$]
$\sigma_c = \frac{\sigma_s}{E_s} \times E_c$
$\sigma_c = \frac{\sigma_s}{2}$
$\sigma_c = \frac{100}{2} = 50\ MPa$

S156. Ans.(a)
Sol.



$\delta_I = \delta_{II}$
$or, \left(\frac{PL}{AE}\right)_I = \left(\frac{PL}{AE}\right)_{II}$

$or, A_I E_I = A_{II} E_{II}$

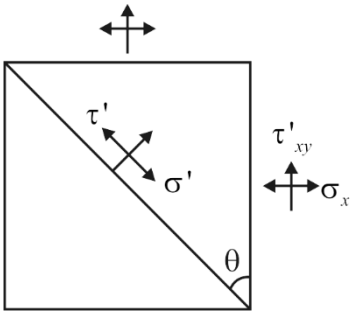
$or, A_{II} = \frac{E_I}{E_{II}} . A_I = 2 \times 10 \times 10 = 200\ mm^2$

$s^2 = 200\ mm^2$

$\Rightarrow s = 14.14\ mm$

S157. Ans.(c)

Sol.



Max shear stress,

$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$

Normal stress on oblique plane

$\sigma' = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\ cos2\theta + \tau_{xy}\ sin2\theta$

$\tau' = \left(\frac{\sigma_x - \sigma_y}{2}\right) sin2\theta + \tau_{xy}\ cos2\theta$

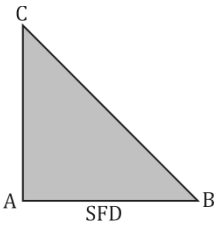
S158. Ans.(d)

Sol. For thick cylinder

1. Variations of hoop stress and radial stress are parabolic across the cylinder wall.
2. at the inner edge, the stresses are maximum.
3. the value of 'permissible or Maximum Hoop stress' is to be considered on the inner edge,
4. the maximum shear stress (σ_{max}) and Hoop, longitudinal and radial strains ($\varepsilon_h, \varepsilon_l, \varepsilon_r$) are calculated as in thin cylinder but separately for inner and outer edges.

S159. Ans.(b)

Sol. The shearing force diagram for a beam is



The bending moment diagram is

S160. Ans.(d)

Sol. Malleability is defined as the property of material due to which it can be converted into thin flat sheet without cracking.

Plasticity refers to the ability of a material to undergo permanent deformation without fracturing when subjected to an external force. Materials that exhibit plastic behavior can change shape or deform under stress but retain their altered shape even after the stress is removed.

Ductility is a physical property of materials that describes their ability to undergo significant deformation before fracturing or breaking. A ductile material can be stretched, drawn, or elongated without losing its integrity or breaking apart.

Elasticity is the property of a material that allows it to return to its original shape and size after being deformed by an external force and once that force is removed. Materials that exhibit elasticity can undergo deformation, but they will return to their initial state once the force causing the deformation is no longer applied.

S161. Ans.(a)

Sol. Coriolis acceleration is a fictitious force that appears to act on objects moving in a rotating reference frame. It arises due to the rotation of the reference frame itself and affects the trajectory of moving objects within that frame.

Coriolis acceleration: $a_c = 2V\omega$

It Depends upon angular velocity

S162. Ans.(c)

Sol.

$$Stroke = \frac{2(Length\ of\ slotted\ bar)\times(Length\ of\ crank)}{(Length\ CR)}$$

$$= \frac{2\times500\times100}{200}$$

= 500 mm

S163. Ans.(a)

Sol. the following things are associated with Ackerman steering mechanism used in automobiles.

1. Less friction and hence long life
2. Mechanically correct in all positions
3. Mechanically not accurate except in three positions
4. Has only turning pairs
5. Controls movement of two front wheels

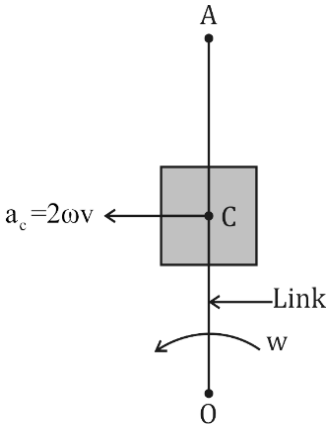
S164. Ans.(c)

Sol. In a circular arc cam with a roller follower, acceleration of the follower depends on

1. Cam speed and location of centre of circular arc
2. Roller diameter and radius of circular arc

S165. Ans.(b)

Sol.



$a_c = 2\omega v$

S166. Ans.(d)

Sol. For a slider crank mechanism, at inner dead centre,

θ = 0°

Velocity of the piston,

$V = r\omega\left(sin\theta + \frac{sin2\theta}{2n}\right) = 0$

Acceleration of piston,

$a = r\omega^2\left(cos\theta + \frac{cos\,2\theta}{n}\right) = r\omega^2\left(1 + \frac{1}{n}\right)$

i.e. $a > r\omega^2$

S167. Ans.(b)

Sol.

Crank radius, r = 10 cm

Stroke length, l = 2r = 20 cm

If crank radius is increased to 12 cm, the new stroke length,

$l_{new} = 24$ cm

So, % increase in stroke length

$= \frac{l_{new} - l}{l} \times 100$

$= \frac{24-20}{20} \times 100 = 20\%$

S168. Ans.(a)

Sol.

Partial balancing in locomotives results in :

(i) Hammer blow

(ii) Variation in tractive effort

(iii) Swaying couple

S169. Ans.(b)
Sol. Centrifugal governors are preferred to the inertia type governor because an inertia governor is highly sensitive and more prone to hunting. In case of centrifugal governors, the balls are operated by the actual change of engine speed, while in case of inertia governors, it is by the rate of change of speed. Therefore, the response of inertia governors is faster than that of centrifugal types.

S170. Ans.(c)
Sol. Watt, Porter and Proell governor are under the category of gravity controlled type governor. A gravity-controlled governor is a type of mechanical device used in engines or machinery to regulate the speed or control the output. It operates based on the principles of centrifugal force and gravity.

The governor typically consists of a system of rotating masses or weights connected to the engine or machinery being regulated. As the speed of the engine increases or decreases, the centrifugal force acting on these weights changes. This causes the weights to move outward or inward along a rotating shaft.

S171. Ans.(d)
Sol. According to Lami's theorem if three forces acting at a point are in equilibrium, each force is proportional to the sine of the angle between the other two.

S172. Ans.(b)
Sol. Two coplanar couples having equal and opposite moments cannot balance each other.

S173. Ans.(a)
Sol. Compound trusses are statically determinant, rigid, and completely constrained.

$m = 2n - 3$

Truss contains a redundant member and is statically indeterminate

$m > 2n - 3$

S174. Ans.(c)
Sol. The pillar and the rope form the right angle triangle. When the pillar is overturn then,
Height of pillar = Distance between man and base of pillar
On applying Pythagorean theorem, we get,
$x^2 + x^2 = l^2$
$2x^2 = l^2$
$x^2 = l^2/2$
On taking square root on both sides, we get,
$\therefore x = l/\sqrt{2}$

S175. Ans.(a)
Sol. Stress–strain analysis (or stress analysis) is an engineering discipline that uses many methods to determine the stresses and strains in materials and structures subjected to forces.

S176. Ans.(b)
Sol. Ultimate stress is the maximum value of stress. It is the point at which the size (cross section area) decreases and a neck is formed, and breaking stress is the stress at which the material actually breaks down.
The value of ultimate stress is always more than the breaking stress as formation of neck (permanent deformation) requires more stress than to actually break.

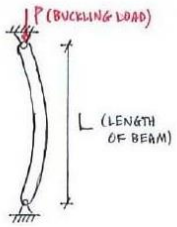
S177. Ans.(c)
Sol. If a part is constrained to move and heated, it will develop compressive stress.

S178. Ans.(d)
Sol. Mild Steel is more elastic than Rubber. Elasticity refers to a material's ability to deform under stress and then return to its original shape when the stress is removed. A highly elastic material can undergo significant deformation and return to its original shape easily.

S179. Ans.(c)
Sol.
μ = 0 to 0.5 (under uni-axial loading)
μ = 0 for cork
μ = 0.5 for perfectly plastic body (Rubber)
μ = .25 to 0.33 for steel

S180. Ans.(d)
Sol.
Critical buckling load

Formula: $P_{cr} = \frac{\pi^2 EI}{L^2}$



P = Buckling Load
I = Moment of Inertia about centroidal axis
L = Effective Length

S181. Ans.(a)
Sol.
$(\sigma_{max})_{per} = 100\ MPa\ ; b = \frac{d}{2}$
$(\sigma_b)_{max} = \frac{6M_{max}}{bd^2}$
$M_{max} = PL = 12 \times 10^3 \times 1.2 \times 10^3$ Nmm
$100 = \frac{6 \times 12 \times 10^6 \times 1.2 \times 2}{d \times d^2}$
$d^3 = 12 \times 12 \times 12 \times 10^3$
d= 120 mm

S182. Ans.(d)
Sol. Edge dislocation is line defect. Frankel and schottkey defect are both point defects.
Frankel & Schottkey defects are point defect. In frankel defect an atom in lattice occupies an interstitial void. In schottkey defect an anion and a cation are absent in lattice.

S183. Ans.(d)
Sol. Except martensite, all others are present in Fe-C equilibrium diagrams. Martensite is produced during heat treatment process in which austenite transform to martensite by quenching.

S184. Ans.(a)
Sol. An elastomer is a polymer with the property of viscoelasticity. Elastomers are a class of polymers known for their exceptional elasticity and resilience. They are materials that possess the ability to return to their original shape after being deformed under stress, making them highly flexible and useful in various applications.

S185. Ans.(a)
Sol. Glass is an amorphous (non-crystalline) solid material. Glasses are typically brittle and optically transparent.
A glass is an amorphous solid that transforms into a liquid upon heating through the glass transition.

S186. Ans.(d)
Sol. Centrifugal casting is used for making bigger size hollow symmetrical pipes. For producing a hollow part, the axis of rotation is placed at the centre of the desired casting. The speed of rotation is maintained as high as to produce a centripetal acceleration of the order of 60 g to 70 g. It should be noted casting of hollow parts need no core in this process.

S187. Ans.(b)
Sol. Carbonaceous material (like, Sea, Coal, Pitch, Graphite) sprinkled on the inner material is called facing sand.
Facing sand: this sand is used directly next to the surface of pattern and comes into contact with the molten when the mould is poured. If it subjected to the services conditions and must possesses therefore, high strength and refractoriness. Therefore, high strength and refractoriness. This same also provide a smothers casting surface and should be of fine texture.

S188. Ans.(a)
Sol. From all the among given options the correct option is In extrusion process, thicker walls can be obtained by increasing the forming pressure.

S189. Ans.(b)
Sol. In wire drawing process tensile stress is subjected for plastic deformation. Wire drawing is a metalworking process used to reduce the diameter of a wire rod or a wire already in existence. It's a cold-working process that involves pulling a metal wire through a series of dies to decrease its diameter while simultaneously increasing its length.

S190. Ans.(b)

Sol. In metal forming process, energy source such as chemical, magnetic and electrical discharge can be used, since in all such processes, the rate of energy flow is of much higher order, these are commonly called high-energy rate (HER) processes.

Three common HER processes are

1. Explosive forming
2. Electrohydraulic forming
3. Electromagnetic forming

S191. Ans.(a)

Sol. The pipes and tubes can be seamless or with seam. Tube with seam are manufactured by the various welding techniques. Seamless tubes are made by

Extrusion and Piercing methods

S192. Ans.(c)

Sol. The drawing operation is mainly used for reducing the diameter of bars and wires. The drawing speed varies from 10 m/min. for a large diameter to 1800 m/min for very thin wire.

S193. Ans.(c)

Sol. The advantage of the welding process is Large number of metals and alloys, both similar and/or dissimilar can be joined.

S194. Ans.(d)

Sol. Sequence of parameters affecting tool life is:

Cutting speed > feed > depth of cut

S195. Ans.(a)

Sol. Flank wear occurs on the Relief face of the tool.

S196. Ans.(c)

Sol. Cobalt improves hot hardness and wear resistance of high speed steel.

S197. Ans.(b)

Sol.

From the merchant second analysis

$2\phi + \beta - \alpha = C$

Where, ϕ = shear angle

β = friction angle

α = Rake angle

S198. Ans.(d)

Sol. Surface speeds of the grinding wheel is very high as compared to workpiece.

S199. Ans.(b)
Sol. Constituents of ceramics are oxides of different materials, which are ground, sintered and palleted to make ready ceramics.

S200. Ans.(a)
Sol. Interference Fit : If maximum size of hole is smaller than the minimum size of shaft than force has to be applied to make the assembling.
Ex. Assembling bush bearing in Housing