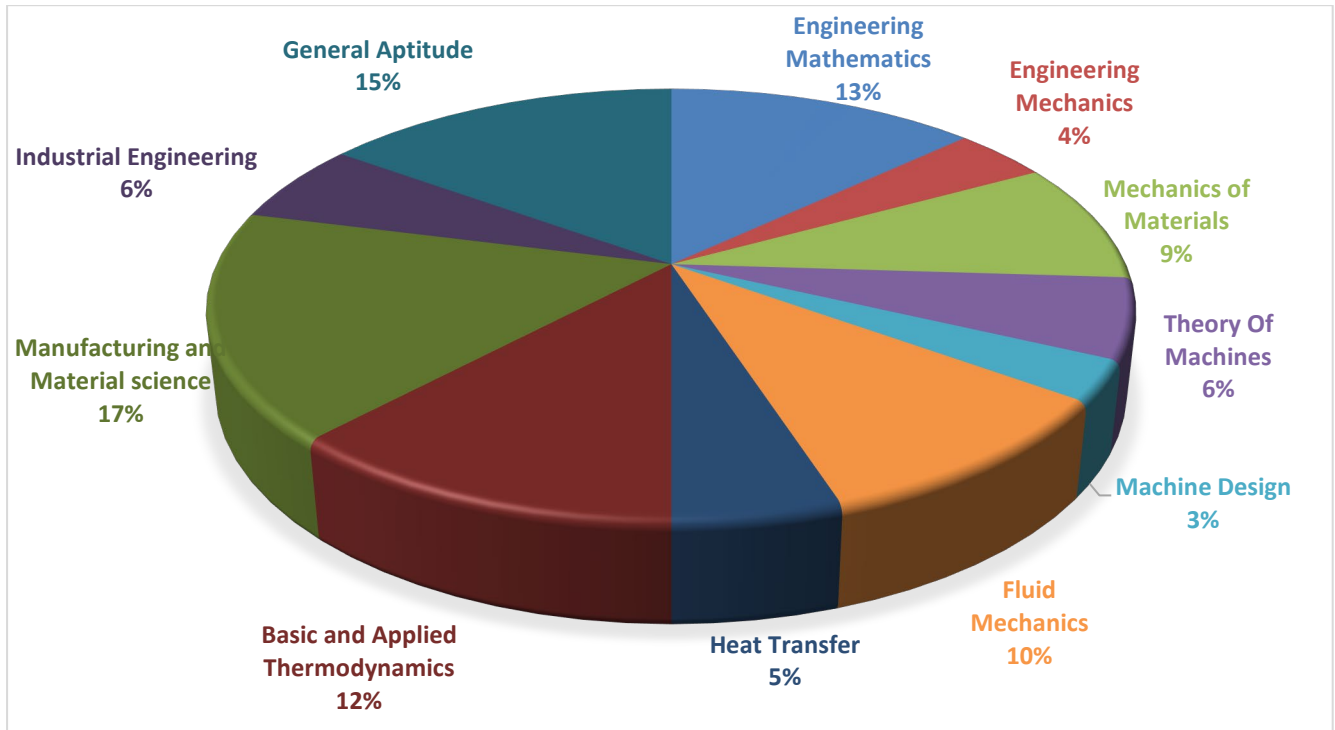




**ANALYSIS OF GATE 2020**  
Memory Based

**Mechanical Engineering**



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### ME ANALYSIS-2020\_Feb-1\_Afternoon

SUBJECT	No. of Ques.	Topics Asked in Paper(Memory Based)	Level of Ques.	Total Marks
Engineering Mathematics	1 Marks:5 2 Marks:4	Matrix, Laplace transform, Complex variable, Integration, Probability	Average	13
Engineering Mechanics	1 Marks:2 2 Marks:1	Kinematics(pure rolling)	Average	4
Mechanics of Materials	1 Marks:1 2 Marks:4	Bending moment, Deflection, Thermal expansion	Difficult	9
Theory Of Machines	1 Marks:2 2 Marks:2	Damping factor, Kinematic chain, Flywheel, Gears, Epicyclic gear, Vibration	Average	6
Machine Design	1 Marks:1 2 Marks:1	Design of springs	Easy	3
Fluid Mechanics	1 Marks:4 2 Marks:3	Metacenter, Bernoulli, Oscillation, Degree of reaction, Barometer	Easy	10
Heat Transfer	1 Marks:1 2 Marks:2	Conduction, Convection, Radiation	Easy	5
Basic and Applied Thermodynamics	1 Marks:2 2 Marks:5	Reverse carnot cycle, Diesel cycle, Psychrometry	Average	12
Manufacturing and Material science	1 Marks:5 2 Marks:6	Welding, Machining, Material science, Forging, Casting, Metal cutting, CNC, Metrology, Non-tradition machine	Difficult	17
Industrial Engineering	1 Marks:2 2 Marks:2	PERT, Inventory, Forecasting	Average	6
General Aptitude	1 Marks:5 2 Marks:5	Data Interpretation, Percentage, Time and Work	Average	15
<b>Total</b>	<b>65</b>			<b>100</b>
Faculty Feedback	Overall paper was average level.			



## GATE 2020 Examination\* (Memory Based)

### Mechanical Engineering

Test Date: 1<sup>st</sup> Feb-2020

Test Time: 2.30 pm to 5.30 pm

Stream Name: Mechanical Engineering

### General Aptitude

Q.1 - Q.5 Carry One Mark each.

1. If the product price is increased by 25% at each level, what is the price paid by the customer \_\_\_\_\_.(in Rs.)

120	Q	R	S	T	Customer
P					

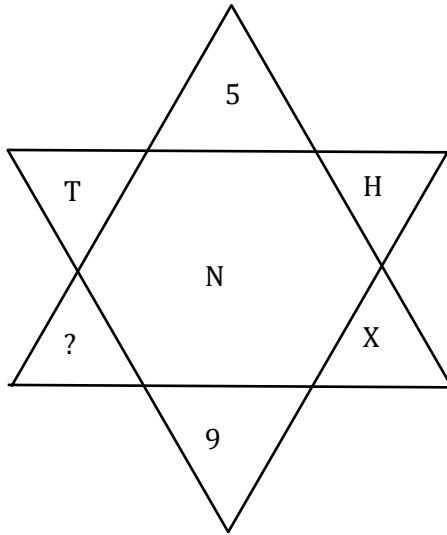
- (A) 234.38  
 (B) 187.5  
 (C) 366.21  
 (D) 292.96
2. Select the word that fits the analogy  
 White: Whitening :: Light: \_\_\_\_\_  
 (A) lightening  
 (B) ligthing  
 (C) lightning  
 (D) enlightening
3. Recent measure to improve the output would \_\_\_\_\_the level of productivity to our satisfaction  
 (A) decrease  
 (B) increase  
 (C) speed  
 (D) equalize
4. In one of the greatest innings ever seen in 142 years of test history, ben stokes upped the temperature in a five and half hour story of 219 balls including 11 fours and 8 sixes that saw him finish on 135 not out as England squared the 5 match series.  
 Which of the meaning does not match?  
 (A) upped=increased  
 (B) squared=lost  
 (C) tempo=enthusiasm  
 (D) saw=result



5. A

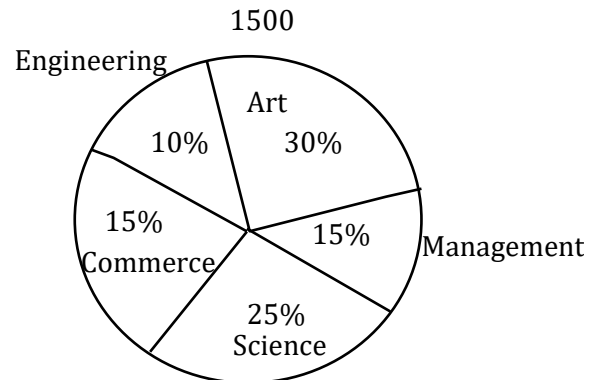
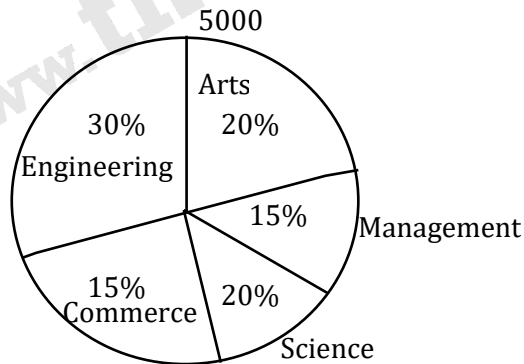
Q.6 - Q.10 Carry Two Mark each.

6. Find the missing element



- (A) E
- (B) Y
- (C) D
- (D) W

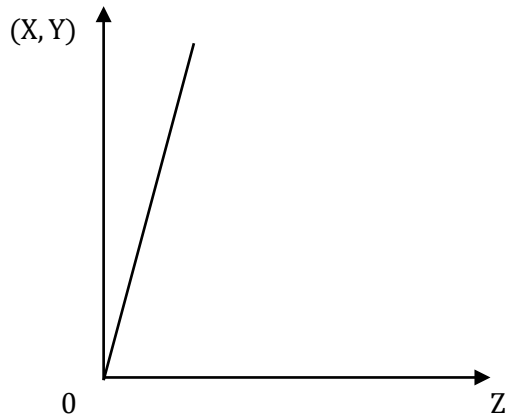
7. The pie charts given below. Show the data of total students and only girls registered in different streams in a university. If the total number of registered students is 5000 and the total number of girls is 1500 then the ratio of boys enrolled in arts to the girls enrolled in the management is \_\_\_\_\_.



- (A) 2:1
- (B) 9:22
- (C) 11:9
- (D) 22:9



8. An Engineer measures 3 quantities X, Y and Z in an experiment. She finds that they follow a relationship that is represented in the figure below. [The product of X and Y linearly varies with Z].



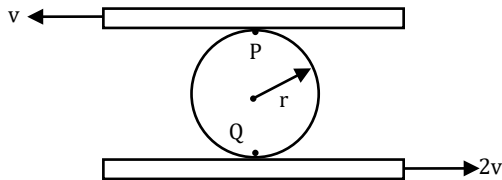
Then which statement is false?

- (A) for fixed Z;  $X \propto Y$   
(B) for fixed X;  $Z \propto Y$   
(C)  $XY/Z$  is constant  
(D) For fixed Y;  $X \propto Z$
9. It was estimated that 52 men can complete a strip in a highway in 10 days. Due to an emergency 12 men were sent to another project. How many number of days more than the original estimate will be required to complete the strip?  
(A) 3  
(B) 10  
(C) 5  
(D) 13
10. A

### Technical

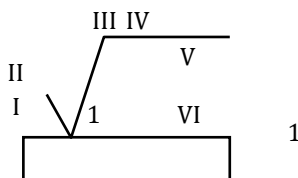
Q.1 - Q.25 Carry One Mark each.

1. A circular disc is confined to roll without slipping at P & Q as shown in figure.



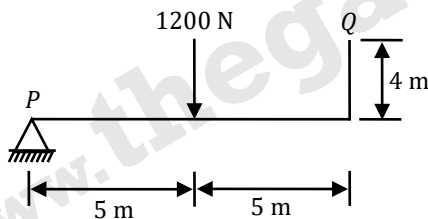
If plates have velocities as shown, the magnitude of angular velocity of disc is

- (A)  $\frac{3v}{2r}$   
 (B)  $\frac{v}{2r}$   
 (C)  $\frac{2v}{3r}$   
 (D)  $\frac{v}{r}$
2. Tapered horn, to focus mechanical energy for machining of glass  
 (A) AJM  
 (B) EDM  
 (C) ECM  
 (D) USM
3. Bars of 250 mm length and 25 mm diameter are to be turned on a lathe with a feed of 0.2mm/rev. each regrinding of tool costs Rs. 20. The time required for each tool change is 1min tool like equation is given as  $VT^{0.2} = 24$  (V cutting speed in m/min T is tool like in min). The optimum tool cost per piece for maximum production rate is Rs \_\_\_\_\_.
4. Symbolic representation of surface texture in a perpendicular lay orientation with indicative values (I through VI), marking the various specifications whose definition are listed below.  
 (P) Maximum Waviness Height (mm)  
 (Q) Maximum Roughness Height (mm)  
 (R) Minimum Roughness Height (mm)  
 (S) Maximum waviness width (mm)  
 (T) Maximum roughness width (mm)  
 (U) Roughness width cut off (mm)



5. In materials requirement planning, if inventory holding cost is very high and the setup cost is zero. Which one of the following lot sizing approaches should be used?
- (A) Base stock level  
 (B) Economic order quantity  
 (C) Fixed period quantity for 2 periods  
 (D) Lot- for -lot
6. Which one of the following statements about a phase diagram is incorrect?
- (A) Relative amount of different phases can be found under given equilibrium conditions  
 (B) It gives information on transformation rates  
 (C) It indicates the a temperature at which different phases start to melt  
 (D) Solid solubility limits are depicted by it
7. Two plates each of 6mm thickness are to be build welded. Consider the following processes and select the correct sequence in increasing under of size of heat affected zone
- 1) AE  
 2) HIG  
 3) LBW  
 4) SAW
- (A) 3-4-1-1  
 (B) 1-4-2-3  
 (C) 3-2-4-1  
 (D) 4-3-2-1

8. A beam of negligible mass is hinged at support P at roller supported at point Q



A point load of 1200 N is applied at point R. The magnitude of reaction force at support Q is \_\_\_\_\_ N.

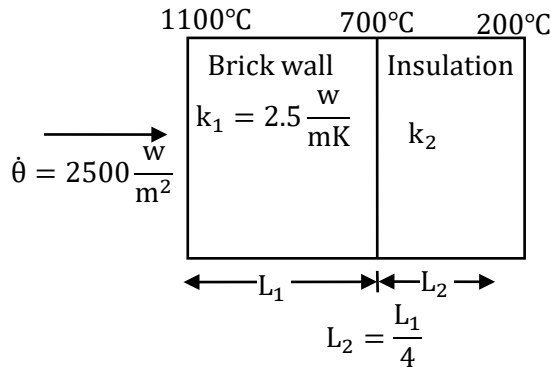
9. The directional derivative of  $f(x, y, z) = xyz$  at point  $(-1, 1, 3)$  in the direction of vector  $\hat{i} - 2\hat{j} + 2\hat{k}$  is
- (A)  $-\frac{7}{3}$   
 (B)  $3\hat{i} - 3\hat{j} - \hat{k}$   
 (C) 7  
 (D)  $\frac{7}{3}$



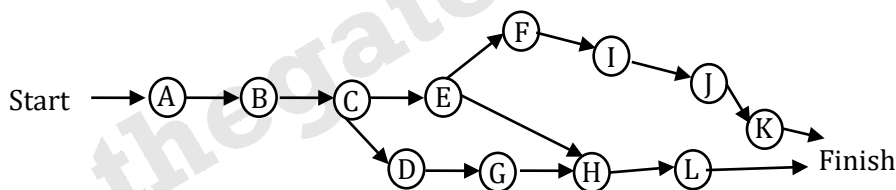
10. A fair coin is tossed 20 times. The probability that head will appear exactly 4 times in the first 10 tosses and tail will appear exactly 4 times in the next 10 tosses is \_\_\_\_\_.  
(Upto 3 decimal).
11. Let  $I$  be a 100 dimensional identity matrix and  $E$  be the set of its distinct (no value appears more than once in  $E$ ) real Eigen values. The number of elements in  $E$  is \_\_\_\_\_.
12. The solution of  $\frac{d^2y}{dt^2} - y = 1$ , which additionally satisfies  $Y|_{t=0} = \frac{dy}{dt}|_{t=0} = 0$  in the Laplace S-domain is  
(A)  $\frac{1}{s-1}$   
(B)  $\frac{1}{s(s+1)(s-1)}$   
(C)  $\frac{1}{s(s-1)}$   
(D)  $\frac{1}{s(s+1)}$
13. The sum of 2 normally distributed R.V.,  $X$  and  $Y$  is  
(A) normally distributed only if  $X$  and  $Y$  are independent  
(B) normally distributed only if  $X$  and  $Y$  have the same S.D  
(C) always normally distributed  
(D) always normally distributed and have the same mean
14. In the space above the Hg column in a Baro tube, the gauge pressure of vapour is  
(A) +ve;  $> 1$  atm  
(B) -ve  
(C) 0  
(D) +ve;  $< 1$  atm
15. A partially submerged body is stable if  
(A)  $M$  lies above  $G$   
(B)  $M$  lies below  $G$   
(C)  $B$  lies below  $G$   
(D)  $B$  lies above  $G$



16. For the composite wall maintained at steady state find out the velocity  $k_2$



17. The spherical distribution of radiation from block body of  $T_1 = 3000 \text{ K}$  has a maximum  $W \cdot L = \lambda_{\text{max}}$ . The body cools down at  $T_2$ . If  $\lambda_2 = 1.2 \lambda_{\text{max}}$  then  $T_2 = \text{_____ K}$
18. Water flows through a 3 cm ID and  $L = 30 \text{ m}$ . The outside surface of the tube is heated electrically so that it is subjected to uniform heat flux circumferentially and axially.  $T_{m1} = 10^{\circ}\text{C}$ ,  $T_{m2} = 70^{\circ}\text{C}$ ,  $\dot{m} = 720 \text{ kg/m}$ . Disregard the thermal resistance of tube wall,  $h_i = 1697 \text{ W/m}^2\text{K}$ ,  $C_p = 4.179 \text{ kJ/kgK}$ . The inner surface temperature at the exit section of the tube is \_\_\_\_\_ $^{\circ}\text{C}$
19. Consider the following network of activities, with each activity named A-L illustrated in the nodes of the network



20. In materials requirement planning, if inventory holding cost is very high and the setup is zero, which one of the following lot sizing approaches should be used?
- (A) Based stock level
  - (B) Economic order quantity
  - (C) Fixed point quantity, for 2 points
  - (D) Lot-for-lot



21. The forecast for the monthly demand of a product is in the table below

Month	Forecast	Actual Sales
1	32	30.00
2	31.8	32.00
3	31.82	30.00

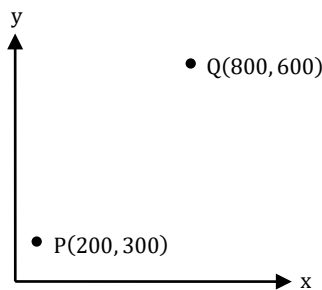
The forecast is made by using exponential smoothing method. The exponential smoothing coefficient used in forecasting the demand is

- (A) 0.10  
(B) 1.00  
(C) 0.50  
(D) 0.40
22. If a reversible Carnot cycle operates between the temperature of  $27^{\circ}\text{C}$  and  $-3^{\circ}\text{C}$  then  $(\text{COP})_{\text{ref}}/(\text{COP})_{\text{HPis}}$  \_\_\_\_\_
23. For an air standard diesel cycle  
(A) HA at  $V = C$ , HR at  $P = C$   
(B) HA at  $V = C$ , HR at  $V = C$   
(C) HA at  $P = C$ , HR at  $V = C$   
(D) HA at  $P = C$ , HR at  $P = C$
24. A
25. A

Q.26 - Q.55 Carry Two Mark each.

26. A helical spring has spring constant  $K$ . If wire diameter, spring diameter and number of coils are doubled then the spring constant of new spring becomes  
 (A)  $16K$   
 (B)  $8K$   
 (C)  $K$   
 (D)  $K/2$
27. Two identical shaping machines  $S_1 \times S_2$ . In machine  $S_2$  the width of work piece is increased by 10% and feed is decreased by 10% with respect to that of  $S_1$ . If all other condition remain the same then the ratio of total time per pass in  $S_1$  &  $S_2$  will be\_\_\_\_\_

28. A point 'P' on a CNC controlled x y-stage is moved to another point Q using the coordinate system shown below and rapid partitioning command G00.



A pair of stepping motors with maximum speed of 800 rpm. controlling both the x & y motion of the stage are directly coupled to a pair of lead screw each with a uniform pitch of 0.5mm. Time needed=?

29.  $V = 1100$  cc, sprue = 10 cm CSA at base of sprue  $2 \text{ cm}^2$ ,  $g = 9.81 \text{ m/s}^2$  P. T =?

30. Cylindrical bar 200 mm diameter turned

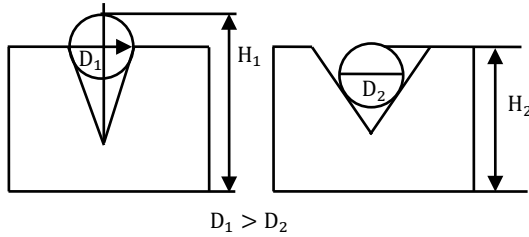
0-9-7-8-15-30-0.05 (inch)  $\rightarrow F_{c1}$

0-9-7-8-15-0-0.05 (inch)  $\rightarrow F_{c2}$

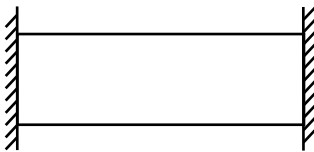
$SPCE \text{ (J/mm}^3) = U_c = U_o(t_1)^{0.4}$

$t_1 =$  uncut chip thickness

$$\left( \frac{F_{c2} - F_{c1}}{F_{c1}} \right) \times 100 = ?$$

31.  $\alpha = ?$ 

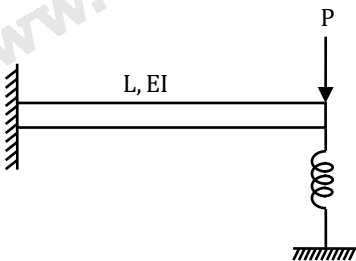
32. A thin walled cylindrical of radius 'r' and thickness 't' is opened at both ends and fits slightly between two rigid walls under ambient conditions as shown in figure.



The material of cylinder has young's modulus 'E', Poisson's ratio  $\gamma$  and coefficient of thermal expansion ' $\alpha$ '. What is the minimum rise in temperature  $\Delta T$  of cylinder (assume uniform cylinder temperature with no buckling of cylinder) required to prevent gas leakage, if the cylinder has to store the gas at internal pressure of P above the atmosphere

- (A)  $\Delta T = \frac{\gamma Pr}{\alpha t E}$   
 (B)  $\Delta T = \left(\gamma - \frac{1}{4}\right) \frac{Pr}{\alpha t E}$   
 (C)  $\Delta T = \left(\gamma + \frac{1}{2}\right) \frac{Pr}{\alpha t E}$   
 (D)  $\Delta T = \frac{3\gamma Pr}{2\alpha t E}$

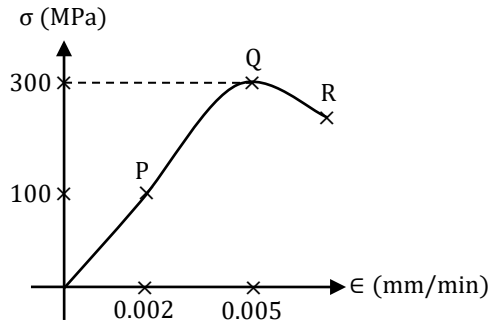
33. A cantilever of length 'l' and flexural rigidity EI stiffened by a spring of stiffness K is loaded by a transverse force P as shown



The transverse deflection under the load is

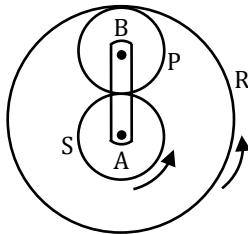
- (A)  $\frac{PL^3}{3EI} \left( \frac{3EI}{3EI + 2KL^3} \right)$   
 (B)  $\frac{PL^3}{3EI} \left( \frac{6EI - KL^3}{6EI} \right)$   
 (C) K  
 (D)  $\frac{PL^3}{3EI} \left( \frac{3EI - KL^3}{3EI} \right)$

34. Uniaxial compression test data for a solid metal bar of length 1 m is shown in figure.



The bar material has a linear response from O to P followed by a nonlinear response. The point P represents the yield point of material. The rod is pinned at both the ends. The minimum diameter of bar so that it does not buckle under axial loading before reaching the yield point \_\_\_\_\_ mm.

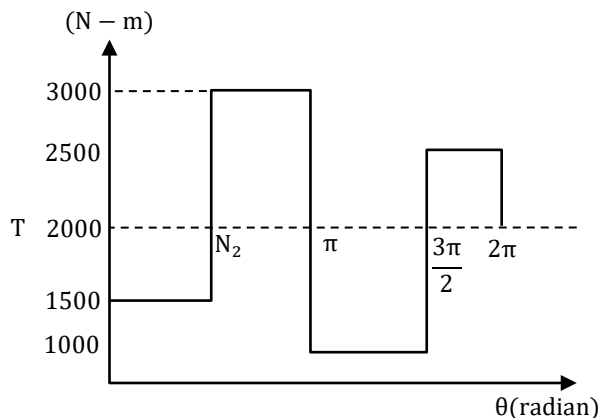
35. The sum (S) and planet (P) of an Epicyclic gear train shown in figure have identical number of teeth.



If sun (S) and outer ring (R) gear are rotated in same direction with angular speed  $\omega_S$  &  $\omega_R$  respectively, then angular speed of arm AB is

- (A)  $\frac{3}{4} \omega_R + \frac{1}{4} \omega_S$
- (B) 1
- (C)  $\frac{3}{4} \omega_R - \frac{1}{4} \omega_S$
- (D)  $\frac{1}{2} \omega_R - \frac{1}{2} \omega_S$

36. The turning moment diagram of flywheel fitted to a fictitious engine is shown in figure.

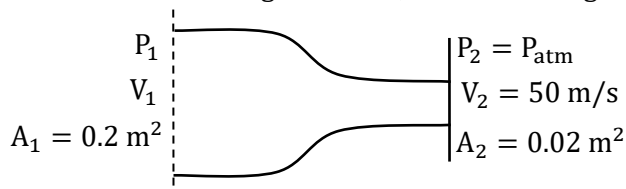


If  $T_m = 2000 \text{ N} - \text{m}$  average, engine speed is 1000 RPM. For the fluctuation of speed within  $\pm 2\%$ . The mass moment of inertia of flywheel \_\_\_\_\_  $\text{kg} - \text{m}^2$

37. The function  $y(z)$  of a complex variable  $z = x + iy$ ; where  $i = \sqrt{-1}$  is given as  $f(z) = (x^3 - 3xy^2) + i v(x, y)$ . For this function to be analytic  $v(x, y)$  should be
- (A)  $(3x^2y^2 - y^3) + \text{Constant}$   
 (B)  $(3xy^2 - y^3) + \text{Constant}$   
 (C)  $(3x^2y - y^3) + \text{Constant}$   
 (D)  $(x^3 - 3x^2y) + \text{Constant}$

38. For the integral  $\int_0^{\pi} (8 + 4 \cos x) dx$ , the absolute % error in numerical evaluation with the trapezoidal rule, using only the end points is \_\_\_\_\_ (1 decimal place).

39. Consider flow through a nozzle, as shown in figure



The air flow is steady, incompressible and inviscid ( $\rho_{\text{air}} = 1.23 \text{ kg/m}^3$ ). The pressure difference ( $P_1 - P_{\text{atm}}$ ) is \_\_\_\_\_ kPa.

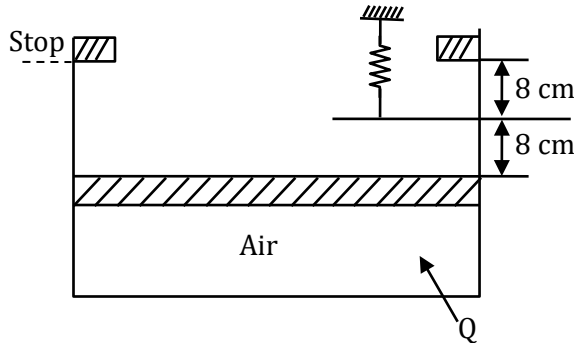
[Ans. \*]Range: 1.522 to 1.522

40. Water ( $\rho = 1000 \text{ kg/m}^3$ ) flow through an inclined pipe of uniform diameter. The velocity, pressure and elevation at section a are  $V_A = 3.2 \text{ m/s}$ ,  $P_A = 186 \text{ kPa}$  and  $Z_A = 24.5 \text{ m}$  respectively and those at B are  $V_B = 3.2 \text{ m/s}$ ,  $P_B = 260 \text{ kPa}$ ,  $Z_B = 9.1 \text{ m}$ ,  $g = 10 \text{ m/s}^2$  then the  $h_L$  due to friction is \_\_\_\_\_ m

[Ans. \*]Range: 8 to 8

41. A hollow spherical ball of radius 20 cm floats in still water with half of volume submerging taking  $\rho_w = 1000 \text{ kg/m}^3$  and  $g = 10 \text{ m/s}^2$ . The  $\omega_n$  of small oscillation of ball normal to water surface is \_\_\_\_\_

42. Air is contained in a frictionless piston cylinder arrangement as shown in figure



$$P_{atm} = 100 \text{ kPa}$$

$$P_i = 105 \text{ kPa}$$

$$A_p = 300 \text{ cm}^2$$

Heat is added and piston moves slowly until it reaches the stop  $k = 12.5 \text{ N/mm}$ .

Considering the air inside the cylinder system, the work interaction is \_\_\_\_\_ J

43. Keeping all the other parameters identical, the C.P of an A.S diesel cycle is  $\uparrow$  from 15 to 21.  $r = 1.3, s = 2$ . The difference between new and old efficiencies values (in %)  $\eta_{nes} - \eta_{old} = \text{_____}\%$
44. One kg of air in a closed system undergoes an irrelevant process from  $P_1 = 1 \text{ bar}, T_1 = 27^\circ\text{C}$  to a final state of  $P_2 = 3 \text{ bar}, T_2 = 127^\circ\text{C}, R = 287 \text{ J/kgK}, r = 1.4 (s_2 - s_1) = \text{_____J/kgK}$ .
45. Moist air at 105 kPa,  $30^\circ\text{C}$  and 80% RH flows over a cooling coil in an insulated A-C duct. Saturated air exits the duct at 100 kPa and  $15^\circ\text{C}$ .  $P_{sat}$  for water of  $30^\circ\text{C}$  and  $15^\circ\text{C}$  are 4.24 kPa and 1.7 kPa respectively. The mass of water considering out from the duct is \_\_\_\_\_ g/kg of D.A
46. In a steam PP, sub heated steam of 10 MPa,  $500^\circ\text{C}$  is expanded isentropically in turbine until it becomes saturation vapour. It is then reheated at  $P = C$  to  $500^\circ\text{C}$ . The steam is next expanded isentropically in turbine until it reaches the  $P_c = 20 \text{ kPa}$ . The properties are given  $\omega_{T_1} + \omega_{T_2} = \text{_____kJ/kg}$

Sup. steam				Sat. Steam					
P(MPa)	T( $^\circ\text{C}$ )	h	s	P	T	h		S	
						$h_f$	$h_g$		
10	500	3373.6	6.5965	1 MPa	179.91	762.4	2778.1	2.1386	6.5965
1	500	3478.4	7.7621	70 kPa	60.06	251.38	2609.7	0.8319	7.9085



- 47. A
- 48. A
- 49. A
- 50. A
- 51. A
- 52. A
- 53. A
- 54. A
- 55. A
- 56. A
- 57. A
- 58. A
- 59. A
- 60. A
- 61. A
- 62. A
- 63. A
- 64. A
- 65. A

Will update soon



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