UPPSC

Uttar Pradesh Public Service Commission

Combined State Engineering Services Examination, 2019

Assistant Engineer

Mechanical Engineering

Previous Solved Papers

- Technical Section (Memory Based)
- General Hindi
- General Studies

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UPPSC-AE : Mechanical Engineering Previous Solved Papers

Edition: 2020

UPPSC : Exam Pattern

As per notification of

Combined State Engineering Service Examination, 2019
Assistant Engineer

Paper I : Objective **Maximum Time : 2½ Hours • Maximum Marks : 375** Each question carries 3 marks. There is a penalty of –1 mark for every wrong attempted answer	
General Hindi	25 Questions
Technical Paper I	100 Questions
Total	**125 Questions** (375 Marks)

Paper II : Objective **Maximum Time : 2½ Hours • Maximum Marks : 375** Each question carries 3 marks. There is a penalty of –1 mark for every wrong attempted answer	
General Studies	25 Questions
Technical Paper II	100 Questions
Total	**125 Questions** (375 Marks)

Contents

Mechanical Engineering

Section-A : Technical

Section-B : General Hindi

Section-C : General Studies (Topicwise)

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UPPSC

Combined State Engineering Services Examination

Memory Based Previous Year Solved Papers

Section-A

Technical

Mechanical Engineering

UPPSC-AE Paper-I : 2013

Mechanical Engineering

(Memory Based Questions)

Q.1 In High velocity forming, the forming speed is greater than
(a) 3 m/s (b) 5 m/s
(c) 8 m/s (d) 15 m/s

Q.2 Which control chart is used to measure variability of 'Variability with in the sample'?
(a) $\bar{x}$ chart (b) *c* chart
(c) *u* chart (d) chart

Q.3 If the demand for an item is doubled and the ordering cost is halved, the economic order quantity for the item will be
(a) A half of the earlier quantity
(b) Double of the earlier quantity
(c) Increased by a factor of
(d) Will remain unchanged

Q.4 An industry produces 300 spark plugs in one shift of 8 hours. If standard time per piece is 1.5 minute, the productivity would be
(a) 3/4 (b) 5/8
(c) 7/16 (d) 15/16

Q.5 If '*m*' is the number of constraints in a linear programming problem with two variables 'x' and 'y' and non-negativity constraints x & $y \geq 0$. The feasible region in the graphical solution will be surrounded by
(a) *m* lines (b) $m + 1$ lines
(c) $m + 2$ lines (d) $m + 4$ lines

Q.6 Effect of stockout of a commodity is
(a) Loss of profit
(b) Loss of customers
(c) Loss of goodwill
(d) All of the above

Q.7 The annual demand for an item is 3200 parts. Unit cost is Rs. 6 and the inventory carrying charges are estimated as 25% per annum. If the cost of one procurement is Rs. 150, what will be the number of orders per year?
(a) 4 (b) 6
(c) 8 (d) 10

Q.8 In queuing theory, the ratio of mean arrival rate and the mean service rate is termed as
(a) Work factor (b) Utilization factor
(c) Slack constant (d) Production rate

Q.9 If in graphical solution of linear programming problem, the objective function line is parallel to the line representing constraint equation, then the solution of problem is
(a) Infeasible solution
(b) Unbound solution
(c) Multiple optimum solution
(d) None of the above

Q.10 Low helix angle drills are used for drilling holes in
(a) Plastics (b) Copper
(c) Cast steel (d) Carbon steel

Q.11 In a queuing problem, if the arrivals are completely random then the probability distribution of number of arrivals in a given time follows
(a) Normal distribution
(b) Poisson distribution
(c) Binomial distribution
(d) Exponential distribution

Q.12 In ABC analysis of inventories, '*A*' items usually constitute
(a) 10% (b) 20%
(c) 30% (d) 70%

Q.13 Increase in economic order quantity results in
(a) Increase in inventory carrying cost
(b) Decrease in ordering cost
(c) Decrease in total cost
(d) Total cost first decreases and then increases

Q.14 In ABC analysis items are classified in three categories namely *A*, *B*, and *C* in accordance with their
(a) Values (b) Number
(c) Characteristics (d) Priorities

Q.15 Control limits of a $\bar{X}$ chart are

(a) $\bar{\bar{X}} \pm \sigma$ (b) $\bar{\bar{X}} \pm 2\sigma$

(c) $\bar{\bar{X}} \pm 3\sigma$ (d) $\bar{\bar{X}} \pm 6\sigma$

Q.16 Following is not a method of solving a transportation problem

(a) Northwest corner method
(b) Least cost method
(c) Vogel's approximation method
(d) Dynamic method

Q.17 If work station times are not same, the overall production rate of an assembly line is determined by the

(a) Fastest station time
(b) Slowest station time
(c) Average of all station times
(d) Average of slowest and fastest station times

Q.18 Which one of the following is not the control chart for attributes?

(a) p chart (b) c chart

(c) R chart (d) $\bar{x}$ chart

Q.19 At breakeven point

(a) Sales revenue > total cost
(b) Sales revenue = total cost
(c) Sales revenue < total cost
(d) None of the above

Q.20 In operating characteristics curve, abscissa (x-axis) represents

(a) Number of defectives
(b) Percentage defectives
(c) Sample number
(d) Probability of acceptance

Q.21 For a vibrating system with viscous damping, the characteristics equation is given as

$$M + c\dot{x} + kx = 0$$

If the roots of the characteristics equation are real and equal, the system is

(a) Over damped (b) Critically damped

(c) Underdamped (d) Cannot be predicted

Q.22 For isotropic materials, shear and elastic moduli are related to each other and to Poisson's ratio according to

(a) $E = G(1 + 2\mu)$ (b) $E = 2G(1 + \mu)$

(c) $E = G(2 + \mu)$ (d) $E = (2 + G)$

Q.23 A body is having a simple harmonic motion. Product of its frequency and time period is equal to

(a) Zero (b) One

(c) Infinity (d) 0.5

Q.24 The shear stress at the centre of a circular shaft under torsion is

(a) Maximum (b) Minimum

(c) Zero (d) Unpredictable

Q.25 The resultant deflection of a beam under unsymmetrical bending is

(a) Parallel to the neutral axis
(b) Perpendicular to the neutral axis
(c) Parallel to the axis of symmetry
(d) Perpendicular to the axis of symmetry

Q.26 Euler's formula holds good for

(a) Short columns only
(b) Long columns only
(c) Both long and short columns
(d) Weak columns

Q.27 In a beam when shear force changes sign, the bending moment will be

(a) Zero (b) Maximum

(c) Minimum (d) Infinity

Q.28 The point of contraflexure occurs in

(a) Cantilever beams
(b) Simply supported beams
(c) Overhanging beams
(d) Fixed beams

Q.29 In thick cylinder, the radial stresses in the wall thickness

(a) is zero
(b) negligible small
(c) varies from the inner face to outer face
(d) None of the above

Q.30 A solid circular shaft is subjected to a maximum shear stress of 140 MPa. Magnitude of maximum normal stress developed in the shaft is

(a) 60 MPa (b) 90 MPa

(c) 110 MPa (d) 140 MPa

Q.31 A hollow shaft has external and internal diameters of 10 cm and 5 cm respectively. Torsional section modulus of shaft is

(a) 375 cm^3 (b) 275 cm^3

(c) 184 cm^3 (d) 84 cm^3

Q.32 Two cars ' *A*' and '*B*' move at 15 m/s in the same direction. Car '*B*' is 300 m ahead of car '*A*'. If car '*A*' accelerate at 6 m/s^2 while car '*B*' continues to move with the same velocity, car '*A*' will overtake car '*B*' after
(a) 7.5 s (c) 12 s
(b) 10 s (d) 15 s

Q.33 Two balls are dropped from a common point after an interval of 1 second. If acceleration due to gravity is 10 m/s^2, separation distance 3 second after the release of the first ball will be
(a) 5 m (c) 25 m
(b) 15 m (d) 30 m

Q.34 A ball of 2 kg drops vertically onto the floor with a velocity of 20 m/s. It rebounds with an initial velocity of 10 m/s, impulse acting on the ball during contact will be
(a) 20 (b) 40
(c) 60 (d) 30

Q.35 Kinetic energy of a solid cylinder of mass '*m*', radius '*r*' and angular velocity 'ω' is
(a) $mr^2\omega^2$ (b) $mr\omega$
(c) $mr\omega^2$ (d) mr^2

Q.36 Impulse is
(a) Minimum momentum
(b) Maximum momentum
(c) Average momentum
(d) Final momentum - Initial momentum

Q.37 A cable with uniformly distributed load per horizontal metre run will take the following shape
(a) Straight line (b) Parabola
(c) Ellipse (d) Hyperbola

Q.38 Mohr's circle may be used to determine following stress on an inclined plane
(a) Normal stress (b) Principal stress
(c) Tangential stress (d) All of the above

Q.39 State of plane stress at a point is described by $x = y = \sigma$ and $xy = 0$
The normal stress on a plane inclined at 45° to the horizontal is
(a) 2σ (b) $\sqrt{2}\sigma$
(c) $\sqrt{3}\sigma$ (d) σ

Q.40 If load at the free end of the cantilever beam is gradually increased, failure will occur at
(a) In the middle of beam
(b) At the fixed end
(c) Anywhere on the span
(d) None of the above

Q.41 Kinematic pair constituted by cam and follower mechanism is
(a) Higher and open type
(b) Lower and open type
(c) Lower and closed type
(d) Higher and closed type

Q.42 If the diameter of a long column is reduced by 20 percent, the reduction in Euler buckling load in percentage is nearly
(a) 4 (b) 36
(c) 49 (d) 59

Q.43 Ultrasonic machining is best suited for
(a) Amorphous material
(b) Brittle material
(c) Non ferrous material
(d) All of the above

Q.44 A column of length 'l' is fixed at both the ends. The equivalent length of the column is
(a) $2l$ (b) $0.5l$
(c) $4l$ (d) l

Q.45 The Coriolis component of acceleration acts
(a) Along the sliding surface
(b) Perpendicular to the sliding surface
(c) At 45° to the sliding surface
(d) None of the above

Q.46 A slider on a link rotating with angular velocity 'ω' have linear velocity 'ν' The magnitude of Coriolis component of acceleration is
(a) $\sqrt{2}\nu\omega$ (b) $2\nu\omega$
(c) $\nu\omega$ (d) $\frac{\nu\omega}{2}$

Q.47 Coriolis component of acceleration exists whenever a point moves along a path that has
(a) Tangential acceleration
(b) Centripetal acceleration
(c) Linear motion
(d) Rotational motion

Q.48 When the applied force is less than the limiting frictional force, the body will
(a) Start moving
(b) Remain at rest
(c) Slide backward
(d) Skid

Q.49 Critical speed of a shaft depends on
(a) Diameter of disc
(b) Length of shaft
(c) Eccentricity
(d) All of the above

Q.50 Which of the following equilibrium equation should be satisfied by the joints in truss?
(a) $\Sigma H = 0, \Sigma M = 0$
(b) $\Sigma H = 0, \Sigma V = 0$
(c) $\Sigma V = 0, \Sigma M = 0$
(d) $\Sigma H = 0, \Sigma V = 0$ and $\Sigma M = 0$

Q.51 When the number of members 'n' in a truss is more than $2j - 3$, where 'j' is the number of joints, the frame is said to be
(a) Perfect truss (b) Imperfect truss
(c) Deficient truss (d) Redundant truss

Q.52 Turning a key into the lock is a case of
(a) Coplaner forces
(b) Non-coplaner forces
(c) Couple
(d) Moment

Q.53 When a wire is stretched to double its original length, the longitudinal strain produced in it is
(a) 0.5 (b) 1.0
(c) 1.5 (d) 2.0

Q.54 The electrolyte used in ECM process is
(a) Transformer oil
(b) White spirit
(c) Aqueous solution of common salt
(d) None of the above

Q.55 According to law of transmissibility of forces, effect of force acting on the body is
(a) Different at different points of the body
(b) Minimum when it acts at centre of gravity of the body
(c) Maximum when it acts at centre of gravity of the body
(d) Same at every point in its line of action

Q.56 Maximum shear stress in a Mohr's circle is
(a) Equal to the radius of Mohr's circle
(b) Greater than the radius of Mohr's circle
(c) 2 times the radius of Mohr's circle
(d) Could be any of the above

Q.57 The ratio of the compressive critical load for a long column fixed at both the ends and a column with one end fixed and the other end being free is
(a) 2 : 1 (b) 4 : 1
(c) 8 : 1 (d) 16 : 1

Q.58 Elongation of bar under its own weight as compared to that when the bar is subjected to a direct axial load equal to its own weight will be
(a) The same (b) One fourth
(c) A half (d) Double

Q.59 A simply supported beam of length 'l' has uniformly distributed load 'w' kilogram acting per unit length. Bending moment at mid span is
(a) $\frac{wl^2}{8}$ (b) $\frac{wl^2}{4}$
(c) $\frac{wl^2}{2}$ (d) None of the above

Q.60 Uniformly distributed load 'w' act over per unit length of a cantilever beam of 3 m length. If the shear force at the midpoint of beam is 6 kN, what is the value of 'w'
(a) 2 kN/m (b) 3 kN/m
(c) 4 kN/m (d) 5 kN/m

Q.61 Elastic constants E, G and K are related by the expression
(a) $E = \frac{GK}{2K + G}$ (b) $E = \frac{2GK}{2K + G}$
(c) $E = \frac{3GK}{K + 2G}$ (d) $E = \frac{9GK}{3K + G}$

Q.62 A material has elastic modulus of 120 GPa and shear modulus of 50 GPa. Poisson's ratio for the material is
(a) 0.1 (b) 0.2
(c) 0.3 (d) 0.33

Q.63 A simply supported beam of length 'l' carries a point load 'W' at the midspan. Deflection in beam at the centre will be

(a) $\frac{Wl^3}{3EI}$ (b) $\frac{Wl^3}{8EI}$

(c) $\frac{Wl^3}{48EI}$ (d) $\frac{5}{384}\frac{Wl^3}{EI}$

Q.64 An object falls from the top of a tower. If comes down half the height in 2 seconds. Time taken by the object to reach the ground is

(a) 2.8 s (b) 3.2 s
(c) 4.0 s (d) 4.5 s

Q.65 A body moving with a velocity of 1 m/s has kinetic energy of 1.5 Joules. Mass of the body is

(a) 0.75 kg (b) 1.5 kg
(c) 3.0 kg (d) 30 kg

Q.66 A particle is projected at such an angle with the horizontal that the maximum height attained by the particle is one-fourth of the horizontal range. The angle of projection should be

(a) 30° (b) 45°
(c) 60° (d) 75°

Q.67 A bullet of 0.03 kg mass moving with a speed of 400 m/s penetrates 12 cm into a block of wood. Force exerted by the wood block on the bullet is

(a) 10 kN (b) 20 kN
(c) 25 kN (d) 30 kN

Q.68 A block resting on an inclined plane begins to slide down the plane when the angle of inclination is gradually increased to 30°. The coefficient of friction between the block and the plane is

(a) 0.50 (b) 0.578
(c) 0.72 (d) 0.866

Q.69 The shearing area of a key of length 'l', breadth 'b' and depth 'd' is equal to

(a) $b \times d$ (b) $l \times d$

(c) $l \times b$ (d) $l \times \frac{d}{2}$

Q.70 The gear train usually employed in clocks is a

(a) Reverted gear train
(b) Simple gear train
(c) Sun and planet gear
(d) differential gear

Q.71 Universal joint is an example of

(a) Lower pair (b) Higher pair
(c) Rolling pair (d) Sliding pair

Q.72 The outer circle of spur gear is called as

(a) Pitch circle (b) Addendum circle
(c) Dedendum circle (d) Base circle

Q.73 Axes of a pair of spur gears are 200 mm apart. The gear ratio is 3:1 and number of teeth on pinion is 20. The module of the gear is

(a) 4 mm (b) 5 mm
(c) 8 mm (d) 10 mm

Q.74 In a flat belt drive, slip between the driver and belt is 1% and that between belt and follower is 3%. If the pulley diameters are same, the velocity ratio of the drive is

(a) 0.99 (b) 0.98
(c) 0.97 (d) 0.96

Q.75 In case of a flywheel, maximum fluctuation in energy is

(a) Sum of maximum and minimum energies
(b) Difference of maximum and minimum energies
(c) Ratio of maximum and minimum energies
(d) Ratio of minimum and maximum energies

Q.76 Which pair of gears usually has higher frictional losses?

(a) Spur gears (b) Helical gears
(c) Bevel gears (d) Worm and worm wheel

Q.77 Average tensions on the tight side and slack side of a flat belt drive are 700 N and 400 N respectively. If linear velocity of the belt is 5m/s, the power transmitted will be

(a) 1.5 kW (b) 2.5 kW
(c) 2.8 kW (d) 3.0 kW

Q.78 Which one of the following in-line engine working on a four stroke cycle is completely balanced inherently?

(a) 2 cylinder engine (b) 3 cylinder engine
(c) 4 cylinder engine (d) 6 cylinder engine

Q.79 If Hartnell governor uses a spring of greater stiffness, it will become

(a) Less sensitive
(b) More sensitive
(c) Remain unaffected
(d) Isochronous

Q.80 A disc clutch has n_1 discs on driving shaft and n_2 discs on driven shaft. Number of pairs of contact surfaces will be
(a) $n_1 + n_2$ (b) $n_1 + n_2 + 1$
(c) $n_1 + n_2 - 1$ (d) $n_1 - n_2$

Q.81 A spring controlled governor is found unstable. It may be made stable by
(a) Increasing spring stiffness
(b) Decreasing spring stiffness
(c) Increasing ball weight
(d) Decreasing ball weight

Q.82 Centre distance between two involute teeth gears of base radii R and r and pressure angle f, is expressed by
(a) $(R+r)\sin\phi$ (b) $\dfrac{(R+r)}{\cos\phi}$
(c) $(R+r)\cos\phi$ (d) $\dfrac{(R+r)}{\sin\phi}$

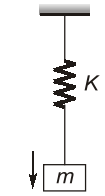
Q.83 An engine running at 150 r.p.m. drives a shaft with belt arrangement. If diameter of engine pulley is 55 cm and shaft pulley 33 cm, find the speed of shaft
(a) 100 r.p.m. (b) 150 r.p.m.
(c) 200 r.p.m. (d) 250 r.p.m.

Q.84 In EDM process the tool and workpiece are separated by
(a) Electrolyte (b) A metal conductor
(c) Dielectric fluid (d) None of the above

Q.85 The equivalent bending moment under combined action of bending moment 'M' and torque 'T' is
(a) $\sqrt{M^2 + T^2}$ (b) $\dfrac{1}{2}\sqrt{M^2 + T^2}$
(c) $M + \sqrt{M^2 + T^2}$ (d) $\dfrac{1}{2}(M + \sqrt{M^2 + T^2})$

Q.86 Lewis equation in gears is used to find the
(a) Bending stress
(b) Tensile stress
(c) Centrifugal stress
(d) Fatigue stress

Q.87 A spring mass system shown in Figure is actuated by a load $P = 0.75 \sin 2t$. If mass of the N block is 0.25 kg and stiffness of the spring is $4\dfrac{N}{m}$, displacement of the block will be



$P = 0.75 \sin 2t$

(a) 0.25 (b) 0.5
(c) 1.0 (d) 2.25

Q.88 Dimensional formula ML^2T^{-3} represents
(a) Work (b) Force
(c) Momentum (d) Power

Q.89 A framed structure is said to be perfect if the following correlation is met between the number of joints 'j' and the number of the members
(a) $m = 2j - 3$ (b) $m = 3j - 3$
(c) $m = 2j - 1$ (d) $m = j - 2$

Q.90 If ratio of excitation and natural frequency of vibration $\dfrac{\omega}{\omega_n} = \sqrt{2}$; the transmissibility of vibration will be
(a) 0.5 (b) 1.0
(c) 1.5 (d) 2.0

Q.91 Which one of the following is the preferred mode of transmission of power from one shaft to another when distance between the shafts is relatively small?
(a) Gears (b) Belts
(c) Ropes (d) Chains

Q.92 If there is a gradual reduction in amplitude of vibration with time, the body is said to be in
(a) Free vibration (b) Forced vibration
(c) Damped vibration (d) Undamped vibration

Q.93 Porter governor is a
(a) Pendulum type governor
(b) Dead weight type governor
(c) Spring loaded governor
(d) Inertia type governor

Q.94 Sensitivity of an isochronous governor is
(a) Zero (b) One
(c) Two (d) Infinity

Q.95 Velocity of the belt for maximum power transmission by the belt and pulley arrangement is

(a) $\sqrt{\frac{T_{max}}{3m}}$ (b) $\sqrt{\frac{T_{max}}{4m}}$

(c) $\sqrt{\frac{T_{max}}{5m}}$ (d) $\sqrt{\frac{T_{max}}{m}}$

Q.96 Which type of gears are used in connecting two coplaner and intersecting shafts?

(a) Spur gear
(b) Bevel gear
(c) Helical gear
(d) Worm and worm wheel

Q.97 Which one of the following does not require a flywheel?

(a) Steam engine (b) Engine driven press
(c) CI engine (d) Gas turbine

Q.98 If 'μ' is the actual coefficient of friction in a belt moving in grooved pulley and groove angle is α. The virtual coefficient of friction will be

(a) $\frac{\mu}{\sin\alpha}$ (b) $\frac{\mu}{\cos\alpha}$

(c) $\mu\sin\alpha$ (d) $\cos\alpha$

Q.99 Magnification factor for a single degree of freedom vibration is expressed by

(a) $\frac{X}{X_{st}} = \frac{1}{\sqrt{(1-r^2)^2 + (2\xi r)^2}}$

(b) $\frac{X}{X_{st}} = \frac{1}{\sqrt{(1-r)^2 + (2\xi r)^2}}$

(c) $\frac{X}{X_{st}} = \frac{1}{\sqrt{1-r^2}}$

(d) $\frac{X_{st}}{X} = \frac{1}{\sqrt{(1-r)^2 - (2\xi r)^2}}$

Q.100 Primary unbalanced force due to inertia of reciprocating parts in a reciprocating engine is given by

(a) $mr\omega^2 \sin$ (b) $mr\omega^2 \cos$

(c) $m\omega^2 r\left(\frac{\sin 2\theta}{n}\right)$ (d) $m\omega^2 r\left(\frac{\cos 2\theta}{n}\right)$

Q.101 The mathematical technique for finding the best use of limited resources in an optimum manner is called

(a) Linear programming
(b) Network analysis
(c) Queueing theory
(d) None of the above

Q.102 For a speed reduction of 50 : 1, which gear arrangement will be used?

(a) Spur gears
(b) Bevel gears
(c) Worm and worm wheel
(d) Herringbone gears

Q.103 For a 20° full depth involute gear teeth system, minimum number of teeth on a pinion is

(a) 12 (b) 14
(c) 16 (d) 18

Q.104 In a spring mass system if one spring of same stiffness is added in series, new frequency of vibration will be

(a) $\frac{\omega_n}{\sqrt{2}}$ (b) ω_n

(c) $\frac{\omega_n}{2}$ (d) $\frac{\sqrt{2}}{\omega_n}$

Q.105 During the dwell period of the cam, the follower

(a) Remains at rest
(b) Moves in a straight line
(c) Moves with uniform speed
(d) Does simple harmonic motion

Q.106 Which one of the following correctively expresses the sensitivity of a governor?

(a) $\frac{N_1 + N_2}{2N_1N_2}$ (b) $\frac{N_1 - N_2}{N_1N_2}$

(c) $\frac{N_1 + N_2}{N_1 - N_2}$ (d) $\frac{N_1 + N_2}{2(N_1 - N_2)}$

Q.107 Which one of the following is electrically most conductive?

(a) Copper (b) Silver
(c) Aluminium (d) Gold

Q.108 A relatively large plate of glass is subjected to a tensile stress of 40 MPa. If specific surface energy and Elastic modulus for glass are 0.3 J/m^2 and 69 GPa, respectively, the maximum length of a surface crack that is possible without fracture is
(a) 4.1 μm (b) 8.2 m
(c) 41 m (d) 82 m

Q.109 In the graphical method of linear programming problem the optimum solution would lie in the feasible polygon at
(a) Its one corner
(b) Its center
(c) The middle of any side
(d) None of the above

Q.110 Coordination number for FCC crystal structure is
(a) 4 (b) 6
(c) 8 (d) 12

Q.111 Atomic packing factor for unit cell of HCP crystal structure is
(a) 0.68 (b) 0.52
(c) 0.74 (d) 0.82

Q.112 Relationship between atomic radius 'R' and unit cell length 'a' for BCC crystal structure is
(a) $a = \frac{4R}{\sqrt{3}}$ (b) $a = 2R\sqrt{2}$
(c) $a = \frac{2R}{\sqrt{3}}$ (d) $a = 3R\sqrt{2}$

Q.113 Which statement is not true in case of martensite?
(a) Crystal structure is BCC
(b) Transformation does not involve diffusion
(c) Grains are plate like or needle like in appearance
(d) It is a non-equilibrium phase

Q.114 Which of the following statements is not true for diamond?
(a) It is hardest known material
(b) Diamond is non-metallic
(c) It has high thermal conductivity
(d) It has a very high electrical conductivity

Q.115 Which one of the following has the highest value of specific stiffness?
(a) Steel
(b) Aluminium
(c) Fibre glass
(d) Carbon fibre composite

Q.116 If a material expands freely due to heating, it will develop
(a) Thermal stresses
(b) Tensile stresses
(c) Compressive stresses
(d) No stresses

Q.117 Crystal lattice structure for mild steel is
(a) Single cubic (b) BCC
(c) FCC (d) HCP

Q.118 In tensile test of mild steel, necking will start
(a) At lower yield stress
(b) At upper yield stress
(c) At ultimate tensile stress
(d) Just before fracture

Q.119 Which medium is used for fastest cooling during quenching of steel?
(a) Air (b) Oil
(c) Water (d) Brine (salt water)

Q.120 Compressive test performed on cast iron will have fracture occurring
(a) Along an oblique plane
(b) Along the axis of load
(c) Perpendicular to the axis of load
(d) None of the above

Q.121 Eutectoid steel consists of
(a) Fully pearlite
(b) Fully Austenite
(c) Ferrite + Pearlite
(d) Cementite + Pearlite

Q.122 Maximum principal strain theory of failure gives satisfactory result for
(a) Brittle materials only
(b) Brittle as well as ductile materials
(c) Ductile materials only
(d) None of the above

Q.123 Property of absorbing large amount of energy before fracture is known as
(a) Ductility (b) Toughness
(c) Elasticity (d) Hardness

Q.124 Which one of the following is weaker than hydrogen bonds?
(a) Ionic bond (b) Vander Waals bond
(c) Covalent bond (d) Metallic bond

Q.125 Increase in ferrite phase in steel leads to increase in
(a) Strength (b) Hardness
(c) Ductility (d) Brittleness

Q.126 Austenite decomposes into ferrite and cementite at a temperature of
(a) 727 °C (b) 1148 °C
(c) 1495 °C (d) 1539 °C

Q.127 Slow plastic deformation in metals under a static load over a period of time is
(a) Fatigue (b) Endurance
(c) Creep (d) Dislocation

Q.128 Which of the following statements is not true for austenitic stainless steels?
(a) They are hardened and strengthened by cold working
(b) They are most corrosion resistant amongst stainless steels
(c) Austenitic phase is extended to room temperature
(d) They are magnetic in nature

Q.129 The crystal structure of alpha iron is
(a) Body centered cubic
(b) Face centered cubic
(c) Hexagonal closed pack
(d) Simple cubic

Q.130 18/8 stainless steel contains
(a) 18% vanadium, 8% chromium
(b) 18% chromium, 8% nickel
(c) 18% tungsten, 8% nickel
(d) 18% tungsten, 8% chromium

Q.131 Important property requirements for tool materials employed for high speed machining are
(a) Impact strength, melting point and hardness
(b) Hot hardness, wear resistance and toughness
(c) Melting point, toughness and shear strength
(d) Shear strength, wear resistance and impact strength

Q.132 Carbon content is highest in
(a) Mild steel
(b) Eutectoid steels
(c) Hypoeutectoid steels
(d) Hypereutectoid steels

Q.133 Principal stress at a point in a plane stressed element are: $\sigma_x = \sigma_y = 500$ N/m^2.
Normal stress on the plane inclined at 45° to x-axis will be
(a) 0 (b) 500 N/m^2
(c) 707 N/m^2 (d) 1000 N/m^2

Q.134 If there are bad effects on strain hardening on a cold formed parts, the part must be
(a) Annealed (b) Tampered
(c) Hardened (d) Normalised

Q.135 Cold working is the process of deforming a metal plastically
(a) At recrystallization temperature
(b) Below recrystallization temperature
(c) Above recrystallization temperature
(d) At annealing temperature

Q.136 Which one of the following materials is most elastic?
(a) Rubber (b) Steel
(c) Aluminium (d) Glass

Q.137 The temperature at which new stress free grains are formed in the metal is called
(a) Critical temperature
(b) Eutectic temperature
(c) Recrystallization temperature
(d) Yield temperature

Q.138 Toughness of steel is increased by adding
(a) Nickel (b) Sulphur
(c) Chromium (d) Tungsten

Q.139 In rolling process, the state of stress of the material undergoing deformation is
(a) Pure compression
(b) Pure shear
(c) Compression and shear
(d) Tension and shear

Q.140 Which one of the following is a point imperfection?
(a) Vacancy (b) Frenkel defect
(c) Schottky defect (d) All of the above

Q.141 Which one of the following is closest to the purest form of iron?
(a) Cast iron (b) Wrought iron
(c) Grey cast iron (d) Mild steel

Q.142 Addition of magnesium to cast iron increases its
(a) Hardness (b) Corrosion resistance
(c) Creep resistance (d) Ductility

Q.143 Which one of the following cannot be recycled?
(a) Thermoplastics (b) Thermosets
(c) Elastomers (d) Polymers

Q.144 The most suitable manufacturing process for machining a turbine blade made of nimonic alloy is
(a) Milling and lapping
(b) Electric discharge machining
(c) Ultrasonic machining
(d) Electro-chemical machining

Q.145 Strain in direction at right angle to the direction of applied force is known as
(a) Lateral strain (b) Shear strain
(c) Volumetric strain (d) None of the above

Q.146 If the diameter of the hole is subjected to considerable variation, for locating in jigs and fixtures, the pressure type locator used is
(a) Conical locator (b) Diamond pin locator
(c) Vee-locator (d) Cylindrical locator

Q.147 Inter electrode gap in electro-chemical grinding is controlled by controlling the
(a) Pressure of electrolyte flow
(b) Applied static load
(c) Size of abrasives in the wheel
(d) Texture of the workpiece

Q.148 Pneumatic comparators work on following theory
(a) Newton's theory (b) Bernouli's theory
(c) Pascal's theory (d) Legendre's theory

Q.149 In machining processes, the percentage of heat generated in shear action is carried away by the chips to the extent of
(a) 10% (b) 25%
(c) 50% (d) 90%

Q.150 For a two dimensional stress system, the coordinates of the centre of Mohr circles are?
(a) $\sigma_x, 0$ (b) $0, \frac{\sigma_x + \sigma_y}{2}$
(c) $\frac{\sigma_x + \sigma_y}{2}, 0$ (d) $\sigma_y, 0$

Q.151 Which of the following is not a limitation for ECM process
(a) Very expensive
(b) Sharp corners are difficult to produce
(c) Surface finish is not good
(d) Use of corrosive media as electrolyte makes it difficult to handle

Q.152 The rate of work material removal in USM operation is proportional to the
(a) Volume of work material removed per impact
(b) Number of particles making impact per cycle
(c) Frequency of vibration
(d) All of the above

Q.153 Which of the following is not the assumption in Merchant's theory
(a) Tool is perfectly sharp
(b) Shear is occurring on a plane
(c) Uncut chip thickness is constant
(d) A continuous chip with built up edge (BUE) is produced

Q.154 Which technique is utilized to find percent idle time for man or machine?
(a) Work sampling (b) Time study
(c) Method study (d) ABC analysis

Q.155 In Electro-chemical machining material removal is due to
(a) Corrosion (b) Erosion
(c) Fusion (d) Ion displacement

Q.156 In simplex method of linear programming the objective row of the matrix consists of
(a) Names of the variables
(b) Coefficient of the objective function
(c) Slack variables
(d) None of the above

Q.157 Which one of the following type of layout is used for the manufacturing of large aircrafts?
(a) Product layout
(b) Process layout
(c) Fixed position layout
(d) Combination layout

Q.158 Which of the following operations does not use a jig?
(a) Turning (b) Drilling
(c) Reaming (d) Tapping

Q.159 The quality of machined surface depends on
(a) The material of the workpiece
(b) Rigidity of machine work-tool system
(c) Cutting conditions
(d) All of the above

Q.160 The tool life of a cutting tool mainly depends on
(a) Cutting speed
(b) Tool geometry
(c) Ambient temperature
(d) None of the above

Q.161 Use of jigs and fixtures leads to
(a) High operational cost
(b) High maintenance cost
(c) High Initial cost
(d) High manufacturing cost

Q.162 For the two shafts connected in parallel, which of the following in each shaft is same?
(a) Torque (b) Shear stress
(c) Angle of twist (d) Torsional stiffness

Q.163 Lee and Shaffer equation showing relationship between rake angle (α) , shear angle (ϕ) and friction angle (β) is expressed as

(a) $\phi = \frac{\pi}{4} + \alpha - \beta$ (b) $\phi = \frac{\pi}{4} + \beta - \alpha$

(c) $\phi = \frac{\pi}{2} + \alpha - \beta$ (d) $\phi = \frac{\pi}{2} + \beta - \alpha$

Q.164 Metal in electro-chemical machining process is removed by
(a) Migration of ions towards the tool
(b) Ionization and shearing
(c) Chemical action and abrasion
(d) Chemical etching

Q.165 In an orthogonal cutting operation, the chip thickness and the uncut thickness are equal 0.45 mm each. If the tool rake angle is 0°, the shear plane angle is
(a) 18° (b) 30°
(c) 45° (d) 60°

Q.166 In a single point turning operation Taylor's exponent is 0.25. If the cutting speed is halved then the tool life will become
(a) Half (b) Two times
(c) Eight times (d) Sixteen times

Q.167 Standardization deals with the characteristics of product that include
(a) Its dimensions
(b) Method of testing the product
(c) Composition and properties of its material
(d) All of the above

Q.168 The critical speed of a shaft is affected by its
1. Eccentricity
2. Span
3. Diameter
Which of the above are correct?
(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

Q.169 Whirling speed of a shaft coincides with the natural frequency of its
(a) Longitudinal vibration
(b) Transverse vibration
(c) Torsional vibration
(d) Coupled bending torsional vibration

Q.170 Experts of same rank assemble for product development in
(a) Delphi technique
(b) Brain storming
(c) Direct expert comparison
(d) Morphological analysis

Q.171 A production line is said to be balanced, if at each station
(a) There is equal number of machine
(b) There is equal number of operators
(c) Waiting time for service is same
(d) Operation time is same

Q.172 When ordering cost is increased to 16 times, the EOQ will be increased to
(a) 2 times
(b) 4 times
(c) 8 times
(d) None of the above

Q.173 Manufacturer's risk is the probability of
(a) Rejecting a good lot which otherwise would have been accepted
(b) Defective batch being accepted which otherwise would have been rejected
(c) Bad components in a lot
(d) None of the above

Q.174 Term "Value" in value engineering refers to
(a) Total cost of the product
(b) Selling price of the product
(c) Utility of the product
(d) Manufacturing cost of the product

Q.175 Which one of the following shows the percentage of the area in normal distribution curve for ±2 limits?
(a) 99.73 %
(b) 95.45 %
(c) 68.26 %
(d) None of the above

Q.176 In sampling, AQL stands for
(a) Average quality level
(b) Acceptable quality level
(c) Asymmetric quality level
d) Available quality level

Q.177 There are 'm' rows and 'n' columns in a transportation problem. Degeneracy will occur if the number of allocations are
(a) Less than $(m + n - 1)$
(b) Greater than $(m + n - 1)$
(c) Equal to $(m + n - 1)$
(d) Less than $(m - n - 1)$

Q.178 C-chart is based on one of the following
(a) Number of defects per unit of a product
(b) Fraction defectives in the sample
(c) Number of defectives in the sample
(d) None of the above

Q.179 TQM is related to
(a) Quality control (b) Control chart
(c) Sampling (d) Work study

Q.180 The point of contraflexure occurs in
(a) Cantiliver beams
(b) Simply supported beams
(c) Overhanging beams
(d) Fixed beams

■■■■

Answers UPPSC-AE Paper-I : 2013

1.	(b)	2.	(a)	3.	(d)	4.	(d)	5.	(c)	6.	(a)	7.	(a)	8.	(b)
9.	(c)	10.	(d)	11.	(b)	12.	(a)	13.	(d)	14.	(a)	15.	(c)	16.	(d)
17.	(b)	18.	(d)	19.	(b)	20.	(b)	21.	(b)	22.	(b)	23.	(b)	24.	(c)
25.	(b)	26.	(b)	27.	(b)	28.	(d)	29.	(c)	30.	(d)	31.	(c)	32.	(b)
33.	(c)	34.	(a)	35.	(*)	36.	(d)	37.	(a)	38.	(d)	39.	(d)	40.	(b)
41.	(a)	42.	(d)	43.	(d)	44.	(b)	45.	(b)	46.	(b)	47.	(d)	48.	(b)
49.	(c)	50.	(d)	51.	(d)	52.	(c)	53.	(b)	54.	(c)	55.	(d)	56.	(a)
57.	(c)	58.	(c)	59.	(a)	60.	(c)	61.	(d)	62.	(b)	63.	(c)	64.	(a)
65.	(c)	66.	(b)	67.	(b)	68.	(b)	69.	(c)	70.	(a)	71.	(b)	72.	(b)
73.	(b)	74.	(d)	75.	(b)	76.	(d)	77.	(a)	78.	(d)	79.	(a)	80.	(c)
81.	(b)	82.	(b)	83.	(d)	84.	(c)	85.	(d)	86.	(d)	87.	(a)	88.	(d)
89.	(a)	90.	(b)	91.	(a)	92.	(c)	93.	(b)	94.	(d)	95.	(a)	96.	(b)
97.	(a)	98.	(a)	99.	(a)	100.	(b)	101.	(a)	102.	(c)	103.	(d)	104.	(c)
105.	(a)	106.	(d)	107.	(a)	108.	(*)	109.	(a)	110.	(d)	111.	(c)	112.	(a)

113. (a)	**114.** (d)	**115.** (b)	**116.** (d)	**117.** (b)	**118.** (c)	**119.** (d)	**120.** (a)
121. (c)	**122.** (a)	**123.** (b)	**124.** (b)	**125.** (c)	**126.** (a)	**127.** (c)	**128.** (d)
129. (a)	**130.** (b)	**131.** (b)	**132.** (d)	**133.** (b)	**134.** (a)	**135.** (b)	**136.** (b)
137. (c)	**138.** (a)	**139.** (c)	**140.** (d)	**141.** (b)	**142.** (d)	**143.** (b)	**144.** (d)
145. (a)	**146.** (b)	**147.** (c)	**148.** (b)	**149.** (d)	**150.** (c)	**151.** (c)	**152.** (d)
153. (d)	**154.** (a)	**155.** (d)	**156.** (b)	**157.** (c)	**158.** (a)	**159.** (d)	**160.** (a)
161. (c)	**162.** (c)	**163.** (a)	**164.** (a)	**165.** (c)	**166.** (d)	**167.** (d)	**168.** (c)
169. (b)	**170.** (b)	**171.** (d)	**172.** (b)	**173.** (a)	**174.** (c)	**175.** (b)	**176.** (b)
177. (a)	**178.** (a)	**179.** (a)	**180.** (c)				

Explanations

1. (b)

In conventional forming, inertia is neglected as the velocity of forming is typically less than 5 m/s whereas typically high velocity forming operations are carried out at workpiece velocities of about 100 m/s.

2. (a)

The X-bar chart is used to monitor the sample means of a variable that results from a particular process.

3. (d)

$$\text{EOQ} = \sqrt{\frac{2DC_0}{C_c}}$$

$D' = 2D;\ C_0' = \dfrac{C_0}{2}$

$$\text{EOQ}' = \sqrt{\frac{2 \times 2D \times C_0}{2 \cdot C_c}}$$

$$\text{EOQ}' = \sqrt{\frac{2DC_0}{C_c}}$$

$$\text{EOQ} = \text{EOQ}'$$

4. (d)

Number of spark plugs = 300

Time duration = 8 hours

Standard time per piece = 1.5 minutes

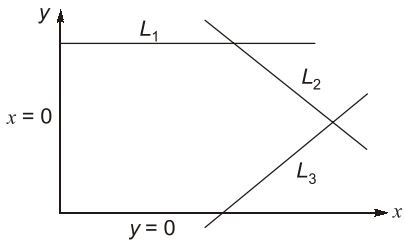
Time required to produce spark plug

$$= \frac{8 \times 60}{300} = 1.6 \text{ minutes}$$

$$\text{Productivity} = \frac{1.5}{1.6} = \frac{15}{16}$$

5. (c)

Constraints 3, the feasible region is surrounded by more two lines x-axis and y-axis.



7. (a)

Given data:

D = 3200 parts, Cu = Rs.6, Co = Rs.150

Ch = 24% per annum = 0.25 × 6 = Rs. 1.5

$$\text{EOQ} = \sqrt{\frac{2DC_o}{Ch}} = \sqrt{\frac{2 \times 3200 \times 150}{1.5}}$$

$$= 800 \text{ units}$$

$$\text{Number of orders} = \frac{3200}{800} = 4$$

8. (b)

$$\text{Utilization factor} = \frac{\text{Mean arrival rate}}{\text{Mean service rate}}$$

13. (d)

$$EOQ = \sqrt{\frac{2DC_o}{C_c}}$$

14. (a)

In ABC analysis, items are classified in categories based on their usage value.

15. (c)

Control limits of $\bar{X}$ chart $\rightarrow \bar{\bar{X}} \pm 3\sigma$.

16. (d)

Transportation problem can be solved by

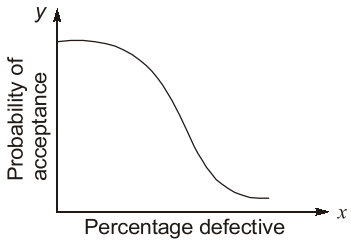
1. Northwest corner method
2. Least cost method
3. Vogel's approximation method

18. (d)

Control charts for attributes

1. p chart
2. np chart
3. c chart
4. u chart

20. (b)



22. (b)

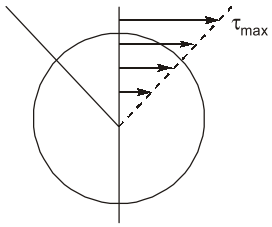
$$E = 2G(1 + \mu)$$

E = Elastic moduli; μ = Poisson's ratio

G = Shear moduli

24. (c)

Shear stress distribution for a circular shaft under torsion is,



30. (d)

$$\tau_{max} = 140 \text{ MPa}$$
$$\sigma_{max} = 140 \text{ MPa}$$

31. (c)

$D = 10$ cm, $d = 5$ cm

Torsional section modulus of shaft,

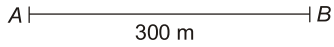
$$z = \frac{\pi(D^4 - d^4)}{16D}$$

$$= \frac{\pi}{16}\frac{(10^4 - 5^4)}{10} = 184 \text{ cm}^3$$

32. (b)

Given, $V_A = V_B = 15$ m/s, $a_n = 6$ m/s^2

Suppose affect time t, the car A reaches the car B, then distance travelled by B i.e., X_B and the distance by A i.e., X_A



$$X_A = X_B + 300$$
$$\therefore \quad 300 + 15t = 15t + 3t^2$$
$$3t^2 = 300$$
$$t = 10 \text{ sec}$$

33. (c)

Distance travelled by ball in time t is $\frac{1}{2}9t^2$.

Separation; $s = \frac{1}{2}9t_1^2 - \frac{1}{2}9t_2^2$

$t_1 = 3$ sec, $t_2 = 2$ sec

$$s = \frac{1}{2} \times 10 \times (3^2 - 2^2)$$
$$= 5 \times 5 = 25 \text{ m}$$

34. (a)

$m = 2$ kg, $V_1 = 20$ m/s, $V_2 = 10$ m/s

$$\text{Impulse} = mV_f - mV_i$$
$$= mV_2 - mV_1$$
$$= 2 \times (10 - 20) = 20$$

35. (*)

$$\text{KE} = \frac{1}{2}Iw^2 + \frac{1}{2}IV^2$$
$$= \frac{1}{2}\left(\frac{2r^2}{2}\right)w^2 + \frac{1}{2}m(rw)^2$$
$$= \frac{mr^2w^2}{4} + \frac{mr^2w^2}{2}$$
$$\text{KE} = \frac{3mr^2w^2}{4}$$

No option available.

39. (d)

$$\sigma_x = \sigma_y = \sigma,$$
$$\tau \times y = 0$$

$$\sigma = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau \times y \cdot \sin 2\theta$$

$$\theta = 45^\circ$$
$$\sigma_N = \sigma$$

42. (d)

Eulers buckling load $(P) = \dfrac{\pi^2 EI}{le^2}$

$$I = \frac{\pi d^4}{64}$$

$$p \propto d^4$$

$$\frac{p_1}{p_2} = \left(\frac{d_1}{d_2}\right)^4$$

$$d_2 = 0.8 d_1$$

$$\therefore \quad \frac{p_1}{p_2} = \left(\frac{d_1}{0.8 d_1}\right)^4$$

$$0.4096 p_1 = p_2$$

Percentage reduction in Euler's buckling load

$$= \frac{p_1 - p_2}{p_1} \times 100 = 59.04\%$$

44. (b)

Equivalent length for the column with fixed at both ends $\dfrac{l}{2}$.

46. (b)

Coriolis component of acceleration = $2v\omega$
where, ν = linear velocity; ω = angular velocity

48. (b)

The body start moving when applied force is more than the limiting frictional force.

51. (d)

If $n = 2j - 3$, then frame is perfect frame,
If $n > 2j - 3$, then frame is redundant frame,
If $n < 2j - 3$, then frame is deficient frame,
where n = number of member, j = number of joints

53. (b)

$$\text{Longitudinal strain} = \frac{\text{Change in length}}{\text{Original length}}$$

55. (d)

The principle of transmissibility of forces states that the point of application of forces can be moved anywhere along its line of action without changing the external reaction forces on a rigid body.

57. (c)

Compressive critical load $(p) = \dfrac{\pi^2 EI}{le^2}$

For a long column fixed at both ends, $(le)_1 = \dfrac{l}{2}$

For a column with one end fixed and other end being free, $(le)_2 = 2l$

$$p \propto \frac{l}{le^2}$$

$$\frac{p_1}{p_2} = \left(\frac{le_2}{le_1}\right)^2$$

$$\frac{p_1}{p_2} = \left(\frac{2le_2}{l/2}\right)^2$$

$$\frac{p_1}{p_2} = 8$$

58. (c)

Elongation of bar under its own weight,

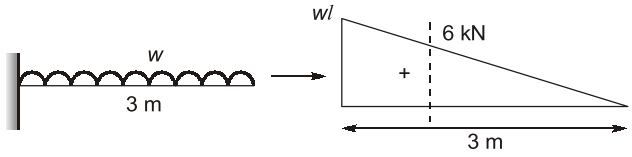
$$\delta_1 = \frac{wl}{2AE}$$

Elongation of bar subjected to direct axial load,

$$\delta_2 = \frac{wl}{AE}$$

$$\therefore \delta_2 = 2\delta_1, \qquad \delta_1 = \frac{\delta_2}{2}$$

60. (c)



Shear force diagram

$$\frac{wl}{3} = \frac{6}{1.5}, \qquad l = 3$$

$$w = \frac{6}{1.5} = 4 \text{ kN/m}$$

61. (d)

$$E = 2G(1 + \mu)$$

$$E = 3K(1 + 2\mu)$$

$$\frac{E}{2G} - 1 = \mu$$

$$\frac{E}{3K} = 1 - 2\mu$$

$$1 - \frac{E}{3K} = 2\mu$$

$$\frac{3K-E}{6K} = \mu$$

$$\frac{E-2G}{2G} = \frac{3K-E}{6K}$$

$$6EK - 12GK = 6GK - 2GE$$

$$\therefore \quad E = \frac{18GK}{6K+2G}$$

$$E = \frac{9GK}{3K+G}$$

62. (b)

$E = 120$ GPa, $G = 50$ GPa

$$E = 2G(1+\mu)$$
$$120 = 2\times 50(1+\mu)$$
$$1.2 = 1+\mu$$
$$\mu = 0.2$$

63. (c)

For a simply supported beam of length 'l' with point load of w has deflection at centre equal to

$$\delta = \frac{Wl^3}{48EI}$$

64. (a)

According to equation of motion,

$$x = ut + \frac{1}{2}at^2$$

here, $u = 0$, $g = a = 9.81$ m/s^2

Let, $x = \frac{h}{2}$, $t = 2$ sec

$$\therefore \quad \frac{h}{2} = \frac{1}{2}\times 9.81\times 4$$
$$\therefore \quad h = 4\times 9.81 = 39.24 \text{ m}$$
$$\therefore \quad 39.24 = \frac{1}{2}\times 9t^2$$
$$\therefore \quad \frac{39.24\times 2}{9.81} = t^2$$
$$t = 2.8 \text{ sec}$$

65. (c)

$$\text{KE} = \frac{1}{2}mV^2$$
$m = ?$
$V = 1$ m/s
$$1.5 = \frac{1}{2}\times m\times 1$$
$$m = 3 \text{ kg}$$

66. (b)

Maximum height attained by the particle

$$H = \frac{u^2\cdot\sin^2\theta}{2g}$$

Horizontal range, $R = \frac{u^2\cdot\sin 2\theta}{g}$

As per given condition,

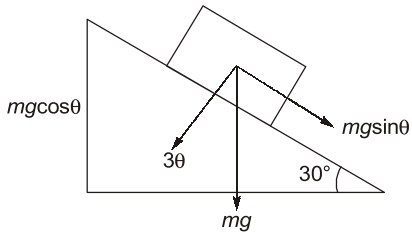
$$H = \frac{R}{4}$$
$$\frac{u^2\cdot\sin^2\theta}{2g} = \frac{u^2\cdot\sin 2\theta}{g}$$
$$2\sin^2\theta = \sin 2\theta$$
$$2\sin^2\theta = 2\sin\theta\cdot\cos\theta$$
$$\tan\theta = 1$$
$$\theta = 45^\circ$$

67. (b)

$m = 0.03$ kg, $V = 400$ m/s, $X = 12$ cm

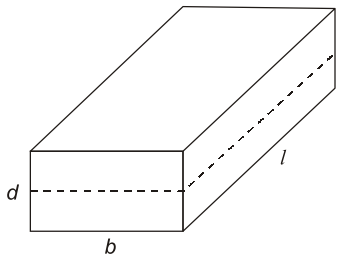
$$V^2 = u^2 + 2as$$
$$0 = 400^2 + 2\times a\times(0.12)$$
$$a = \frac{-200000}{3} \text{ m/s}^2$$
$$F = m\cdot a$$
$$F = 0.03\times\frac{2000000}{3} = 20 \text{ kN}$$

68. (b)



$$\mu = \tan\theta$$
$$\mu = \tan 30$$
$$\mu = 0.578$$

69. (c)



Shearing area $= l\times b$

73. (b)

Centre distance = 200 mm

Gear ratio = 3 : 1

$$T_p = 20, \qquad \frac{T_p}{T_g} = \frac{w_g}{w_p} = \frac{1}{3}$$

$$3T_p = T_g, \qquad T_g = 60$$

$$m(T_p + T_g) = 200 \times 2 = 400$$

$$m = \frac{400}{60+20} = \frac{400}{80} = 5 \text{ mm}$$

77. (a)

$T_1 = 700$ N, $T_2 = 400$ N, $V = 5$ m/s

$$P = (T_1 - T_2) \cdot V$$

$$= (700 - 400) \times 5$$

$$= 300 \times 5 = 1500 \text{ W} = 1.5 \text{ kW}$$

82. (b)

If R and r are base raddi of two involute gear, and pressure angle ϕ,

$$\text{Centre distance} = \frac{(R+r)}{\cos\phi}$$

83. (d)

$Ne = 150$ rpm, $Ns = ?$ $de = 55$ cm, $ds = 33$ cm

$$\frac{ds}{de} = \frac{Ne}{Ns}$$

$$\frac{33}{55} = \frac{150}{N_s}$$

$$N_s = 250 \text{ rpm}$$

85. (d)

Equivalent bending moment under combined action of bending moment 'M' and torque T is,

$$= \frac{1}{2}(M + \sqrt{M^2 + T^2})$$

87. (a)

$P = 0.75\sin 2t$; $K = 4$ N/m, $m = 0.25$ kg

$$\omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{4}{0.25}} = 4 \text{ rad/s}$$

$$\omega = 2 \text{ rad/s}$$

$$\frac{\omega}{\omega_n} = \frac{2}{4} = \frac{1}{2}$$

$$A = \frac{F_0/K}{1-\left(\frac{\omega}{\omega_n}\right)^2} = \frac{0.75/4}{1-\left(\frac{1}{2}\right)^2}$$

$$= \frac{0.75}{4 \times 0.75} = 0.25 \text{ units}$$

88. (d)

Work $\rightarrow [ML^2T^{-2}]$

Force $\rightarrow [ML^1T^{-2}]$

Momentum $\rightarrow [M^1L^1T^{-1}]$

Power $\rightarrow [M^1L^2T^{-3}]$

89. (a)

Number of joints = j

Number of members = m

A framed structure is said to be perfect,

$$m = 2j - 3$$

90. (b)

Value of $\frac{\omega}{\omega_n} = \sqrt{2}$

Formula for transmissibility, ($\varepsilon = 0$)

$$\varepsilon = \pm \frac{1}{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]} = 1$$

When no damper is used.

94. (d)

$$\text{Sensitivity of governor is given by} = \frac{\text{Mean speed}}{\text{Range speed}}$$

For isochronous governor, range of speed is zero. Hence sensitivity is infinitely.

95. (a)

Velocity of the belt for maximum power transmission by the belt and pulley arrangement,

$$= \sqrt{\frac{T_{max}}{3m}}$$

98. (a)

$$\text{Virtual coefficient friction} = \frac{\mu}{\sin\alpha}$$

99. (a)

$$\text{Magnification factor} = \frac{X}{X_{st}} = \frac{1}{\sqrt{(1-r^2)^2 + (2\xi r)^2}}$$

100. (b)

Primary unbalanced force $m r \omega^2 \cos$

103. (d)

Minimum number of teeth on a pinion,

$$= \frac{2}{\sin^2\theta}, \quad \theta = 20°$$

$$= \frac{2}{\sin^2 2\theta} \approx 17.09 \approx 18$$

104. (c)

For series connection,

$$\frac{1}{K_{eq}} = \frac{1}{K} + \frac{1}{K} = \frac{2}{K}$$

$$K_{eq} = \frac{K}{2}$$

$$\omega_n' = \sqrt{\frac{K'}{m'}} = \sqrt{\frac{K}{2 \times 2m}}$$

$$= \frac{1}{2}\sqrt{\frac{K}{m}} = \frac{\omega_n}{2}$$

106. (d)

$$\text{Sensitivity of governor} = \frac{\text{Mean speed}}{\text{Range speed}}$$

$$= \frac{N_1 + N_2}{2(N_1 - N_2)}$$

108. (*)

$$\sigma_c = \left(\frac{2E\gamma_s}{\pi a}\right)^{1/2}$$

$$40 \times 10^6 = \left(\frac{2 \times 69 \times 10^9 \times 0.3}{\pi \times n}\right)^{1/2}$$

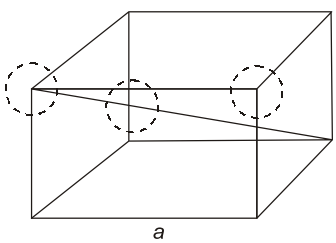
$$a = 8.2 \times 10^6 \text{ m} = 8.2 \ \mu\text{m}$$

112. (a)

For BCC crystal structure,

$$4R = \sqrt{3}\, a$$

$$a = \frac{4R}{\sqrt{3}}$$



113. (a)

Crystal structure of martensite is BCT.

115. (b)

$$\text{Specific stiffness} = \frac{\text{Young modulus}}{\text{Density}}$$

127. (c)

Creep of materials is defined as time dependent deformation under a fixed stress at an elevated temperature roughly 0.5 T_m, where T_m is the absolute melting temperature.

128. (d)

Austenitic stainless steel are not magnetic in nature.

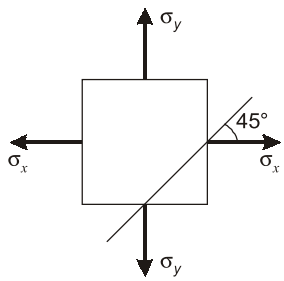
130. (b)

In 18/8 stainless steel - 18% chromium, 8% nickel.

132. (d)

Mild steel $\rightarrow$ C < 0.3%
Eutectoid steels $\rightarrow$ C – 0.8%
Hypoeutectoid steels $\rightarrow$ C < 0.8%
Hypereutectoid steels $\rightarrow$ C > 0.8%

133. (b)



$$\sigma = \left[\frac{\sigma_x + \sigma_y}{2}\right] + \left[\frac{\sigma_x - \sigma_y}{2}\right]\cos 2\theta + \tau_{xy} \sin 2\theta$$

$$\sigma = \frac{500 + 500}{2} = 500 \text{ N/m}^2$$

135. (b)

At or above recrystallization temperature, grain refinement takes place. So cold working is done below recrystallization temperature.

137. (c)

Recrystallization temperature: It is the minimum temperature at which plastically deformed material from new grains at specified time.

Recrystallization temperature = $\frac{1}{3}$ to $\frac{1}{2}$ of melting temperature in Kelvin.

140. (d)

Point imperfection are:

(i) Vacancy defect
(ii) Schottky defect
(iii) Substitutional impurity
(iv) Interstitial impurity

142. (d)

Addition of magnesium to cast iron increases its ductility and strength in tension.

143. (b)

Thermosets polymer cannot be recycled.

145. (a)

Strain in direction of load - Longitudinal strain,
Strain transverse to applied load - Lateral strain

146. (b)

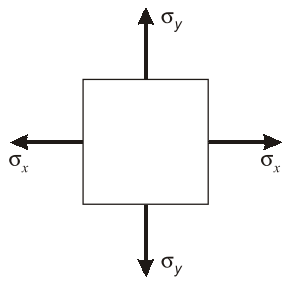
If dimensions variation between center to center distance of holes, diamond pin locator is used.

148. (b)

The pneumatic comparator are working based on the Bernoulis theory.

150. (c)

For two dimensional stress system.

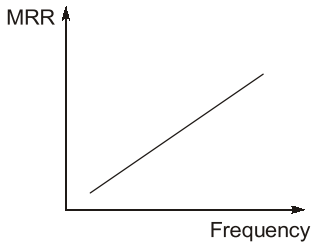


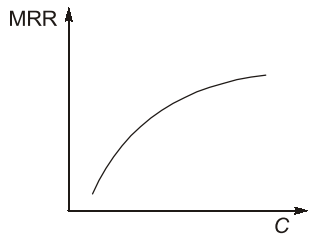
Center of Mohr circle, $\left[\frac{\sigma_x + \sigma_y}{2},\ 0\right]$

151. (c)

Surface finish is good in ECM process - Surface finishes of up to R_a 0.05 μm.

152. (d)





C = volume concentration of abrasive in water slurry.

153. (d)

A continuous chip without any BUE is produced.

155. (d)

ECM is a subtractive method that work on principle of anodic metal dissolution (ion exchange).

158. (a)

Other threes are hole making procedure, so they require jigs.

160. (a)

From Taylor's equation

$$VT^n = C$$

where, V = Cutting seed, T = Tool life,
C, n = Constants

161. (c)

Jigs and fixture arrangement is done at the start of manufacturing, so it gives high initial cost.

163. (a)

According to Lee and Shaffer equation,

$$\phi = \frac{\pi}{4} + \alpha - \beta$$

where, ϕ = shear angle, α = rake angle
β = friction angle

164. (a)

Electrochemical machining (ECM) is the controlled removal of metal by anodic dissolution in an electrolytic cell in which the workpiece is the anode and the tool is the cathode.

165. (c)

We know that,

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha}$$

$$r = \frac{t}{t_c} = 1$$

$$\alpha = 0$$

$$\tan\phi = \frac{1\cos 0^\circ}{1 - 1\sin 0^\circ} = 1$$

$$\phi = 45^\circ$$

166. (d)

From Taylor's equation,

$$VT^n = C$$

$$V_1T_1^n = V_2T_2^n$$

$$V_1T_1^n = \frac{V_1}{2}(T_2)^n$$

$$\left(\frac{T_2}{T_1}\right)^n = 2$$

$$\frac{T_2}{T_1} = (2)^{1/n} = (2)^4 = 16$$

168. (c)

Natural frequency,

$$\omega_n = \sqrt{\frac{g}{\Delta}} = \sqrt{\frac{g \times 48 \times E \times I}{mg \times L^3}}$$

$$= \sqrt{\frac{48 \times E \times I}{mL^3}}$$

$$\omega_n \propto \sqrt{I} \text{ and } \omega_n \propto \frac{1}{\sqrt{L_3^3}}$$

171. (d)

A production line is said to be in balance when every worker's task takes the same amount of time.

172. (b)

We know that,

$$EOQ = \sqrt{\frac{2 \times D \times C_0}{C_h}}$$

$$EOQ \propto \sqrt{C_0}$$

$$\frac{EOQ_1}{EOQ_2} = \frac{\sqrt{C_{01}}}{\sqrt{C_{02}}} = \frac{\sqrt{1}}{\sqrt{16}} = \frac{1}{4}$$

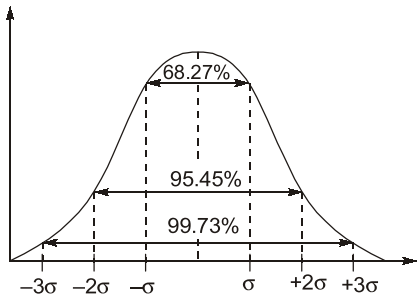
$$EOQ_2 = 4 \times EOQ_1$$

174. (c)

$$\text{Value} = \frac{\text{Function}}{\text{Cost}}$$

It defines the utility of the product.

175. (b)



176. (b)

AQL = Acceptable quality level

179. (a)

TQM = Total quality management

■■■■