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# UPPSC-2021

UTTAR PRADESH

PUBLIC SERVICE COMMISSION 2021

## Assistant Engineer

# Mechanical Engineering

## PAPER-II

Exam held on 29-05-2022

Scroll down for
Questions and Answer Keys

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# UPPSC - 2021

## Mechanical Engineering | Assistant Engineer

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**Q.1** Which of the following are the exclusive powers of the Lok Sabha ?

1. To introduce the Money Bill.
2. To ratify the declaration of emergency.
3. To pass a motion of no confidence against the Council of Ministers.
4. To impeach against the President.

Choose the correct answer from the code given below:

Codes:

(a) 1 and 3 (b) 1 and 4
(c) 3 and 4 (d) 2 and 3

**Ans. (a)**

**Q.2** Which of the following sea is situated between Philippines and Vietnam ?

(a) Philippines Sea
(b) Celebes Sea
(c) South China Sea
(d) East China Sea

**Ans. (c)**

**Q.3** The provision for Anti Defection Act is mentioned in which of the following Schedules of the Constitution of India ?

(a) $9^{th}$ (b) $12^{th}$
(c) $11^{th}$ (d) $10^{th}$

**Ans. (d)**

**Q.4** With reference to the Vikramshila University which of the following statements is/are correct?

1. Vikramshila was one of the most important centre of learning in India during the Pala period.
2. Rakshit, Virochan, Ateesh, Deepankar and Ratnakar Shanti were very important Acharya of Vikramshila University.

Select the correct answer using the code given below:

Code :

(a) Only 1 (b) Neither 1 nor 2
(c) Both 1 and 2 (d) Only 2

**Ans. (c)**

**Q.5** What was the theme of the $40^{th}$ Indian International Trade Fair held in November, 2021?

(a) Atmanirbhar Bharat
(b) Vocal for Local
(c) Is of Doing Business
(d) None of the above

**Ans. (a)**

**Q.6** With reference to National Ayurveda Day 2021, which of the following statement is/are correct?

1. It was celebrated on $23^{rd}$ October, 2021.
2. It's theme was 'Ayurveda for Poshan'.

Select the correct answer from the code given below:

(a) 1 only (b) Neither 1 nor 2
(c) both 1 and 2 (d) 2 only

**Ans. (d)**

**Q.7** In which of the following Puranas, the five characteristics of the Puranas are mentioned ?

(a) Vaman (b) Matsya
(c) Vayu (d) Vishnu

**Ans. (b)**

**Q.8** By which Constitutional Amendment 'Part IX B' was added in the Indian Constitution ?

(a) $52^{nd}$ Constitutional Amendment
(b) $97^{th}$ Constitutional Amendment
(c) $93^{rd}$ Constitutional Amendment
(d) $73^{rd}$ Constitutional Amendment

**Ans. (b)**

**Q.9** Which one of the following States is a leading producer of diamonds in India?

(a) Telangana (b) Karnataka
(c) Madhya Pradesh (d) Odisha

**Ans.** (c)

**Q.10.** In India, the voting age was lowered from 21 to 18 years by which of the following Constitutional Amendment ?
(a) $56^{th}$ (b) $88^{th}$
(c) $72^{nd}$ (d) $61^{st}$

**Ans.** (d)

**Q.11** Knock-Knee syndrome results due to Pollution of
(a) Heavy metal (b) Phosphate
(c) Fluorides (d) Nitrate

**Ans.** (c)

**Q.12** Baltic Republics do NOT include which of the following ?
1. Denmark 2. Estonia
3. Finland 4. Latvia

Select the correct answer using the code given below.
**Code:**
(a) 1 and 2 (b) 2 and 4
(c) 2 and 3 (d) 1 and 3

**Ans.** (d)

**Q.13** Which French traveller called Kashi as 'Athens of India'.
(a) Thevenot (b) Manucci
(c) Tavernier (d) Bernier

**Ans.** (d)

**Q.14** Which of the following App is introduced by the Election Commission of India in October, 2021 for digital mapping of all polling stations?
(a) Arjun App (b) Chatbot App
(c) Trishul App (d) Garuda App

**Ans.** (d)

**Q.15** Match **List-I (Blue Flag Certified Beach)** with **List-II (Location)** and select the correct answer using the code given below.

| List-I | List-II |
|---|---|
| A. Ghoghla | 1. Andhra Pradesh |
| B. Kasarkod | 2. Kerala |
| C. Kappad | 3. Karnataka |
| D. Rushikonda | 4. Diu |

**Code:**

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

**Ans.** (b)

**Q.16** Match **List-I (Code)** with **List-II (Year of Introduction)** and select the correct answer using the code given below.

| List-I | List-II |
|---|---|
| A. Code of Civil Procedure | 1. 1862 |
| B. Indian Penal Code | 2. 1859 |
| C. Criminal Procedure Code | 3. 1861 |
| D. Police Act | 4. 1860 |

**Code:**

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

**Ans.** (a)

**Q.17** Which of the following pairs represent units of the same physical quantity.
(a) Kelvin and Joule
(b) Newton and Calorie
(c) Kelvin and Calorie
(d) Joule and Calorie

**Ans.** (d)

**Q.18** Which of the following Article makes provision that "the law declared by the Supreme Court shall be binding on all the Courts within the territory of India"?
(a) Article 140 (b) Article 143
(c) Article 142 (d) Article 141

**Ans.** (d)

**Q.19** With reference to Delhi Sultanate consider the following statements.

1. Sultangarhi was built by Sultan Iltutmish.
2. Located in Delhi, it is the first tomb built by Turks.

Select the correct answer using the code given below :

**Code:**

(a) Only 1
(b) Neither 1 nor 2
(c) Both 1 and 2
(d) Only 2

**Ans.** (c)

**Q.20** In which of the following States of India 'Chitrakote waterfall' is located?

(a) Uttar Pradesh (b) Jharkhand
(c) Chhattisgarh (d) Madhya Pradesh

**Ans.** (c)

**Q.21** Who among the following is the Chairperson of GST Council?

(a) President
(b) Deputy Chairman of NITI Ayog
(c) Union Finance Minister
(d) Prime Minister

**Ans.** (c)

**Q.22** What is the rank of India in 'Global Food Security Index, 2021'?

(a) 54 (b) 83
(c) 71 (d) 62

**Ans.** (c)

**Q.23** In the battle of Chandawar (1194 CE) King Jaichand was defeated by Muhammad Gori. Present geographical location of Chandawar is

(a) Etawah district in U.P. at the bank of river Yamuna
(b) Varanasi, U.P. at the bank of river Ganga
(c) Kannauj, U.P. at the bank of river Yamuna
(d) Prayagraj district in U.P. at the bank of river Yamuna

**Ans.** (a)

**Q.24** Match **List-I** with **List-II** and select the correct answer using the code given below.

| List-I | List-II |
|---|---|
| A. Acetic acid | 1. Ant's sting |
| B. Lactic acid | 2. Spinach |
| C. Formic acid | 3. Vinegar |
| D. Oxalic acid | 4. Curd |

**Code:**

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

**Ans.** (b)

**Q.25** Which one of the following is NOT correctly matched?

(a) Shaukat Usmani – Kanpur Conspiracy Case
(b) Khudiram Bose – Assembly Bomb case
(c) Ashfaqullah Khan – Kakori Train Robbery Case
(d) Surya Sen – Chatgaon Revolt Case

**Ans.** (b)

**Q.26** Maximum deflection of a cantilever beam of length L, carrying uniformly distributed load W per unit length is

[Where, E is the modulus of elasticity of the beam material and $I$ is moment of inertia of cross section of beam]

(a) $\frac{WL^4}{8EI}$ (b) $\frac{WL^4}{EI}$

(c) $\frac{WL^4}{384EI}$ (d) $\frac{WL^4}{4EI}$

**Ans.** (a)

**Q.27** An actuator having a stem movement of full travel of 30 mm mounted with a control valve having an equal percentage plug and with minimum flow rate of 2 $m^3/s$ and maximum flow rate of 24 $m^3/s$. When the steam movement is 10 mm, the flow rate will be

(a) 4.2 $m^3/s$ (b) 3.4 $m^3/s$
(c) 4.6 $m^3/s$ (d) 3.8 $m^3/s$

**Ans.** (c)

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|---|---|
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| EC : 16th June, 2022 | ME : 16th June, 2022 |
| ME : 16th June, 2022 | EE : 16th June, 2022 |
| EE : 16th June, 2022 | EC : 16th June, 2022 |
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**Q.28** Grinding ratio is defined as

(a) $\dfrac{\text{Cutting speed}}{\text{Feed}}$

(b) $\dfrac{\text{Volume of wheel wear}}{\text{Volume of material removed from work piece}}$

(c) $\dfrac{\text{Longitudinal feed}}{\text{Transverse feed}}$

(d) $\dfrac{\text{Volume of material removed from work piece}}{\text{Volume of wheel wear}}$

**Ans.** **(d)**

**Q.29** Which of the following expression is used as Wahl's factor for design of closed coiled helical springs?
[Where $c$ is spring index]

(a) $\dfrac{4c-4}{4c-1}+\dfrac{0.615}{c}$

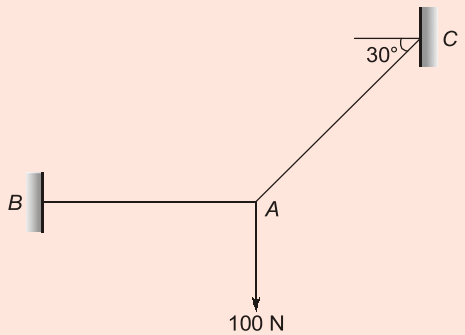
(b) $\dfrac{4c-4}{4c-1}$

(c) $\dfrac{4c-1}{4c-4}$

(d) $\dfrac{4c-1}{4c-4}+\dfrac{0.615}{c}$

**Ans.** **(d)**

**Q.30** Force in the cable AB shown in the below figure is




(a) $200\sqrt{3}$ N (b) $100\sqrt{3}$ N

(c) $\dfrac{200}{\sqrt{3}}$ N (d) $\dfrac{100}{\sqrt{3}}$ N

**Ans.** **(b)**

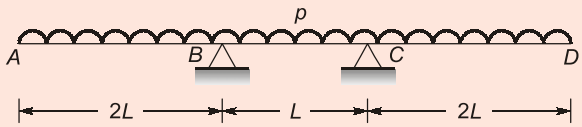
**Q.31** A planar mechanism has 8 links and 10 rotary joints. The number of degrees of freedom of mechanism using Grubler's criterion is

(a) 2 (b) 0

(c) 3 (d) 1

**Ans.** **(d)**

**Q.32** Beam ABCD as shown in the figure is loaded by UDL of intensity $p$ over entire length. The point of contraflexrure will




(a) Not occur in the beam

(b) Occur at B and C

(c) Occur at mid points of AB and CD

(d) Occur at mid point of B and C

**Ans.** **(a)**

**Q.33** A body of mass 10 kg moving with a velocity of 1 m/s is acted upon by a force of 50 N for two seconds. The final velocity will be

(a) $\sqrt{21}$ m/s (b) 22 m/s

(c) 11 m/s (d) 1 m/s

**Ans.** **(c)**

**Q.34** 'Gantt charts" are used for

(a) Linear programing

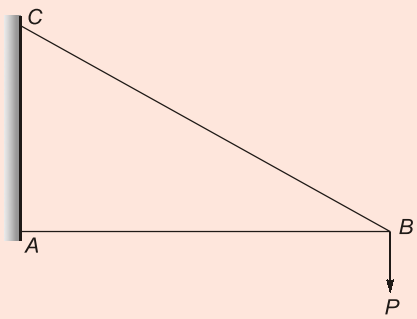
(b) Production scheduling

(c) Forecasting sales

(d) Scheduling and routing

**Ans.** **(d)**

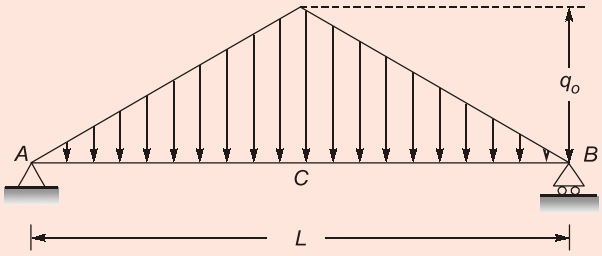
**Q.35** Two bars AB and BC, each of negligible mass support a load P as shown in figure. In this arrangement.



(a) None of the bars AB and BC is subjected to bending.
(b) Bar AB is subjected to bending but bar BC is not subjected to bending.
(c) Both AB and BC are subjected to bending.
(d) Bar AB is not subjected to bending but bar BC is subjected to bending.

**Ans.** (a)

**Q.36** C is the middle point of a simply supported beam at A and B, loading on the beam is uniformly varying loading with maximum intensity of loading $q_o$ at C. Choose the correct option from the following.




(a) C is a point of inflexion
(b) SF is maximum at C
(c) Slope of the deflection curve is maximum at C.
(d) BM is maximum at C.

**Ans.** (d)

**Q.37** Consider the following statements:
The form factor of spur gear tooth depends upon the
1. Number of teeth
2. Pressure angle
3. Addendum modification coefficient
4. Circular pitch

Of the above statements:
(a) 1, 2 and 3 are correct
(b) 1 and 3 are correct
(c) 1 and 4 are correct
(d) 2 and 4 are correct

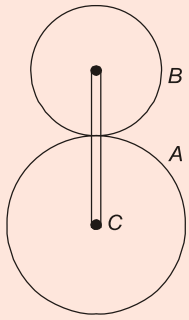
**Ans.** (a)

**Q.38** With a solidification factor of $0.97 \times 10^6$ s/m$^2$, the solidification time in seconds for a spherical casting of 200 mm diameter is

(a) 4311 second
(b) 539 second
(c) 3233 second
(d) 1073 second

**Ans.** (d)

**Q.39** In the epicyclic gear train shown in the figure, A is fixed. A has 100 teeth and B has 20 teeth. If the arm C makes 3 revolution, the number of revolutions made by B will be




(a) 18 (b) 12
(c) 24 (d) 15

**Ans.** (a)

**Q.40** Setup cost include
(a) Maintenance cost of machines
(b) Labour cost of setling of machines
(c) Cost of processing the work piece
(d) Ordering cost of raw material

**Ans.** (a, b, d)

**Q.41** Match **List-I** and **List-II** and select the correct answer using the codes:

**List-I**
(a) Nitriding
(b) Annealing
(c) Martempering
(d) Normalizing

**List-II**
1. Improves the hardness of whole mass
2. Refined grain structure
3. Improves surface hardness
4. Improves ductility

Codes :

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

**Ans.** (c)

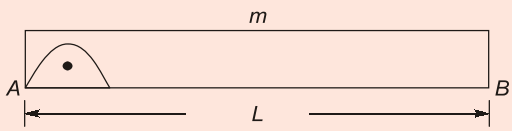
**Q.42** Work done by conservative force is equal to
(a) Decrease in kinetic energy
(b) Decrease in potential energy
(c) Increase in kinetic energy
(d) Increase in potential energy

**Ans.** (b)

**Q.43** Using Taylor's tool life equation, with exponent $n = 0.5$, if cutting speed is reduced to 50%, the ratio of new tool life to the original tool life is
(a) 1 (b) 4
(c) 0.5 (d) 2

**Ans.** (b)

**Q.44** A rod of mass $m$ and length $L$ is free to rotate in vertical plane as shown in figure. It is released from rest in horizontal position, the magnitude of velocity of point B of the rod at stable equilibrium position is




(a) $\sqrt{2gL}$ (b) $\sqrt{3gL}$
(c) $\sqrt{gL}$ (d) None of the above

**Ans.** (b)

**Q.45** Arithmetic and logical unit
I. Performance arithmetic operations
II. Store data
III. Perform comparisons
IV. Communicate with input devices
Choose the correct answer:
(a) I and II (b) I only
(c) I and III (d) III only

**Ans.** (c)

**Q.46** A train walled cylindrical vessel of wall thickness '$t$' and diameter '$d$' is filled with gas to a gauge pressure '$p$'. The maximum shear stress in vessel wall will be

(a) $\frac{pd}{4t}$ (b) $\frac{pd}{t}$

(c) $\frac{pd}{8t}$ (d) $\frac{pd}{2t}$

**Ans.** (a)

**Q.47** Crystal structure of γ iron is
(a) BCC (b) BCT
(c) FCC (d) HCP

**Ans.** (c)

**Q.48** Break even analysis is carried out to find the point where following are equal
(a) Holding cost and ordering cost
(b) Overhead cost and fixed cost
(c) Sales volume value and overall cost
(d) None of the above

**Ans.** (c)

**Q.49** A uniform bar, simply supported at the ends, carries a concentrated load P at mid span. If the same load is uniformly distributed over the full length of the bar, the maximum deflection of the bar will decrease by
(a) 37.5% (b) 25.5%
(c) 50% (d) 31.5%

**Ans.** (a)

**Q.50** Particulars of a spur gear are
Gear ratio 10 : 1, distance between centres = 660 mm, pinion transmits 500 kW at 1800 rpm. Involute teeth of standard proportion (addendum = $m$) with pressure angle of 22.5. Minimum number of teeth on pinion in order to avoid interference will be
(a) 16 (b) 12
(c) 18 (d) 14

**Ans.** (d)

**Q.51** The cast iron which possesses all the carbon in the combined form as cementite is known as

(a) Grey cast iron
(b) White cast iron
(c) Spheroidal cast iron
(d) Malleable cast iron

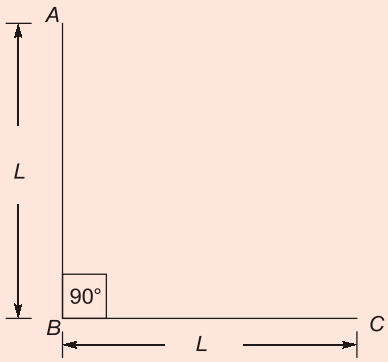
**Ans.** (b)

**Q.52** In simple exponential smoothing forecasting, to give higher weightage to recent demand information, the smoothing constant must be close to

(a) 0.5 (b) –1
(c) 1 (d) Zero

**Ans.** (c)

**Q.53** A wire of length 2L and uniform cross section is arranged as shown in figure. The distance of point B from its centre of gravity is




(a) $\frac{L\sqrt{2}}{2}$ (b) 0

(c) $\frac{L\sqrt{2}}{4}$ (d) $\frac{L}{2}$

**Ans.** (c)

**Q.54** The difference between tensions on the tight and slacks of a belt drive is 3000 N. If the belt speed is 15 m/s, the power transmitted is

(a) 90 kW (b) 45 kW
(c) 100 kW (d) 22.5 kW

**Ans.** (b)

**Q.55** The effective number of lattice points in unit cell of simple cubic, body centered cubic and face centered cubic space lattices, respectively are

(a) 2, 3, 4 (b) 1, 2, 2
(c) 2, 4, 4 (d) 1, 2, 4

**Ans.** (d)

**Q.56** A radial ball bearing has a basic load rating of 50 kN. If the desired rating life of the bearing is 6000 hours, the bearing at 500 rev/min, can carry a radial load of

(a) 12.5 kN (b) 18.85 kN
(c) 14.25 kN (d) 8.85 kN

**Ans.** (d)

**Q.57** A hollow cylinder of mass M and length L has its internal and external radii of $R_1$ and $R_2$ respectively. The moment of inertia of the hollow cylinder about its axis is

(a) $M\left(R_2^2 - R_1^2\right)$ (b) $\frac{M}{2}\left(R_1^2 + R_2^2\right)$

(c) $\frac{M}{2}\left(R_2^2 - R_1^2\right)$ (d) $M\left(R_1 + R_2^2\right)$

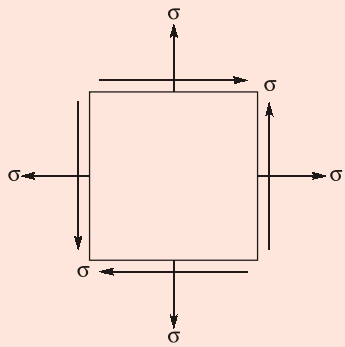
**Ans.** (b)

**Q.58** A rotating disc of 1 m diameter has two eccentric masses of 0.5 kg each at radii of 50 mm and 60 mm at angular positions of 0° and 150° respectively. A balancing mass of 0.1 kg is to be used to balance the rotor. The radial position of the balancing mass is

(a) 150 mm (b) 50 mm
(c) 280 mm (d) 120 mm

**Ans.** (a)

**Q.59** The maximum principal stress for the state of stresses shown in the figure is




(a) 3σ (b) σ
(c) 1.5σ (d) 2σ

**Ans.** (d)

**Q.60** A projectile is fixed at an angle of 30° from horizontal with a speed of $V_o$ m/s . The maximum height attained by the projectile is

(a) $\frac{V_o^2}{6g}$ (b) $\frac{V_2^2}{2g}$

(c) $\frac{V_0^2}{8g}$ (d) $\frac{V_0^2}{4g}$

**Ans.** (c)

**Q.61** A company uses 2555 units for an item annually. Delivery lead time is 8 days. The reorder point, in number of units, to order optimum quantity is

(a) 56 (b) 7

(c) 60 (d) 8

**Ans.** (a)

**Q.62** A production line is said to be balanced when

(a) The waiting time for service at each station is same.

(b) There are equal number of machines at each work station.

(c) The operation time at each work station is same.

(d) There are equal number of operations at each work station.

**Ans.** (c)

**Q.63** Robot motion

(a) Imitates human motion

(b) Is not dependent on robot structure

(c) Is same for all robots

(d) None of the above

**Ans.** (a)

**Q.64** A vehicle suspension system consists of a spring and a damper. The stiffness of the spring is 3.6 kN/m and damping constant of the damper is 400 Ns/m. If mass is 50 kg, the damping factor and damped natural frequency respectively are

(a) 0.666 and 1.35 Hz

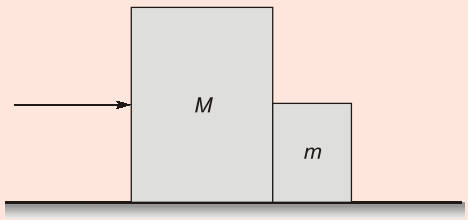
(b) 0.471 and 1.19 Hz

(c) 0.666 and 8.50 Hz

(d) 0.471 and 7.48 Hz

**Ans.** (b)

**Q.65** Two blocks of masses $M$ and $m$ are in contact with each other as shown in the figure. Horizontal surface is frictionless. When a force $F$ is applied to the heavier block towards right, the force between the two blocks will be




(a) $\frac{mF}{M}$ (b) $\frac{(M+m)F}{m}$

(c) $\frac{mF}{(M+m)}$ (d) $\frac{MF}{m}$

**Ans.** (c)

**Q.66** In a balanced transportation problem, cost entries $c_{ij}$ changed to $c_{ij}+ a_i + b_j$

(a) Feasibility of the solution will be affected

(b) Optimality of the solution will not be affected.

(c) The objective function value will change by an amount equal to the total of such changes made to cost coefficients.

(d) Optimality of the solution will be affected.

**Ans.** (c)

**Q.67** In a linear arc welding process, the heat input per unit length in inversely proportional to

(a) Welding speed

(b) Welding current

(c) Duty cycle of the power source

(d) Welding voltage

**Ans.** (a)

**Q.68** In a double riveted butt joint with two cover plates for a longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm$^2$. Assume joint efficiency of 75%,

allowable tensile strength in the plate 90 MPa. Thickness of the boiler shell plate and diameter of rivet will respectively be

(a) 15 mm, 25 mm
(b) 10 mm, 20 mm
(c) 18 mm, 27 mm
(d) 12 mm, 20 mm

**Ans.** (b)

**Q.69** Match List-I and List-II and select the correct answer using the codes :

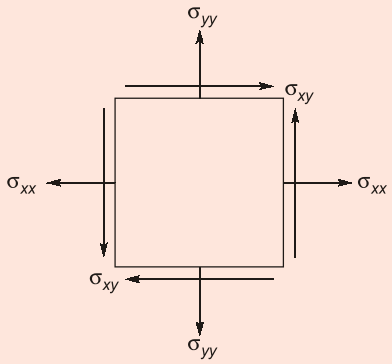
| List-I | List-II |
|---|---|
| (a) Strain rosette | 1. Critical speed |
| (b) Section modulus | 2. Mohr's circle |
| (c) Wahl's stress | 3. Coil springs |
| (d) Fatigue | 4. Flexural rigidity |
| | 5. Endurance limit |
| | 6. Core section |

Codes :

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

**Ans.** (d)

**Q.70** In the state of stress shown $\sigma_{xx}$ = 110 MPa, $\sigma_{yy}$ = 30 MPa and $\sigma_{xy}$ = 30 MPa. The radius of Mohr's circle of principal stresses in MPa are

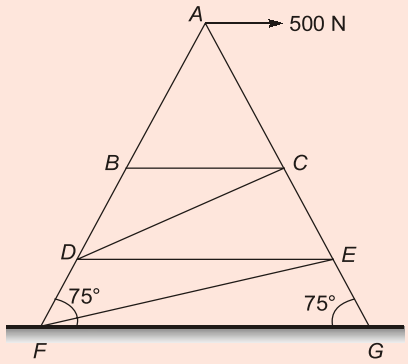



Principal stresses

| | Radius | $\sigma_1$ | $\sigma_2$ |
|---|---|---|---|
| (a) | 60 | 140 | 20 |
| (b) | 50 | 120 | 20 |
| (c) | 70 | 140 | 0 |
| (d) | 55 | 120 | 30 |

**Ans.** (b)

**Q.71** Number of zero force members in the truss shown below is




(a) 5 (b) 3
(c) 6 (d) 4

**Ans.** (d)

**Q.72** Tracking signal is used in the context of

(a) Forecasting
(b) Quality management
(c) Inventory management
(d) None of the above

**Ans.** (a)

**Q.73** A planar closed kinematic chain is formed with four rigid links PQ = 2 m, QR = 3 m, RS = 2.5 m and SP = 2.7 m with four revolute joints. The link to be fixed for obtaining a double rocker mechanism is

(a) RS (b) PQ
(c) SP (d) QR

**Ans.** (a)

**Q.74** The maximum length of arc of contact for two mating gears to avoid interference is

Where,

$r$ = Pitch circle radius of pinion,

$R$ = Pitch circle radius of gear,

$\phi$ = Pressure angle

(a) $(R + r)\sin\phi$
(b) $(R + r)\tan\phi$
(c) $(R + r)\cos\phi$
(d) None of the above

**Ans.** (b)

**Q.75** In an orthogonal cutting, a tool has rake angle of zero degree. Measured cutting force and thrust force are 500 N and 250 N respectively. The coefficient of friction between the tool and chip is

(a) 0.5 (b) 0

(c) 0.4 (d) 2

**Ans.** (a)

**Q.76** A solid round bar of 6 cm diameter is 2.5 m long. It is used as column with one end fixed and other end hinged. If elastic modulus is 200 GPa, the Euler's buckling load will be

(a) 402 kN (b) 804 kN

(c) 201 kN (d) None of the above

**Ans.** (a)

**Q.77** At a point in a structure, there are two mutually perpendicular tensile stresses of 800 N/cm$^2$ and 400 N/cm$^2$. If the Poisson's ratio is 0.25, what would be the equivalent stresses in simple tension according to maximum principal strain theory?

(a) 700 N/cm$^2$ (b) 1200 N/cm$^2$

(c) 400 N/cm$^2$ (d) 900 N/cm$^3$

**Ans.** (a)

**Q.78** Consider the following statements regarding a stepper motor:

1. The angle of rotation of motor is proportional to the input pulse.
2. The motor has full torque at stand still.
3. The speed and electric signal of the motor vary mutually linearly.

Which of the above statements are correct?

(a) 2 and 3 only (b) 1 and 2 only

(c) 1, 2 and 3 (d) 1 and 3 only

**Ans.** (c)

**Q.79** The bearing characteristic number in a hydrodynamic bearing depends on

(a) Viscosity, speed and load

(b) Length, width and load

(c) Viscosity, speed and bearing pressure

(d) Length, width and speed

**Ans.** (c)

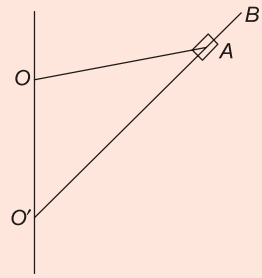
**Q.80** A cube shaped casting solidifies in 5 min. Solidification time (in min.) for a cube of same material, which is 8 times heavier than the original casting will be

(a) 25 (b) 10

(c) 40 (d) 20

**Ans.** (d)

**Q.81** Figure shows a quick return motion mechanism. The crank OA rotates clockwise uniformly. OA = 2 cm, OO′ = 4 cm. The ratio of times of forward motion to that for return motion is




(a) $\sqrt{2}$ (b) 0.5

(c) 1 (d) 2

**Ans.** (d)

**Q.82** For a single server with Poisson arrival, with the decrease in the mean of exponential service times, the average waiting time is going to reduce

(a) At a decreasing rate

(b) In a negative exponential manner

(c) At an increasing rate

(d) In a positive exponential manner

**Ans.** (b)

**Q.83** A bar of length L and cross section A is subjected to axial forces P at ends. The energy stored in the bar will be

(a) $\frac{PL^2}{2AE}$ (b) $\frac{P^2L}{2AE}$

(c) $\frac{P^2L^3}{2AE}$ (d) $\frac{P^2L^2}{2AE}$

**Ans.** (b)

**Q.84** The relationship between true shear stress, $\sigma$ and engineering stress $\sigma_o$ is given by (where, $\in$ is the conventional strain)

(a) $\frac{\sigma}{\sigma_o} = (1+\in)^2$ (b) $\frac{\sigma}{\sigma_o} = 1+\in$

(c) $\frac{\sigma}{\sigma_o} = \frac{1}{(1+\in)^2}$ (d) $\frac{\sigma}{\sigma_o} = \frac{1}{1+\in}$

**Ans.** (b)

**Q.85** Under torsion, brittle material generally fail

(a) along surface forming a 45° angle with the longitudinal axis.
(b) along plane perpendicular to the axis.
(c) not in any specific manner.
(d) in the direction of minimum tension.

**Ans.** (a)

**Q.86** In designing a plate clutch, assumption of uniform wear conditions is made because

(a) it leads to cost effective design.
(b) it is closer to real life situation.
(c) no other assumption is possible.
(d) it leads to a safer design.

**Ans.** (b)

**Q.87** Match List-I and List-II and select the correct answer using the codes :

**List-I**

(a) Charpy test
(b) Knoop test
(c) Spiral test
(d) Cupping test

**List-II**

1. Fluidity
2. Micro hareness
3. Formability
4. Toughness
5. Permeability

**Codes :**

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

**Ans.** (c)

**Q.88** Which of the following elements determine maximum attainable hardness in steel?

1. Cr 2. Mn
3. C 4. Mo

Select the correct answer using codes given below.

(a) 1 and 2 (b) 1 only
(c) 2 and 4 (d) 3 only

**Ans.** (d)

**Q.89** Correlate the statements given below using the code:

I. Castings have strength, ductility and toughness equal in all directions.
II. Gun barrels, cylinder liners and piston rings are casted.

(a) I is correct but II is not correct.
(b) Both I and II are correct and I is the reason for it.
(c) II is correct but I is not correct.
(d) I and II are independently correct.

**Ans.** (c)

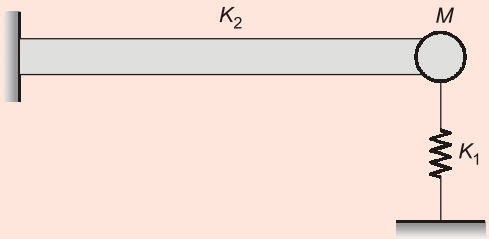
**Q.90** Two particles with masses in the ratio of 1 : 4 are moving with equal kinetic energies. The magnitudes of their linear momentums will be in the ratio of

(a) $\sqrt{2}:1$ (b) 1 : 8
(c) 2 : 1 (d) 1 : 2

**Ans.** (d)

**Q.91** A cantilever beam of negligible weight is carrying a mass M at its free end. It is supported by an elastic spring support of stiffness $K_1$ as shown in figure below. If $K_2$

represents the bending stiffness of the beam, the natural frequency in rad/s is




(a) $\sqrt{\frac{K_1+K_2}{M}}$ (b) $\sqrt{\frac{K_1K_2}{M(K_1+K_2)}}$

(c) $\sqrt{\frac{K_1-K_2}{M}}$ (d) $\sqrt{\frac{2(K_1+K_2)}{M}}$

**Ans.** (a)

**Q.92** A solid circular shaft carries a torque of 50 Nm. If the allowable shear stress of the material is 140 MPa, assuming factor of safety 2, the minimum diameter required for the shaft is

(a) 24 mm (b) 8 mm
(c) 32 mm (d) 16 mm

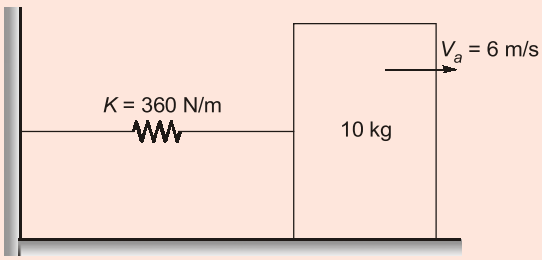
**Ans.** (d)

**Q.93** A single degree of freedom system, having mass of 1 kg and stiffness of 10 kN/m is at rest. It is subjected to an impulsive force of magnitude 5 kN for $10^{-4}$ seconds. The amplitude (in mm) of the resulting free vibration is

(a) 5.0 (b) 0.5
(c) 10.0 (d) 1.0

**Ans.** (a)

**Q.94** A block of mass 10 kg is attached to a spring of stiffness 360 N/m. A velocity of 6 m/s is given to the mass when the spring is in unstretched condition. The block will come to rest after moving a distance of




(a) 1.0 m (b) 0.5 m
(c) 1.25 m (d) 0.75 m

**Ans.** (a)

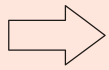
**Q.95** Moment of inertia of a thin spherical shell of mass M and radius R about a diameter is

(a) $\frac{3}{5}MR^2$ (b) $\frac{2}{5}MR^2$

(c) $\frac{4}{5}MR^2$ (d) $\frac{2}{3}MR^2$

**Ans.** (d)

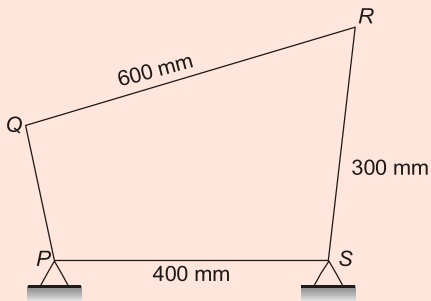
**Q.96** The symbol used for transport in work study is

(a)  (b) 

(c)  (d) T

**Ans.** (b)

**Q.97** A four bar chain is shown in the figure. For the mechanism to be a crank rocker mechanism, the length of the link PQ can be




(a) 300 mm (b) 80 mm
(c) 350 mm (d) 200 mm

**Ans.** (b)

**Q.98** A thick cylinder with 10 mm internal diameter and 20 mm external diameter, is subjected to an internal fluid pressure of 60 MPa. The hoop stress at the inner surface is

(a) 40 MPa (b) 140 MPa
(c) –60 MPa (d) 100 MPa

**Ans.** (d)

**Q.99** The shear strength of a sheet metal is 300 MPa. The blanking force required to produce a blank of 100 mm dia. from a 1.5 mm thick sheet is close to

(a) 141 kN (b) 45 kN
(c) 3500 kN (d) 70 kN

**Ans.** (a)

**Q.100** Consider the following statements:
For increasing the fatigue strength of welded joints, it is necessary to employ
1. Grinding
2. Coating
3. Hammer peening

Of the above statements:
(a) 1 and 3 are correct
(b) 1 and 2 are correct
(c) 1, 2 and 3 are correct
(d) 2 and 3 are correct

**Ans.** (c)

**Q.101** A manufacturer can produce 12000 bearings per day. The manufacturer receives an order of 8000 bearings per day from a customer. The cost of holding a bearing in stock is Rs. 0.20 per month. Setup cost per production run is Rs. 500. Assuming 300 working days in a year, the duration of production run should be

(a) 6.8 days (b) 4.5 days
(c) 6.8 months (d) 4.5 months

**Ans.** (a)

**Q.102** The main cutting force acting on a tool during a turning operation of a metal is 400 N. The turning was performed using 2 mm depth of cut and 0.1 mm/rev feed rate. The specific cutting pressure is

(a) 3000 N/mm$^2$ (b) 1000 N/mm$^2$
(c) 4000 N/mm$^2$ (d) 2000 N/mm$^2$

**Ans.** (d)

**Q.103** Solubility of two non ferrous metals both in liquid and solid states is governed by
1. Crystal structure
2. Relative size factor
3. Chemical affinity factor
4. Relative valency factor

Select the correct answer using the codes given below:
(a) 1 and 4 only (b) 1, 2 and 3 only
(c) 1, 2, 3 and 4 (d) 2, 3 and 4 only

**Ans.** (c)

**Q.104** Match **List-I** (Processes) and **List-II** (Characteristics/Applications) and select the correct answer using the codes:

**List-I**
(a) Friction welding
(b) Gas metal arc welding
(c) Tungsten inert gas welding
(d) Electro slag welding

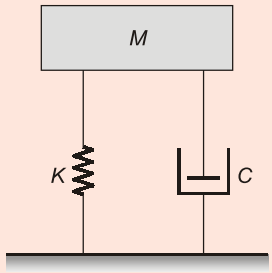
**List-II**
1. Non-consumable electrodes
2. Joining of thick plates
3. Consumable electrode wire
4. Joining of cylindrical dissimilar materials

**Codes :**

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

**Ans.** (*)

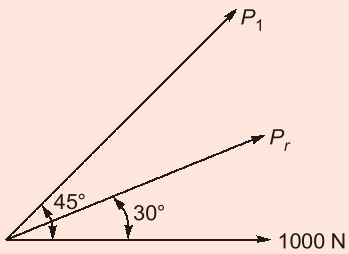
**Q.105** In a single degree of freedom underdamped spring mass system as shown in figure, an additional damper is added in parallel such that the system still remains under damped. The statements which always remains true is



(a) Time period of free oscillation will increase.
(b) Transmissibility will increase.
(c) Time period of free oscillation will decrease.
(d) Transmissibility will decrease.

**Ans.** (a)

**Q.106** If resultant of 1000 N and $P_1$ as shown in the figure is $P_r$, the value of $P_r$ is




(a) 2000 N (b) 1732 N
(c) 2732 N (d) 1000 N

**Ans.** (c)

**Q.107** Consider the following theories of failure.
1. Maximum principal stress theory
2. Maximum strain theory
3. Maximum shear stress theory
4. Maximum distortion energy theory

The most suitable for ductile materials is
(a) 1 and 4 (b) 1 and 2
(c) 3 and 4 (d) 1 and 3

**Ans.** (c)

**Q.108** Maximum torque transmitted by a hollow shaft of external radius $R$ and internal radius $r$ is (where, $f_s$ is shear strength of material)

(a) $\frac{\pi}{8R}\left(R^4 - r^4\right)f_s$

(b) $\frac{\pi}{16}\left(R^3 - r^3\right)f_s$

(c) $\frac{\pi}{32}\left(R^4 - r^4\right)f_s$

(d) $\frac{\pi}{2R}\left(R^4 - r^4\right)f_s$

**Ans.** (d)

**Q.109** A simply supported beam carries a concentrated load and maximum bending moment is M. If the same load is uniformly distributed over the beam length, the maximum bending moment will be

(a) $\frac{M}{3}$ (b) $M$

(c) $2M$ (d) $\frac{M}{2}$

**Ans.** (d)

**Q.110** A PERT network has nine activities on its critical path. The standard deviation of each activity on the critical path is 3. The standard deviation of critical path is
(a) 27 (b) 3
(c) 9 (d) 81

**Ans.** (c)

**Q.111** The degrees of freedom of a planar mechanism having $n$ links and J simple hinge joints is
(a) $3n - 2J$ (b) $3(n-3) - 2J$
(c) $2J - 3n + 4$ (d) $3(n-1) - 2J$

**Ans.** (d)

**Q.112** In an arc welding process, welding speed is doubled. Assuming all other parameters to be constant, the cross sectional area of the weld will
(a) decrease by 25%
(b) increase by 25%
(c) decrease by 50%
(d) increase by 50%

**Ans.** (c)

**Q.113** Two springs of stiffness $K_A$ and $K_B$ are placed one inside the other such that they are compressed by the same amount under axial load. The equivalent stiffness of the two springs will be

(a) $\frac{K_A + K_B}{2}$ (b) $\frac{1}{K_A} + \frac{1}{K_B}$

(c) $K_A + K_B$ (d) $\frac{K_A K_B}{K_A + K_B}$

**Ans.** (c)

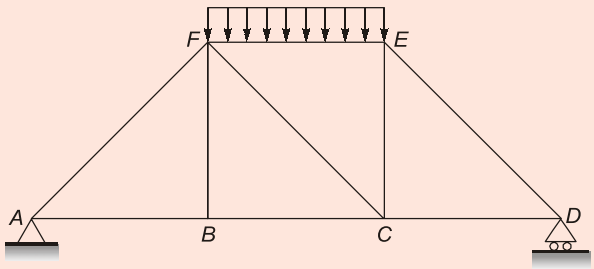
**Q.114** A bar of length L, cross sectional area A and weight W is fixed at the upper end and carries an axial pull of P at the lower end. The increase in the length of the bar is
(where E is the Young's modulus of material)

(a) $\frac{WL}{2AE} + \frac{PL}{2AE}$ (b) $\frac{WL}{2AE} + \frac{PL}{AE}$

(c) $\frac{WL}{2AE} + \frac{2PL}{AE}$ (d) $\frac{WL}{AE} + \frac{PL}{AE}$

**Ans.** (b)

**Q.115** All the vertical and horizontal members of the truss shown in the figure are of length L each. Member EF is loaded by a uniformly distributed load of intensity W per unit length. The force in member BC is




(a) $\frac{WL}{2}$ compression

(b) 0

(c) WL tension

(d) $\frac{WL}{2}$ tension

**Ans.** (d)

**Q.116** For a certain engine having an average speed of 1200 rpm, a flywheel approximated as a solid disc, is required in keep the fluctuation of speed within 2% about mean speed. The fluctuation of kinetic energy per cycle is found to be 2 kJ. The least possible mass of the fly wheel if its diameter is not a allowed to exceed 1 m is

(a) 62 kg (b) 40 kg
(c) 73 kg (d) 51 kg

**Ans.** (d)

**Q.117** The number of atoms per unit cell and the number of slip systems respectively for a Face Centered Cubic crystal are

(a) 4, 12 (b) 3, 3
(c) 4, 48 (d) 3, 12

**Ans.** (c)

**Q.118** A copper bar is fixed at both the ends. Heating of the bar will develop

(a) Compressive stress
(b) Tensile stress
(c) Zero stress
(d) Shear stress

**Ans.** (a)

**Q.119** The state of stress at a point is given by $\sigma_{xx}$ = 60 MPa, $\sigma_{yy}$ = 120 MPa and $\sigma_{xy}$ = 40 MPa.
The radius of Mohr's circle representing the given state of stress is

(a) 60 MPa (b) 40 MPa
(c) 120 MPa (d) 50 MPa

**Ans.** (d)

**Q.120** Babbit is an alloy of

(a) Sn, Cu and Sb
(b) Sn and Cu
(c) Sn, Cu and Mg
(d) Sn, Cu and Pb

**Ans.** (a)

**Q.121** Buckling load will be maximum for a column if its

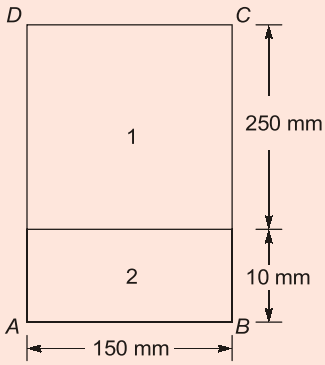
(a) Both ends of the column are hinged.
(b) One end is fixed and other end is free.
(c) One end of the column is hinged and other end is free.
(d) Both ends of the column are clamped.

**Ans.** (d)

**Q.122** The four basic configurations that can be combined to produce a variety of robotic combination are
Cartesian, articulated, cylindrical and
(a) Spherical (b) Oblong
(c) Octagonal (d) Square

**Ans.** (a)

**Q.123** Cross section of a composite beam is given in the figure, $E_1$ = 10 GPa and $E_2$ = 200 GPa. Distance of neutral axis from AB is




(a) 75.7 mm (b) 27.7 mm
(c) 37.5 mm (d) 77.2 mm

**Ans.** (d)

**Q.124** The state of stress at a point in a body is given by $\sigma_x$ = 100 MPa and $\sigma_y$ = 200 MPa. One of the principal stresses $\sigma_1$ = 250 MPa. The magnitude of the other principal stress and shearing stress $\sigma_{xy}$ are respectively.

(a) 50 MPa and $50\sqrt{3}$ MPa

(b) $50\sqrt{3}$ MPa and 50 MPa

(c) $50\sqrt{3}$ MPa and 100 MPa

(d) 100 MPa and $50\sqrt{3}$ MPa

**Ans.** (a)

**Q.125** Which of the following is NOT the component of a control system?
(a) Fixtures (b) Amplifiers
(c) Sensors (d) Actuators

**Ans.** (a)

■■■■