महाराष्ट्र अभियांत्रिकी सेवा (स्थापत्य) (मुख्य) प-2017

प्रश्नपुस्तिका क्रमांक दि 17 डिसेंबर 2017

BOOKLET No. 103941

प्रश्नपुस्तिका-I

संच क्र. **A**

Q10 स्थापत्य अभियांत्रिकी पेपर – 1

वेळ : 2 (दोन) तास

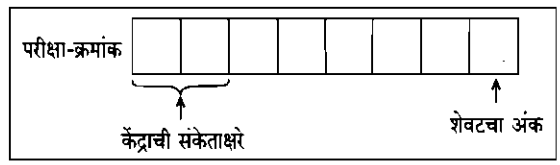
एकूण प्रश्न : 100

एकूण गुण : 200

सूचना

(1) सदर प्रश्नपुस्तिकेत **100** अनिवार्य प्रश्न आहेत. उमेदवारांनी प्रश्नांची उत्तरे लिहिण्यास सुरुवात करण्यापूर्वी या प्रश्नपुस्तिकेत सर्व प्रश्न आहेत किंवा नाहीत याची खात्री करून घ्यावी. असा तसेच अन्य काही दोष आढळल्यास ही प्रश्नपुस्तिका समवेक्षकांकडून लगेच बदलून घ्यावी.

(2) आपला परीक्षा-क्रमांक ह्या चौकोनांत **न विसरता बॉलपेनने** लिहावा.



(3) वर छापलेला प्रश्नपुस्तिका क्रमांक तुमच्या उत्तरपत्रिकेवर विशिष्ट जागी उत्तरपत्रिकेवरील सूचनेप्रमाणे **न विसरता नमूद करावा**.

(4) या प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाला 4 पर्यायी उत्तरे सुचविली असून त्यांना 1, 2, 3 आणि 4 असे क्रमांक दिलेले आहेत. त्या चार उत्तरांपैकी सर्वात योग्य उत्तराचा क्रमांक उत्तरपत्रिकेवरील सूचनेप्रमाणे तुमच्या उत्तरपत्रिकेवर नमूद करावा. अशा प्रकारे उत्तरपत्रिकेवर उत्तरक्रमांक नमूद करताना तो संबंधित प्रश्नक्रमांकासमोर छायांकित करून दर्शविला जाईल याची काळजी घ्यावी. **ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.**

(5) सर्व प्रश्नांना समान गुण आहेत. यास्तव सर्व प्रश्नांची उत्तरे द्यावीत. घाईमुळे चुका होणार नाहीत याची दक्षता घेऊनच शक्य तितक्या वेगाने प्रश्न सोडवावेत. क्रमाने प्रश्न सोडविणे श्रेयस्कर आहे पण **एखादा प्रश्न कठीण वाटल्यास त्यावर वेळ न घालविता पुढील प्रश्नांकडे वळावे**. अशा प्रकारे शेवटच्या प्रश्नापर्यंत पोहोचल्यानंतर वेळ शिल्लक राहिल्यास कठीण म्हणून वगळलेल्या प्रश्नांकडे परतणे सोईस्कर ठरेल.

(6) उत्तरपत्रिकेत एकदा नमूद केलेले उत्तर खोडता येणार नाही. नमूद केलेले उत्तर खोडून नव्याने उत्तर दिल्यास ते तपासले जाणार नाही.

(7) **प्रस्तुत परीक्षेच्या उत्तरपत्रिकांचे मूल्यांकन करताना उमेदवाराच्या उत्तरपत्रिकेतील योग्य उत्तरांनाच गुण दिले जातील. तसेच "उमेदवाराने वस्तुनिष्ठ बहुपर्यायी स्वरूपाच्या प्रश्नांची दिलेल्या चार उत्तरांपैकी सर्वात योग्य उत्तरेच उत्तरपत्रिकेत नमूद करावीत. अन्यथा त्यांच्या उत्तरपत्रिकेत सोडविलेल्या प्रत्येक चार चुकीच्या उत्तरांसाठी एका प्रश्नाचे गुण वजा करण्यात येतील".**

ताकीद

ह्या प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपेपर्यंत ही प्रश्नपुस्तिका आयोगाची मालमत्ता असून ती परीक्षाकक्षात उमेदवाराला परीक्षेसाठी वापरण्यास देण्यात येत आहे. ही वेळ संपेपर्यंत सदर प्रश्नपुस्तिकेची प्रत/प्रती, किंवा सदर प्रश्नपुस्तिकेतील काही आशय कोणत्याही स्वरूपात प्रत्यक्ष वा अप्रत्यक्षपणे कोणत्याही व्यक्तीस पुरविणे, तसेच प्रसिद्ध करणे हा गुन्हा असून अशी कृती करणाऱ्या व्यक्तीवर शासनाने जारी केलेल्या "परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचा अधिनियम-82" यातील तरतुदीनुसार तसेच प्रचलित कायद्याच्या तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.

तसेच ह्या प्रश्नपत्रिकेसाठी विहित केलेली वेळ संपण्याआधी ही प्रश्नपुस्तिका अनधिकृतपणे बाळगणे हा सुद्धा गुन्हा असून तसे करणारी व्यक्ती आयोगाच्या कर्मचारीवृंदापैकी, तसेच परीक्षेच्या पर्यवेक्षकीयवृंदापैकी असली तरीही अशा व्यक्तीविरूद्ध उक्त अधिनियमानुसार कारवाई करण्यात येईल व दोषी व्यक्ती शिक्षेस पात्र होईल.

पर्यवेक्षकांच्या सूचनेविना सील उघडू नये

SEAL

पुढील सूचना प्रश्नपुस्तिकेच्या अंतिम पृष्ठावर पहा

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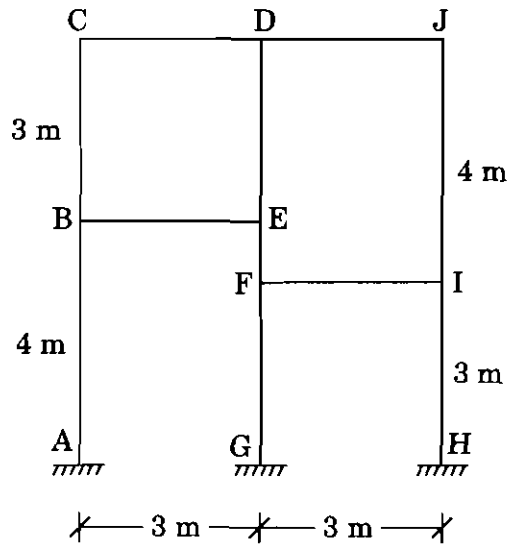
1. Determine the degree of static and kinematic indeterminacy of the frame structure as shown in the figure.



(1) 15, 8 (2) 12, 12

(3) 12, 10 (4) 15, 9

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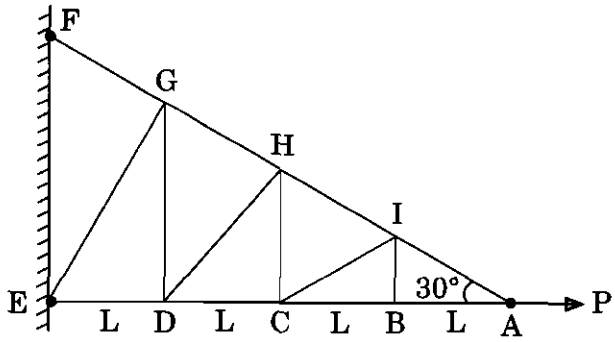
2. A cantilever truss as shown in the figure is subjected to a horizontal load 'P' at joint A. The total number of zero force members in the truss is



(1) 6 (2) 4

(3) 9 (4) 10

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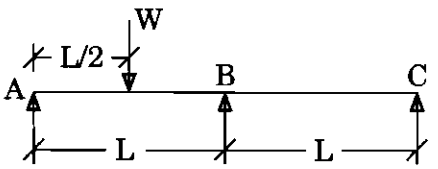
3. A continuous beam ABC is as shown in the figure. End supports are simple (i.e., A and C) and span AB = span BC = L. There is a concentrated load 'W' at the centre of the span AB while no load over the span BC. E_j is same for both the spans. What is the moment at the continuous support B ?



(1) $-\frac{WL^3}{16}$

(2) $-\frac{WL^2}{32}$

(3) $-\frac{3WL^2}{32}$

(4) $-\frac{3WL^2}{16}$

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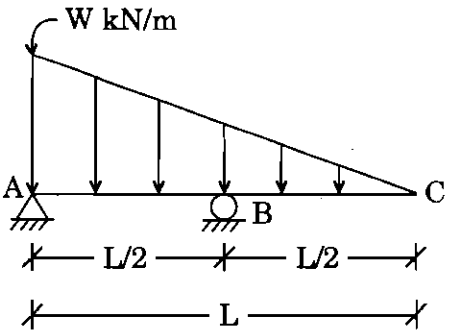
4. A beam ABC is supported and loaded as shown in the figure. Find the support reactions at A and B. (Neglect horizontal reaction at A)



(1) $\frac{WL}{3}, \frac{WL}{3}$

(2) $\frac{WL}{3}, \frac{WL}{6}$

(3) $\frac{WL}{6}, \frac{WL}{3}$

(4) $\frac{WL}{6}, \frac{WL}{6}$

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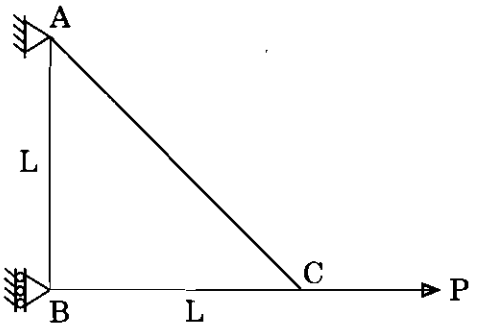
5. A simple truss ABC is supported at A and B as shown in the figure. If a point load (P) along BC is applied at joint C in horizontal direction, then what will be the vertical deflection at C ? Assume same C/5 area and same materials (i.e., A, E, I same for all members).



(1) $\frac{PL}{AE}$ (↑) (2) $\frac{2PL}{AE}$ (↓)

(3) $\frac{PL}{AE}$ (↓) (4) $\frac{2PL}{3AE}$ (↓)

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6. In a fixed beam of span 'L' subjected to a central concentrated load 'W', the fixed end moment and moment at midspan are respectively

(1) $\frac{WL}{12}$ and $\frac{WL}{6}$ (2) $\frac{WL}{8}$ and $\frac{WL}{8}$

(3) $\frac{WL}{6}$ and $\frac{WL}{12}$ (4) None of the above

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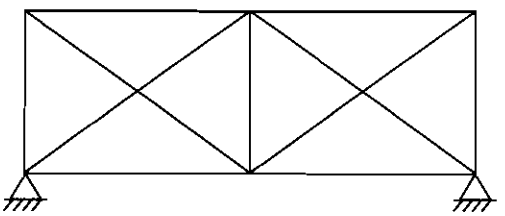
7. In the pin-jointed truss shown in the figure, the static degree of indeterminacy is



(1) 2 (2) 1 (3) 3 (4) 4

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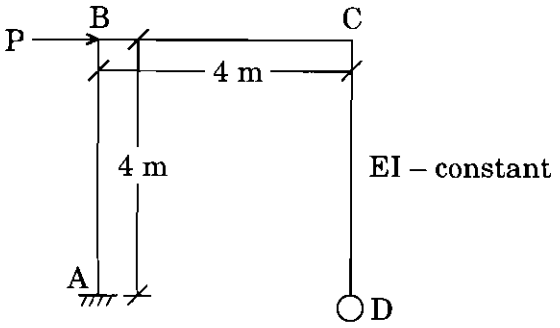
8. For the frame shown in the figure, the shear equation is



(1) $\frac{M_{BA} + M_{AB}}{4} + \frac{M_{CD}}{4} + P = 0$

(2) $\frac{M_{AB} + M_{BC}}{4} + \frac{M_{DC}}{4} + P = 0$

(3) $M_{AB} + M_{BA} + M_{CD} + M_{DC} = 0$

(4) $M_{AB} + M_{BA} + M_{CD} + M_{DC} = P$

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9. In the force method of analysis of indeterminate trusses, if the truss is indeterminate to degree one, the change in length of redundant member due to unit force is found by using the formula

where A is cross-sectional area

I – Moment of Inertia

n – force in the member due to unit load application

N – force in the member due to actual load

E – Modulus of Elasticity

(1) $\sum \frac{n\,NL}{EI}$ (2) $n \sum \frac{NL}{AE}$

(3) $\sum \frac{n\,NL}{AE}$ (4) $\sum \frac{NL}{AE}$

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10. In the moment distribution method, the carry over moment is equal to

(1) double of its corresponding distributed moment and has same sign

(2) one-half of its corresponding distributed moment and has same sign

(3) one-half of its corresponding distributed moment and has opposite sign

(4) None of the above

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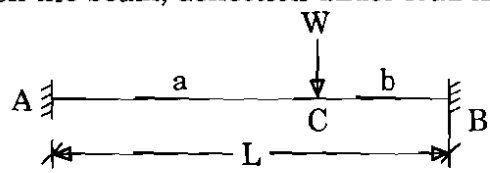
11. For both ends of the fixed beam shown in the figure carrying a concentrated load eccentrically placed on the beam, deflection under load is



(1) $-\frac{W a^2 b^2}{3 EIL^2}$ (2) $-\frac{W ab^2}{3 EIL}$

(3) $-\frac{W a^3 b^3}{3 EIL^3}$ (4) $-\frac{W a^3 b^2}{3 EIL^2}$

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12. A continuous beam ABC is simply supported at supports A, B and C. Portion AB has span of 6 m and BC 4 m. Portion AB is loaded with a concentrated load of 120 kN downward at 3 m from A. The qualitative reactions shall be

(1) Reactions at A and B shall be upward and reaction at C shall be zero

(2) Reactions at A and B shall be upward and reaction at C shall be downward

(3) All reactions i.e., at A, B and C shall be upwards

(4) None of the above

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13. A beam AB is simply supported and has flexural rigidity EI. The flexural strain energy of the beam having span 6 m and carrying a central point load of 10 kN is

(1) 142·38/EI (2) 775/EI

(3) 225/EI (4) None of the above

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14. A given determinate truss is loaded with gravity loads. Under these loads different nodes undergo deflection horizontally and vertically. Thereafter the truss is subjected to a temperature drop of 50°C in the lower chord only. The coefficient of expansion or contraction $\alpha = 11{\cdot}7 \times 10^{-6}$/°C. Which of the following statements is true ?

(1) Vertical and horizontal deflection along lower chord nodes remains the same.

(2) Vertical and horizontal deflections along lower chord nodes shall change.

(3) Horizontal deflection along lower chord nodes shall change but vertical deflection shall not change

(4) None of the above

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15. If the span and dip of a parabolic cable are L and h respectively, then the length of the cable is approximately equal to

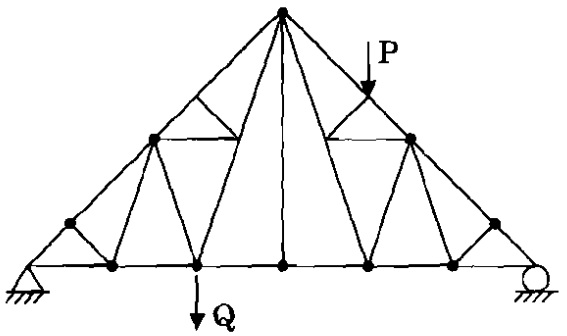
(1) $L + 3/8\ h$ (2) $L + 8/3\ h$

(3) $L + 3/8\ h^2/L$ (4) $L + 8/3\ h^2/L$

16. A three-hinged semicircular arch of radius R carries a uniformly distributed load W per unit run over the whole span.
The horizontal thrust is

(1) R (2) $\frac{WR}{2}$ (3) $\frac{4}{3\pi}WR$ (4) $\frac{2}{3\pi}WR$

17. For the plane truss shown in the figure, the number of zero force members for the given loading is



(1) 4 (2) 8 (3) 11 (4) 13

18. A structure is said to be statically indeterminate when

(1) the number of unknown reaction components exceeds the number of equilibrium conditions.

(2) the number of equilibrium conditions exceeds the number of unknown reaction components.

(3) the number of equilibrium conditions equal to the number of unknown reaction components.

(4) None of the above

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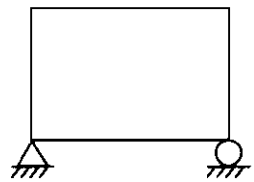
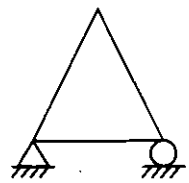
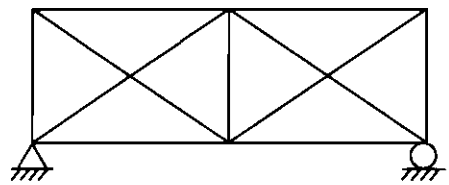
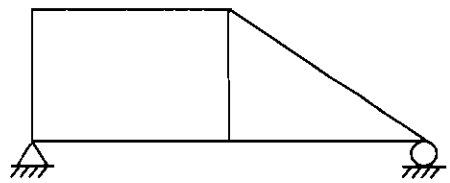
19. Which truss is the perfect truss out of the following ?

(1) 

(2) 

(3) 

(4) 

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20. The flexibility method is also known as the

(1) Energy method (2) Equilibrium method

(3) Displacement method (4) Force method

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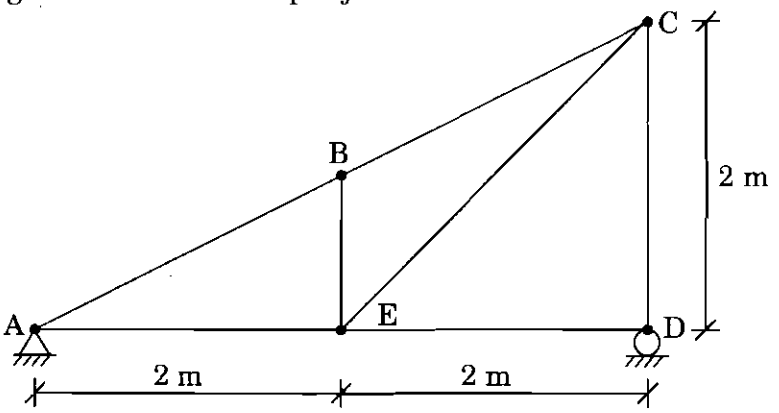
21. The figure given below shows a pin-jointed frame :



What are the forces in members BE, CD and ED ?

(1) 10 kN, 5 kN and 5 kN (2) 10 kN, 5 kN and Zero

(3) 5 kN, 10 kN and Zero (4) 5 kN, 5 kN and Zero

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22. A beam ABC is simply supported at A and B, BC is overhanging. Span AB = 8 m, BC = 2 m. Point 'D' is situated at 3 m from A. Using an influence line diagram or otherwise, find the maximum ordinates at 'D' of the influence line diagram for shear at 'D'.

(1) – 0·375 (2) – 0·625 (3) + 0·625 (4) + 1·875

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23. For compression members with double angle section, unequal angles are preferred to equal angles because

(1) they are easy for connection

(2) they lead to large value of minimum radius of gyration

(3) they have lesser effective length

(4) of saving in gusset plate material

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24. Minimum pitch for riveted connections should ***not*** be less than

(1) 1·5 times the hole diameter

(2) 2·5 times the hole diameter

(3) 1·5 times the nominal diameter of rivet

(4) 2·5 times the nominal diameter of rivet

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25. The effective slenderness ratio of a battened column, λ_e, is taken as 1·10 times the actual slenderness ratio of the column to account for

(1) Axial deformation (2) Bending deformation

(3) Shear deformation (4) All of the above

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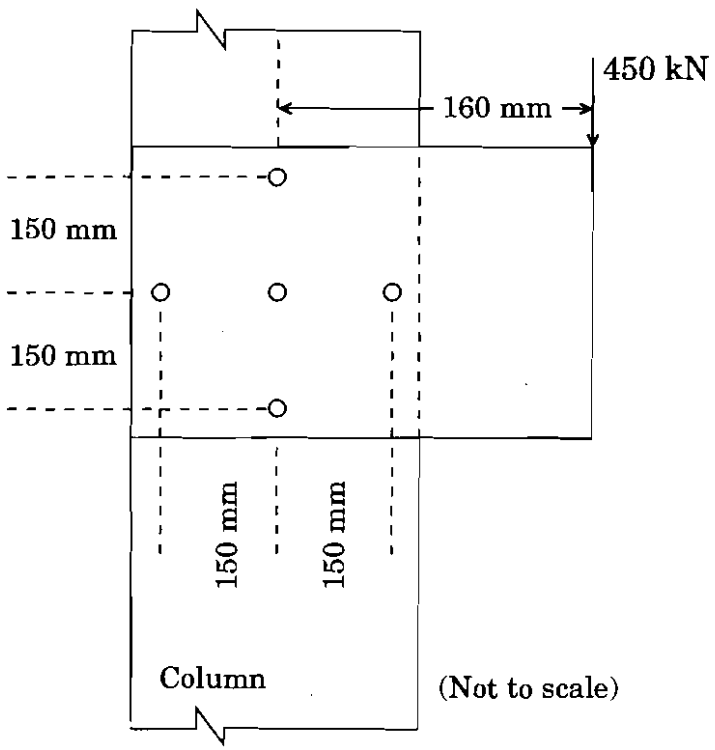
26. The maximum design force for a rivet in the following bracket connection, if spacing between adjacent rivets is 150 mm, is



(1) 150 kN (2) 175 kN

(3) 200 kN (4) 212·5 kN

---

27. The minimum thickness of a base plate, t_s in case of slab base can be calculated by the formula

(1) $t_s = \sqrt{2{\cdot}5w\,(b^2 - 0{\cdot}3a^2)\,f_y / \gamma_{m_0}}$ (2) $t_s = \sqrt{2{\cdot}5\,w\,(b^2 - 0{\cdot}3b^2)\,\gamma_{m_0} / f_y}$

(3) $t_s = \sqrt{2{\cdot}5\,w\,(a^2 - 0{\cdot}3b^2)\,\gamma_{m_0} / f_y}$ (4) $t_s = \sqrt{2{\cdot}5w\,(a^2 - 0{\cdot}3b^2)\,f_y / \gamma_{m_0}}$

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28. The top chord of a roof truss is inclined at an angle of 20°, no access is provided for maintenance. The live load to be considered for the design will be

(1) Zero (2) $0{\cdot}4\ kN/m^2$

(3) $0{\cdot}75\ kN/m^2$ (4) $0{\cdot}55\ kN/m^2$

---

29. If a structure is under fatigue stresses, then the welded joints as compared to riveted joints will fail

(1) Earlier (2) Later

(3) At the same time (4) Not at all

---

30. According to IS 800 : 2007, allowable vertical deflection for gantry girder with crane load (electronically operated up to 50 tons) is

(1) $\frac{\text{span}}{500}$ (2) $\frac{\text{span}}{750}$

(3) $\frac{\text{span}}{1000}$ (4) $\frac{\text{span}}{300}$

---

31. The design bending strength of a laterally supported beam is given by $M_d = (\beta_b.Z_p.f_y)/\gamma_{m_0}$, where β_b, Z_p, f_y and γ_{m_0} have their usual meaning. β_b for plastic and compact sections are given by

(1) 1·0, 0·8 (2) 0·8, 1·0

(3) $1, Z_e/Z_p$ (4) 1, 1

---

32. The deep structural members subjected to transverse loads are called

(1) Beams (2) Columns

(3) Plate girders (4) Trusses

---

33. The optimum thickness of web, t_w, of a plate girder is given by

(1) $t_w = \left(\frac{M_z}{f_y.k^2}\right)^{0.33}$ (2) $t_w = \left(\frac{f_y.k^2}{M_z}\right)^{0.33}$

(3) $t_w = \left(\frac{M_z}{f_y.k^2}\right)$ (4) $t_w = \left(\frac{f_y.k^2}{M_z}\right)$

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34. In a singly reinforced balanced section, if M 30 concrete and Fe 415 steel is used, then the value of neutral axis factor (ku_{max}) in L.S.M. is

(1) 0·42 (2) 0·46

(3) 0·48 (4) 0·52

---

35. The maximum area of tension steel in a beam shall ***not*** exceed

(1) 0·15 bD (2) 0·12 bD

(3) 0·04 bD (4) 1·00 bD

---

36. Effective flange width of a continuous T-beam is

(1) $b_f = \frac{l_0}{6} + b_w + 6\,D_f$ (2) $b_f = \frac{l_0}{12} + b_w + 3\,D_f$

(3) $b_f = \frac{l_0}{\frac{l_0}{b} + 4} + b_w$ (4) $b_f = \frac{0{\cdot}5\,l_0}{\frac{l_0}{6} + 4} + b_w$

---

37. The maximum spacing of shear reinforcement measured along the axis of the member shall ***not*** exceed _____ for the vertical stirrups, where 'd' is the effective depth of the section.

(1) 0·5 d (2) 0·7 d

(3) 0·75 d (4) 0·65 d

---

38. Determine the minimum and maximum longitudinal reinforcement for a square column of size 300 mm × 300 mm having a clear cover of 25 mm.

(1) 500 mm^2 and 3750 mm^2

(2) 500 mm^2 and 5400 mm^2

(3) 720 mm^2 and 3750 mm^2

(4) 720 mm^2 and 5400 mm^2

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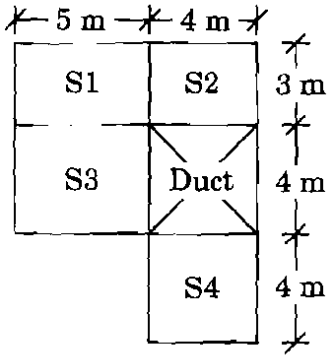
39. Match the end conditions for restrained slab panels :



a.	S1	I.	Four edges continuous
b.	S2	II.	One long edge continuous
c.	S3	III.	Two adjacent edges discontinuous
d.	S4	IV.	Four edges discontinuous
		V.	One short edge continuous

Select the correct response.

	a	b	c	d
(1)	IV	II	V	I
(2)	II	V	I	IV
(3)	III	V	II	IV
(4)	III	IV	II	V

40. For a simply supported beam of span 12 m, the basic value of span to effective depth ratio is

(1) 20 (2) 26 (3) 65/3 (4) 50/3

41. Match the conditions under which the given type of footing is used :

a.	Combined footing	I.	For two or more columns
b.	Mat foundation	II.	For isolated or group of columns
c.	Pile foundation	III.	For individual column
d.	Isolated footing	IV.	For supporting all columns of structure

Select the correct response.

	a	b	c	d
(1)	II	III	IV	I
(2)	I	IV	II	III
(3)	II	I	III	IV
(4)	II	IV	I	III

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42. The height of a retaining wall is 5·5 m. It is to be designed as

(1) Cantilever type (2) Counterfort type

(3) Cantilever or counterfort type (4) None of the above

---

43. A shear key is provided in a retaining wall to avoid

(1) Sliding (2) Overturning

(3) Buckling (4) Bending

---

44. The imposed floor load acting on staircase for residential and educational buildings is to be considered as

(1) 2·0 kN/m^2 and 3·0 kN/m^2 (2) 3·0 kN/m^2 and 2·0 kN/m^2

(3) 4·0 kN/m^2 and 3·0 kN/m^2 (4) 3·0 kN/m^2 and 4·0 kN/m^2

---

45. The extreme stress at the top and bottom edges of a prestressed beam when tendons are placed along the longitudinal axis of the beam are

(1) $\frac{P}{A} \pm \frac{M}{Z}$ (2) $\frac{P}{Z} \pm \frac{M}{A}$

(3) $\frac{P}{A} \pm \frac{M}{I}$ (4) $\frac{P}{I} \pm \frac{M}{A}$

---

46. A simply supported rectangular prestressed concrete beam is subjected to uniformly distributed live load over its entire span, such that the resulting stress at the midspan at bottom fiber is zero. The eccentricity at that section is d/6 below the C.G., where d is the depth of the beam. Location of the thrust line at that section is

(1) At C.G. (2) d/6 above C.G.

(3) d/6 below C.G. (4) d/3 below C.G.

---

47. A 4·8 m long post-tensioned prestressed concrete beam is prestressed by a parabolic cable with eccentricity of 15 mm above C.G. at both supports and 45 mm below C.G. at the midspan. The beam is tensioned from one end. In the estimation of maximum loss due to friction, what should be the cumulative angle turned by the parabolic profile ?

(1) 0·01 radians (2) 0·1 radians

(3) 0·15 radians (4) 0·02 radians

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48. In a pre-tensioned prestressed concrete cross-section,

Statement 1 :

The stress in wires is assumed to be zero at the end supports and increases to its final maximum value over its transmission length.

Statement 2 :

The bond stress between concrete and prestressed wires is maximum near the end supports and decreases to nearly zero over its transmission length.

(1) Statements 1 and 2 are true

(2) Statement 1 is true and statement 2 is false

(3) Statement 1 is false and statement 2 is true

(4) Statements 1 and 2 are false

---

49. To avoid sudden collapse just after a shear crack, minimum shear reinforcement is provided in prestressed concrete member in the form of stirrups. IS 1343 suggested the relation as

(1) $\frac{A_{sv}}{b \, . \, s_v} = \frac{0{\cdot}4 \, d}{0{\cdot}87 \, f_y}$

(2) $\frac{A_{sv}}{bd \, . \, s_v} = \frac{0{\cdot}4}{0{\cdot}87} \times f_y$

(3) $\frac{A_{sv}}{b \, . \, s_v} = \frac{0{\cdot}4}{0{\cdot}87 \, f_y}$

(4) $\frac{A_{sv}}{b \, . \, s_v} = \frac{0{\cdot}4 \, f_{ck}}{0{\cdot}87 \, f_y}$

---

50. What is the maximum possible eccentricity in a prestressed concrete beam of circular cross-section ? Diameter of the section is d. Tension is not allowed anywhere and any time in the cross-section. Neglect dead load (self-weight).

(1) d/8 (2) d/6

(3) d/4 (4) d/3

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51. What will be the maximum possible uniformly distributed load (inclusive of self-weight) over the entire span of a simply supported beam of span 'L' such that the deflection at midspan at service condition is zero ? The cross-section is rectangular. The prestressing force 'P' is applied with uniform eccentricity 'e'. Assume no losses.

(1) $\frac{8Pe}{L^2}$ (2) $\frac{8{\cdot}8Pe}{L^2}$

(3) $\frac{9{\cdot}6Pe}{L^2}$ (4) $\frac{10{\cdot}4Pe}{L^2}$

---

52. The loss due to creep in prestressed concrete shall be determined considering

(1) All loads and prestressing force

(2) Live loads and prestressing force

(3) Permanent loads and prestressing force

(4) Permanent loads only

---

53. The limit state of collapse for prestressed concrete is

(1) Limit state of collapse : Deflection

(2) Limit state of collapse : Cracking

(3) Limit state of collapse : Maximum compression

(4) None of the above

---

54. The designed prestressed concrete element should satisfy the limits specified for permissible stresses at transfer stage as well as service condition. The prestressing force 'P' and eccentricity 'e' evaluated from those limits are

(1) Maximum value of 'P' and maximum value of 'e'

(2) Maximum value of 'P' and minimum value of 'e'

(3) Minimum value of 'P' and maximum value of 'e'

(4) Minimum value of 'P' and minimum value of 'e'

---

55. During tensioning of prestressing tendons the breakage of wires in any one prestressed concrete member shall ***not*** exceed

(1) 2·5% (2) 7·5% (3) 10% (4) 12·5%

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56. Who is known as the Father of Scientific Management ?

(1) Robert Owen

(2) Elton Mayo

(3) F.W. Taylor

(4) Henry Fayol

---

57. ABC analysis is referred to as

(1) Always Better Control analysis

(2) Alphabetical Backup Control analysis

(3) Analytical Boost Crane analysis

(4) None of the above

---

58. A scaled drawing of the proposed construction site showing all the relevant features such as entry and exit points to the site, storage area for materials, toilets, workers quarters, etc. is called

(1) Construction Plan

(2) Job Layout

(3) Development Plan

(4) Architectural Plan

---

59. The event or events that immediately come before another event without any intervening events are called _____ events to that event.

(1) Successor

(2) Dummy

(3) Predecessor

(4) Slack

---

60. Which rule is used for numbering the events in a network, scientifically ?

(1) Stevenson's rule

(2) Jackson's rule

(3) Fulkerson's rule

(4) Watson's rule

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61. The cost inflow a firm receives if a machine still has value at the time of its disposal is known as

(1) Salvage value

(2) Purchase expenses

(3) Operating cost

(4) Ownership cost

---

62. Williams-Steiger Occupational Safety and Health Act (OSH Act) was passed in the year

(1) 1968 (2) 1970

(3) 1974 (4) 1972

---

63. Coefficient of traction for a crawler tractor is upto

(1) 0·9 (2) 0·6

(3) 1·2 (4) 1·0

---

64. Which of the following is a "Class-A" item in ABC analysis ?

(1) Items with low cost but large in number

(2) Items with average cost but moderate in number

(3) Items with high cost but few in number

(4) Items with high cost but large in number

---

65. Which of the following best defines "Negative Stock" ?

(1) Project ahead of schedule

(2) Project on schedule

(3) Project behind schedule

(4) None of the above

---

66. Quality circles in the construction industry can have the following participants :

(1) Engineers and architects

(2) Contractors and raw material suppliers

(3) Clients and consultants

(4) All of the above

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67. After solving the system

$$2x_1 + 4x_2 - 6x_3 = -8,$$

$$x_1 + 3x_2 + x_3 = 10, \text{ and}$$

$$2x_1 - 4x_2 - 2x_3 = -12$$

using Gauss-Jordan method, the values of x_1, x_2 and x_3 are

(1) (1, 2, 3) (2) (1, 3, 2)

(3) (3, 2, 1) (4) (3, 1, 2)

---

68. The solution of the equations

$$5x_1 + x_2 + x_3 + x_4 = 4$$

$$x_1 + 7x_2 + x_3 + x_4 = 12$$

$$x_1 + x_2 + 6x_3 + x_4 = -5$$

$$x_1 + x_2 + x_3 + 4x_4 = -6$$

by Gauss-Jordan method is

(1) $-1, -2, 1, 2$ (2) $-1, -2, -1, 2$

(3) $-1, 2, -1, 2$ (4) $1, 2, -1, -2$

---

69. To find the root of $f(x) = 0$ by using the bisection method, an iteration is begun with the lower and upper guesses of the root. If x_{lower} and x_{upper} are the roots, then at the end of the iteration, the absolute relative approximate error in the estimated value of the root would be

(1) $\left|\frac{x_{upper}}{x_{upper} + x_{lower}}\right|$ (2) $\left|\frac{x_{lower}}{x_{upper} + x_{lower}}\right|$

(3) $\left|\frac{x_{upper} - x_{lower}}{x_{upper} + x_{lower}}\right|$ (4) $\left|\frac{x_{upper} + x_{lower}}{x_{upper} - x_{lower}}\right|$

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70. With initial approximation of $x_1 = x_2 = x_3 = 0$, what is the next value of x_1 in the following set of simultaneous equations ?

$$27x_1 + 6x_2 - x_3 = 81$$

$$6x_1 + 15x_2 + 2x_3 = 75$$

$$x_1 + x_2 + 50x_3 = 110$$

(1) 2·25 (2) 3·0

(3) 3·25 (4) 4·0

71. Match the following :

a.	Newton-Raphson method	I.	f(x) is a linear function of 'x'
b.	Simpson's $1/3^{rd}$ rule	II.	The number of intervals must be even
c.	Trapezoidal rule	III.	Diagonal matrix
d.	Gauss Elimination	IV.	Solution of algebraic and transcendental equations
e.	Gauss-Jordan method	V.	Forward elimination and Backward substitution

Select the correct response.

	a	b	c	d	e
(1)	I	II	III	IV	V
(2)	II	III	I	V	IV
(3)	III	I	II	V	IV
(4)	IV	II	I	V	III

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72. The procedure adopted in the Gauss-Jordan method in solving linear simultaneous equations is

(1) It is required to assume initial approximate values of the variables.

(2) It reduces the given system of equations to a diagonal matrix.

(3) It reduces the given system of equations to an equivalent triangular system.

(4) The given matrix is factored into lower and upper triangular matrices.

---

73. The solution by Gauss-Jordan method for the following equations

$x + y + z = 9$

$2x - 3y + 4z = 13$

$3x + 4y + 5z = 40$

is

(1) $x = 1, y = 2, z = 5$

(2) $x = 1, y = 3, z = 5$

(3) $x = 2, y = 1, z = 3$

(4) $x = 1, y = 3, z = 2$

---

74. The Newton-Raphson method is said to have

(1) Linear convergence

(2) Superlinear convergence

(3) Quadratic convergence

(4) Oscillatory convergence

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75. Back substitution is required in the following method(s) in the solution of linear simultaneous equations :

(1) Gauss-Elimination method

(2) Gauss-Jordan method

(3) Iterative method

(4) All of the above

---

76. The following data is given for the velocity of a body as a function of time. It is required to find the velocity at t = 21 sec. For the purpose a quadratic polynomial $v(t) = at^2 + bt + c$ is to be used. The velocity profile is given as

t in sec	0	13	14	15	18	20	22	24
v(t) in m/s	0	225	248·5	316·6	517·35	535·35	570	589·5

The correct set of equations that will find a, b and c is

(1) $\begin{bmatrix} 169 & 13 & 1 \\ 225 & 15 & 1 \\ 324 & 18 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 248{\cdot}5 \\ 316{\cdot}6 \\ 517{\cdot}35 \end{bmatrix}$

(2) $\begin{bmatrix} 176 & 14 & 1 \\ 225 & 15 & 1 \\ 400 & 20 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 248{\cdot}5 \\ 316{\cdot}6 \\ 535{\cdot}35 \end{bmatrix}$

(3) $\begin{bmatrix} 169 & 13 & 1 \\ 196 & 14 & 1 \\ 225 & 15 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 225 \\ 248{\cdot}5 \\ 316{\cdot}6 \end{bmatrix}$

(4) $\begin{bmatrix} 324 & 18 & 1 \\ 484 & 22 & 1 \\ 225 & 15 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 517{\cdot}35 \\ 589{\cdot}50 \\ 316{\cdot}6 \end{bmatrix}$

---

77. During the determination of roots of equations $x^2 + 2xy = 6$ and $x^2 - y^2 = 3$ using the Newton-Raphson method, the value of Jacobian matrix 'D' is found to be

(1) – 4

(2) – 8

(3) – 12

(4) + 4

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78. What is the minimum crushing strength of Granite used in India ?

(1) 200 N/mm^2 (2) 100 N/mm^2

(3) 50 N/mm^2 (4) 250 N/mm^2

---

79. Which of the following is ***not*** a test for measuring the workability of concrete ?

(1) Slump Test (2) Flow Test

(3) Le Chatelier's Test (4) Compaction Factor Test

---

80. Which of the following is a field test for measuring the consistency of plastic concrete ?

(1) Le Chatelier's Test (2) Compaction Factor Test

(3) Elongation Index Test (4) Kelly Ball Test

---

81. In which type of bond is cavity existing ?

(1) Flemish bond (2) English bond

(3) Rat-trap bond (4) Stretcher bond

---

82. Which of the following is a method of mechanical ventilation ?

(1) Plenum System (2) Bleeding System

(3) Segregation System (4) Natural Ventilation System

---

83. Gypsum is added to Portland cement during its manufacturing so that it may

(1) Accelerate the setting time

(2) Retard the setting time

(3) Decrease the burning temperature

(4) Facilitate grinding

---

84. Principles of planning for buildings include

a. Aspect and Prospect b. Roominess

c. Grouping d. Flexibility and Privacy

Answer options :

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

(3) a and c only (4) a, b, c and d

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85. Timber can be made reasonably fire-resistant by

(1) Soaking it in Ammoniam Sulphate

(2) Coating it with Tar paint

(3) Pumping creosote oil into timber under high pressure

(4) Seasoning process

---

86. Which of the following is ***not*** a non-destructive test ?

(1) Rebound Hammer Test

(2) Surface Hardness Test

(3) Ultrasonic Pulse Velocity Test

(4) Soundness Test

---

87. Which is the major constituent of ordinary Portland cement ?

(1) CaO (2) MgO (3) SO_3 (4) Fe_2O_3

---

88. Which is an example of cased cast-in-situ concrete pile ?

(1) Raymond pile (2) Watson pile

(3) Reynold pile (4) Boston pile

---

89. As per building bye-laws, for fixing up the height of a building, which rule is generally used ?

(1) $63\frac{1}{2}^\circ$ Rule (2) $37\frac{2}{3}^\circ$ Rule

(3) $65\frac{1}{2}^\circ$ Rule (4) 45° Rule

---

90. The stress developed due to external force in an elastic material

(1) Depends on elastic constant

(2) Does not depend on elastic constant

(3) Depends partially on elastic constant

(4) Depends on limit of proportionality

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91. The Modulus of Elasticity in terms of Bulk Modulus and Modulus of Rigidity is

(1) $\frac{9KG}{3K+G}$ (2) $\frac{9KG}{K+3G}$ (3) $\frac{3K+G}{9KG}$ (4) $\frac{K+3G}{9KG}$

---

92. In case of biaxial stresses, the maximum value of shear stress is

(1) Difference of normal stresses

(2) Half the difference of normal stresses

(3) Sum of normal stresses

(4) Half the sum of normal stresses

---

93. If a solid circular shaft is simultaneously subjected to a torque 'T' and a bending moment 'M', the ratio of maximum bending stress and maximum torsional shearing stress is given by

(1) M/T (2) T/M

(3) 2M/T (4) 2T/M

---

94. The slenderness ratio of a vertical column of square cross-section of 2·5 cm sides and 300 cm effective length, is

(1) 200 (2) 360

(3) 240 (4) 416

---

95. Columns of given length, cross-section and material have different values of buckling loads for different end conditions. The strongest column is one whose

(1) one end is fixed and the other end is hinged

(2) both the ends are hinged or pin-jointed

(3) one end is fixed and the other entirely free

(4) both the ends are fixed

---

96. A circular shaft was initially subjected to bending moment and then was subjected to torsion. If the magnitude of bending moment is found to be the same as that of the torque, then the ratio of maximum bending stress to shear stress would be

(1) 0·25 (2) 0·50

(3) 2·0 (4) 4·0

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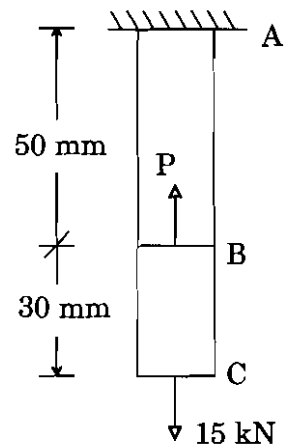
97. A steel bar ABC of uniform cross-section 100 mm^2 is suspended vertically and loaded as shown in the figure. If the lower end of bar C does not move when loads are applied (neglect self-weight), then the value of force P is (E_s = 200 kN/mm^2)



(1) 24 kN (2) 42 kN (3) 36 kN (4) 15 kN

---

98. Principal stresses at a point in a plane stressed element are $\sigma_x = \sigma_y$ = 500 N/mm^2. Normal stress on the plane inclined at 45° to the x-axis will be

(1) Zero (2) 500 N/mm^2

(3) 1000 N/mm^2 (4) 707 N/mm^2

---

99. The Euler's crippling load for a 2 m long slender steel rod of uniform cross-section hinged at both the ends is 1 kN. The Euler's crippling load for a 1 m long steel rod of the same cross-section and hinged at both the ends will be

(1) 0·25 kN (2) 0·5 kN

(3) 2 kN (4) 4 kN

---

100. A solid shaft of diameter 'D' carries a twisting moment that develops maximum shear stress. If the shaft is replaced by a hollow one of outside diameter 'D' and inside diameter $\frac{\text{'D'}}{2}$, then the maximum shear stress will be

(1) 1·067 τ (2) 1·143 τ

(3) 1·33 τ (4) 2 τ

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सूचना – (पृष्ठ 1 वरून पुढे.....)

(8) प्रश्नपुस्तिकेमध्ये विहित केलेल्या विशिष्ट जागीच कच्चे काम (रफ वर्क) करावे. प्रश्नपुस्तिकेव्यतिरिक्त उत्तरपत्रिकेवर वा इतर कागदावर कच्चे काम केल्यास ते कॉपी करण्याच्या उद्देशाने केले आहे, असे मानले जाईल व त्यानुसार उमेदवारावर शासनाने जारी केलेल्या "परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचे अधिनियम-82" यातील तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.

(9) सदर प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपल्यानंतर उमेदवाराला ही प्रश्नपुस्तिका स्वत:बरोबर परीक्षाकक्षाबाहेर घेऊन जाण्यास परवानगी आहे. **मात्र परीक्षा कक्षाबाहेर जाण्यापूर्वी उमेदवाराने आपल्या उत्तरपत्रिकेचा भाग-1 समवेक्षकाकडे न विसरता परत करणे आवश्यक आहे.**

नमुना प्रश्न

Pick out the correct word to fill in the blank :

Q. No. 201. I congratulate you _____ your grand success.

(1) for (2) at

(3) on (4) about

ह्या प्रश्नाचे योग्य उत्तर "(3) on" असे आहे. त्यामुळे या प्रश्नाचे उत्तर "(3)" होईल. यास्तव खालीलप्रमाणे प्रश्न क्र. **201** समोरील उत्तर-क्रमांक "③" हे वर्तुळ पूर्णपणे छायांकित करून दाखविणे आवश्यक आहे.

प्र. क्र. 201. ① ② ● ④

अशा पद्धतीने प्रस्तुत प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाचा तुमचा उत्तरक्रमांक हा तुम्हाला स्वतंत्ररीत्या पुरविलेल्या उत्तरपत्रिकेवरील त्या त्या प्रश्नक्रमांकासमोरील संबंधित वर्तुळ पूर्णपणे छायांकित करून दाखवावा. **ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.**

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