

JEEDEC-2017

Subject : MECHANICAL ENGINEERING

Time Allowed : 2 Hours

Maximum Marks : 100

Booklet No. **70200096**.....

INSTRUCTIONS

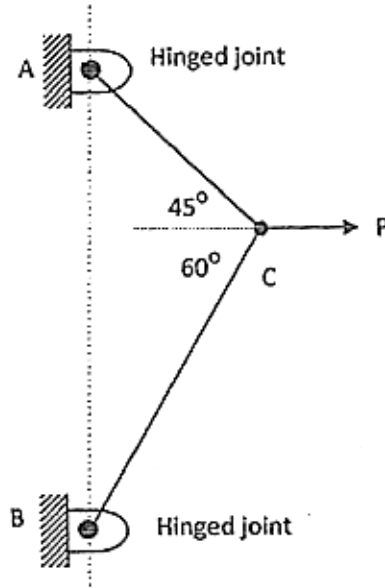
Candidates should read the following instructions carefully before answering the questions:

1. This question paper contains 50 MCQ type objective questions. Each question has four answer options given, viz. A, B, C and D.
2. Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer or any combination of more than one answer will fetch $-\frac{1}{2}$ marks. No answer will fetch 0 marks.
3. Questions must be answered on OMR sheet by darkening the appropriate bubble marked A, B, C, or D.
4. Use only **Black/Blue ball point pen** to mark the answer by complete filling up of the respective bubbles.
5. Mark the answers only in the space provided. Do not make any stray mark on the OMR.
6. Write question booklet number and your roll number carefully in the specified locations of the **OMR**. Also fill appropriate bubbles.
7. Write your name (in block letter), name of the examination centre and put your full signature in appropriate boxes in the OMR.
8. The OMRs will be processed by electronic means. Hence it is liable to become invalid if there is any mistake in the question booklet number or roll number entered or if there is any mistake in filling corresponding bubbles. Also it may become invalid if there is any discrepancy in the name of the candidate, name of the examination centre or signature of the candidate vis-a-vis what is given in the candidate's admit card. The **OMR** may also become invalid due to folding or putting stray marks on it or any damage to it. The consequence of such invalidation due to incorrect marking or careless handling by the candidate will be sole responsibility of candidate.
9. Rough work must be done on the question paper itself. Additional blank pages are given in the question paper for rough work.
10. Handover the OMR to the invigilator before leaving the Examination Hall.

Space for Rough work

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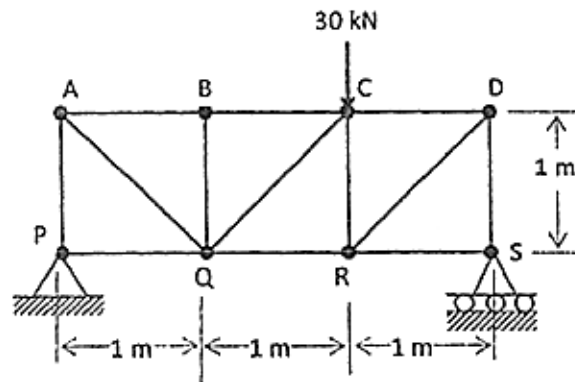
1.



Two members AC and BC are subjected to a horizontal force $P = 1 \text{ kN}$ at point C as shown in the figure. Magnitude of vertical component of reaction force at B in kN is

- (A) 0.634 (B) 0.324
(C) 1.26 (D) 1.46

2.



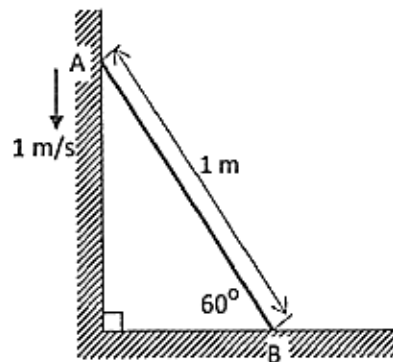
For the plane truss shown in the figure, the magnitude of force induced in the member CD is

- (A) 10 kN (B) 14.14 kN
(C) 20 kN (D) 28.28 kN

3. A car moving with uniform acceleration travels 450 m in 5 seconds and another 700 m in the next 5 seconds. Acceleration of the car is

- (A) 7 m/s^2 (B) 10 m/s^2
 (C) 15 m/s^2 (D) 25 m/s^2

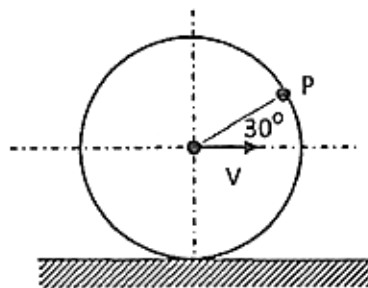
4.



A rod of length 1m is sliding in a corner as shown in the figure. At the instant shown, velocity of point A is 1 m/s downward. Magnitude of the angular speed of the rod at that instant is

- (A) 2 rad/s (B) 1.5 rad/s
 (C) 0.75 rad/s (D) 0.5 rad/s

5.



A circular disc rolls without slipping on a horizontal floor such that the velocity of its centre is V as shown in the figure. Absolute velocity of point P on the periphery of the disc is

- (A) $\sqrt{3}V$ (B) $\frac{\sqrt{3}V}{2}$
 (C) $\frac{V}{2}$ (D) $\frac{2V}{\sqrt{3}}$

6. During direct inelastic collision of two bodies which one of the following is conserved?

- (A) Total linear momentum only (B) Total kinetic energy only
(C) Both linear momentum and kinetic energy (D) Neither linear momentum nor kinetic energy

7. A bullet of mass m travelling horizontally at a high speed V gets embedded in a block of mass M , resting on a rough horizontal plane. The block and the bullet is seen to move a distance S along the floor before coming to rest. If μ is coefficient of friction between the block and the floor, then V is

- (A) $\frac{M-m}{m}\sqrt{2\mu gs}$ (B) $\frac{M+m}{m}\sqrt{2\mu gs}$
(C) $\frac{\mu(M+m)}{m}\sqrt{2\mu gs}$ (D) $\frac{M}{m}\sqrt{2\mu gs}$

g being the acceleration due to gravity.

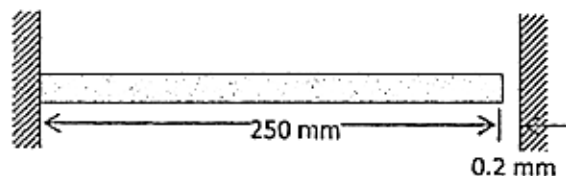
8. A circular solid disc of uniform thickness 20 mm, radius 200 mm and mass 20 kg rotates at 600 rpm about the fixed centroidal polar axis. The kinetic energy of the disc is approximately

- (A) 395 J (B) 790 J
(C) 1580 J (D) 3160 J

9. A rod of length L and diameter D is subjected to an axial tensile load P . Which of the following is sufficient to calculate the resulting change in diameter?

- (A) Young's modulus (B) Shear modulus
(C) Poisson's ratio (D) Both Young's modulus and Shear modulus

10.



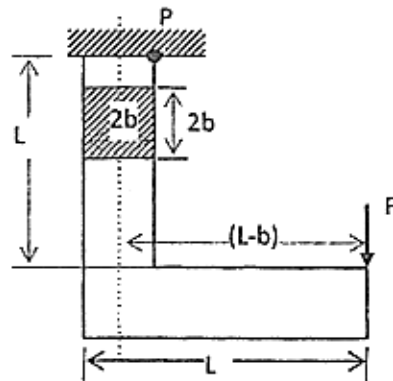
A circular metallic rod of length 250 mm is placed between two rigid immovable supports as shown in the figure. Temperature of the rod is increased by 200°C through heating. If Young's modulus and coefficient of linear expansion of the material of the rod be 200 GPa and $10^{-5}/^{\circ}\text{C}$ respectively, the axial stress developed in the rod is

- (A) 220 MPa (B) 240 MPa
(C) 260 MPa (D) 280 MPa

11. A shaft with a circular cross-section is subjected to a pure torque. The ratio of the largest principal stress to the maximum shear stress is

- (A) 2.0 (B) 1.0
(C) 0.5 (D) 0

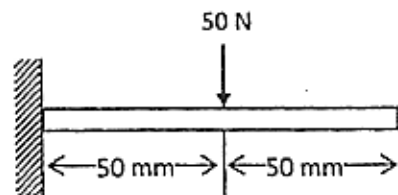
12.



For the component loaded with a force F as shown in the figure, the normal stress at the point P is

- (A) $\frac{F(3L - b)}{4b^3}$ (B) $\frac{F(3L + b)}{4b^3}$
 (C) $\frac{F(3L - 4b)}{4b^3}$ (D) $\frac{F(3L - 2b)}{4b^3}$

13.



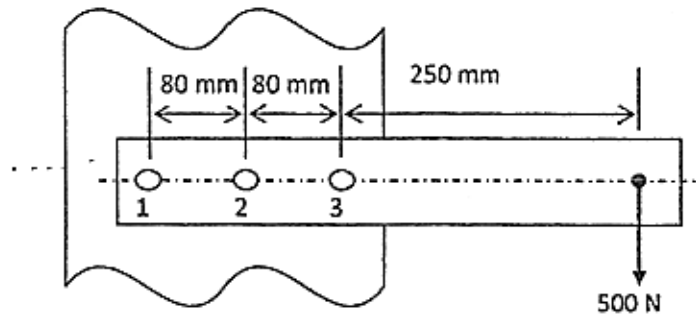
A cantilever beam with flexural rigidity 200 Nm^2 is loaded as shown in the figure. The deflection at the free end of the beam is close to

- (A) 0.22 mm (B) 0.24 mm
 (C) 0.26 mm (D) 0.28 mm

14. The state of stress at a point in the critical section of a machine component is given by $\sigma_x = 80 \text{ MPa}$, $\sigma_y = 20 \text{ MPa}$ and $\tau_{xy} = 40 \text{ MPa}$. If the yield strength of the material be 200 MPa , then factor of safety prevailing at that point according to the maximum shear stress theory is

- (A) 1.0 (B) 2.0
 (C) 2.5 (D) 3.3

15.



A plate is riveted to a vertical steel column by three identical equispaced rivets as shown in the figure. The most critically loaded rivet is

- (A) Rivet 1
(B) Rivet 2
(C) Rivet 3
(D) Unpredictable
16. For fatigue loading, factor of safety is the ratio of
(A) endurance limit to the working stress.
(B) elastic limit to the working stress.
(C) elastic limit to the yield strength.
(D) Young's modulus to the ultimate tensile strength.
17. In a Cottered joint, the cotter may fail by
(A) both tension and compression but no shear.
(B) both tension and shear but no crushing.
(C) both bending and shear and crushing.
(D) only shear and crushing.
18. Which of the following keys transmits power through frictional resistance only?
(A) Tangent key
(B) Saddle key
(C) Woodruff key
(D) Sunk key
19. Which one of the following is the energy equation?
(A) Euler's equation
(B) Bernoulli's equation
(C) Continuity equation
(D) Darcy Weisbach equation
20. Euler's equation may be written as
(A) $\frac{dp}{\rho} + v^2 dv + g dz = 0$
(B) $\frac{dp}{\rho} + v dv + g dz = 0$
(C) $\frac{dp}{\rho} + v dv + g^2 dz = 0$
(D) $\frac{dp}{\rho^2} + v dv + g dz = 0$

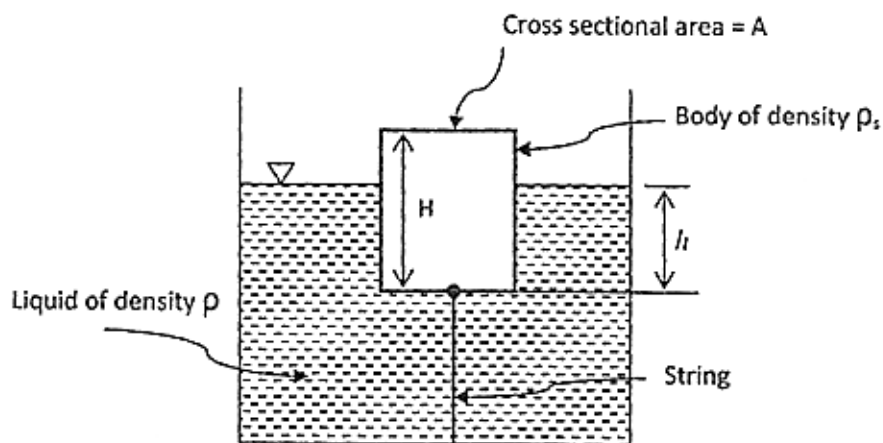
21. A pitot tube is used for measuring

- (A) velocity of flow
(B) pressure of flow
(C) flow rate
(D) total energy

22. A circular plate 1m in diameter is submerged vertically in water such that its topmost point is 8 m below the free surface of water. Total hydrostatic force acting on one side of the plate is close to

- (A) 6.7 kN
(B) 65.4 kN
(C) 45 kN
(D) 77 kN

23.



A prismatic body of uniform cross-sectional area A , height H and density ρ_s is immersed to a depth h in a liquid of density ρ as shown in the figure. It is tied to the bottom and the string is taut in equilibrium. Tension of the string is

- (A) ρghA
(B) $(\rho - \rho_s) gHA$
(C) $(\rho_s - \rho) ghA$
(D) $(\rho h - \rho_s H) gA$

24. In a rectangular channel, the critical depth is given by

- (A) $\left(\frac{q^2}{2g}\right)^{1/3}$
(B) $\left(\frac{q^2}{g}\right)^{1/3}$
(C) $\left(\frac{2q^2}{g}\right)^{1/3}$
(D) $\left(\frac{3q^2}{g}\right)^{1/3}$

q being the discharge rate per unit width and g is the acceleration due to gravity.

25. In order to have maximum power from a pelton turbine, the bucket speed must be

- (A) equal to the jet speed.
(B) equal to half of the jet speed.
(C) equal to twice the jet speed.
(D) independent of the jet speed.

26. Consider two hydraulic turbines having identical specific speed and equal effective head at the inlet. If the speed ratio of the two turbines is 2, then the respective power ratio is

(A) $\frac{1}{2}$

(B) $\frac{1}{\sqrt{2}}$

(C) $\frac{1}{4}$

(D) $\frac{1}{8}$

27. With increasing temperature of intake air, CI engine efficiency

(A) decreases

(B) increases

(C) remains same

(D) depends on other factors

28. An air standard diesel cycle consists of

(A) two adiabatic and two constant volume processes.

(B) two constant volume and two isothermal processes.

(C) one constant volume, one isobaric and two adiabatic processes.

(D) one isobaric, one constant volume and two isothermal processes.

29. An ideal Brayton cycle, operating between pressure limits 1 bar and 6 bar has minimum and maximum temperatures at 300 K and 1500 K respectively. Final temperatures at the end of compression and expansion processes are close to

(A) 500 K and 900 K respectively

(B) 900 K and 500 K respectively

(C) 500 K and 5400 K respectively

(D) 900 K and 900 K respectively

30. A reversible heat engine receives 2kJ of heat from a reservoir at 1000 K and a certain amount of heat from another reservoir at 800 K. If it rejects 1 kJ of heat to a third reservoir at 400 K, then work output of the engine is

(A) 0.8 kJ

(B) 1.0 kJ

(C) 1.4 kJ

(D) 2.0 kJ

31. The condenser of a refrigeration system rejects heat at a rate of 120 kW, while its compressor consumes power at a rate of 30 kW. The C.O.P. of the system would be

(A) $\frac{1}{4}$

(B) 4

(C) $\frac{1}{3}$

(D) 3

32. Specific enthalpy and velocity of steam at inlet and exit of a steam turbine, running under steady state, are as follows:

	sp. enthalpy(kJ/kg)	Velocity(m/s)
Inlet	3250	180
Exit	2360	5

Rate of heat loss from turbine per kg of steam is 5 kW. Power development by the steam turbine per kg of steam is

- (A) 901.2 kW (B) 911.2 kW
(C) 17072.5 kW (D) 17082.5 kW

33. A diesel engine has a compression ratio of 17 and cut-off takes place at 10% of the stroke. Assuming ratio of specific heats as 1.4, the air-standard efficiency is

- (A) 49.6% (B) 59.6%
(C) 62% (D) Insufficient data

34. For minimum work in compressor operating between pressure limits p_1 and p_3 , the best intercooler pressure p_2 is given by

- (A) $p_2 = \frac{p_3 - p_1}{2}$ (B) $p_2 = \frac{p_3 + p_1}{2}$
(C) $p_2 = \sqrt{p_1 p_3}$ (D) $p_2 = \frac{p_3^2}{p_1}$

35. The air standard efficiency of a closed gas turbine cycle is given by

- (A) $\eta = 1 - \frac{1}{r_p^{\gamma-1}}$ (B) $\eta = 1 - (r_p)^{\gamma-1}$
(C) $\eta = 1 - \left(\frac{1}{r_p}\right)^{\gamma-1}$ (D) $\eta = (r_p)^{\frac{\gamma-1}{\gamma}} - 1$

Symbols have usual meaning.

36. Heat Conduction through a hollow cylinder in the radial direction may be expressed as

$$(A) \quad Q = \frac{2\pi l(t_1 - t_2)k}{\log_e \frac{r_2}{r_1}}$$

$$(B) \quad Q = \frac{2\pi l(t_1 - t_2)}{k(r_2 - r_1)}$$

$$(C) \quad Q = \frac{2\pi l \log_e \left(\frac{t_1}{t_2} \right)}{(r_2 - r_1)k}$$

$$(D) \quad \frac{2\pi l(t_2 - t_1)k}{\log_e \frac{r_2}{r_1}}$$

Where, k = thermal conductivity

l = length of cylinder

r_1, r_2 = internal and external radii of the hollow tube

t_1, t_2 = temperatures at internal and external surfaces respectively

37. For infinite parallel planes with emissivities ϵ_1 and ϵ_2 , the interchange factor for radiation from surface 1 to surface 2 is given by

$$(A) \quad \frac{\epsilon_1 \epsilon_2}{\epsilon_1 + \epsilon_2 - \epsilon_1 \epsilon_2}$$

$$(B) \quad \frac{1}{\epsilon_1} + \frac{1}{\epsilon_2}$$

$$(C) \quad \epsilon_1 + \epsilon_2$$

$$(D) \quad \epsilon_1 \epsilon_2$$

38. The law governing the distribution of radiant energy over wavelength of a black body at fixed temperature is referred to as

(A) Planck's Law

(B) Wien's Law

(C) Kirchhoff's Law

(D) Lambert's Law

39. The size of BUE in metal cutting increases with

(A) very high cutting speed.

(B) large uncut chip thickness.

(B) use of cutting fluid.

(D) increase in positive rake angle.

40. For cutting double start screw threads of pitch 1.00mm on a lathe, the thread cutting tool should have a feed rate of

(A) 0.5 mm/rev

(B) 1.0 mm/rev

(C) 2.0 mm/rev

(D) 4.0 mm/rev

41. In a machining operation, doubling the cutting speed reduces the tool life to $\frac{1}{8}$ th of the original value. The exponent of the Taylor's tool life equation is
- (A) $\frac{1}{2}$ (B) $\frac{1}{3}$
 (C) $\frac{1}{4}$ (D) $\frac{1}{8}$
42. If the index crank of a dividing head is turned through one complete revolution and 10 holes in a 30 hole circle plate, the work piece turns through
- (A) 6° (B) 12°
 (C) 24° (D) 48°
43. A single point cutting tool with 12° rake angle is used to machine a steel work piece. The depth of cut is 0.81 mm. If the chip thickness under orthogonal cutting condition be 1.8 mm, the shear angle is close to
- (A) 26° (B) 36°
 (C) 56° (D) 76°
44. The rake angle of a cutting tool is 15° , shear angle 45° and cutting speed 35m/min. The velocity of chip along the tool face is
- (A) 28.5 m/min (B) 27.3 m/min
 (C) 25.3 m/min (D) 23.5 m/min
45. Where is the simplex method used?
- (A) In queuing theory (B) In PERT/CPM network
 (C) In value analysis (D) In Linear Programming
46. Interchangeability can be achieved by
- (A) standardisation (B) better process planning
 (C) simplification (D) better product planning
47. A PERT network has three activities on critical path with mean time 3, 8 and 6, and standard deviations 1, 2 and 3 respectively. The probability that the project will be completed in 20 days is
- (A) 0.50 (B) 0.66
 (C) 0.84 (D) 0.95
48. By a 'Rotameter', one can measure
- (A) specific gravity (B) viscosity
 (C) flow (D) rotation

49. A fit designated by 40 H8/f7 will result in a/an

- (A) clearance fit (B) interference fit
(C) transition fit (D) Not predictable

50. 'Dynamometer' is a device used for the measurement of

- (A) chip thickness ratio. (B) forces during metal cutting.
(C) wear of the cutting tool. (D) deflection of the cutting tool.
-

Space for Rough work

Space for Rough work

JEEDEC-2017

Subject : MECHANICAL ENGINEERING

সময় : ২ ঘণ্টা

সর্বাধিক নম্বর : ১০০

Booklet No.

নির্দেশাবলি

পরীক্ষার্থীদের উত্তর দেওয়ার পূর্বে নির্দেশাবলি ভালো করে পড়ে নিতে হবে :

- ১। এই প্রশ্নপত্রে 50টি MCQ ধরনের প্রশ্ন দেওয়া আছে। প্রতিটি প্রশ্নের A, B, C এবং D এই চারটি সম্ভাব্য উত্তর দেওয়া আছে।
- ২। সঠিক উত্তর দিলে 2 নম্বর পাবে। ভুল উত্তর দিলে অথবা যে কোনো একাধিক উত্তর দিলে $-\frac{1}{2}$ নম্বর পাবে। কোনো উত্তর না দিলে শূন্য পাবে।
- ৩। OMR পত্রে A, B, C অথবা D চিহ্নিত সঠিক ঘরটি ভরাট করে উত্তর দিতে হবে।
- ৪। OMR পত্রে উত্তর দিতে শুধুমাত্র কালো/নীল বল পয়েন্ট পেন ব্যবহার করবে।
- ৫। OMR পত্রে নির্দিষ্ট স্থান ছাড়া অন্য কোথাও কোনো দাগ দেবে না।
- ৬। OMR পত্রে নির্দিষ্ট স্থানে প্রশ্নপত্রের নম্বর এবং নিজের রোল নম্বর অতি সাবধানতার সাথে লিখতে হবে এবং প্রয়োজনীয় ঘরগুলি পূরণ করতে হবে।
- ৭। OMR পত্রে নির্দিষ্ট স্থানে নিজের নাম ও পরীক্ষাকেন্দ্রের নাম লিখতে হবে এবং নিজের সম্পূর্ণ স্বাক্ষর দিতে হবে।
- ৮। OMR উত্তরপত্রটি ইলেকট্রনিক যন্ত্রের সাহায্যে পড়া হবে। সুতরাং, প্রশ্নপত্রের নম্বর বা রোল নম্বর ভুল লিখলে অথবা ভুল ঘর ভরাট করলে উত্তরপত্রটি অনিবার্য কারণে বাতিল হতে পারে। এছাড়া পরীক্ষার্থীর নাম, পরীক্ষাকেন্দ্রের নাম বা স্বাক্ষরে কোনো ভুল থাকলেও উত্তরপত্র বাতিল হয়ে যেতে পারে। OMR উত্তরপত্রটি ভাঁজ হলে বা তাতে অনাবশ্যক দাগ পড়লেও বাতিল হয়ে যেতে পারে। পরীক্ষার্থীর এই ধরনের ভুল বা অসতর্কতার জন্য উত্তরপত্র বাতিল হলে একমাত্র পরীক্ষার্থী নিজেই তার জন্য দায়ী থাকবে।
- ৯। প্রশ্নপত্রে রাফ কাজ করার জন্য ফাঁকা জায়গা দেওয়া আছে। অন্য কোনো কাগজ এই কাজে ব্যবহার করবে না।
- ১০। পরীক্ষাকক্ষ ছাড়ার আগে OMR পত্র অবশ্যই পরিদর্শককে দিয়ে যাবে।