

# Gate Mock Test-VI

## with Solution

Thermal, Fluid mechanics, Heat transfer,  
Theory of machines, Machine Design, Production,  
Mathematics and General aptitude

# Mechanical

By: Mr. Arvind Rai



**i-Gate Mentor**



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# ***i-Gatementor***

## ***Mock Test- 6***

***Instructions:***

1. *This paper contains 65 questions*
2. *All questions are compulsory*
3. *Q. 1-25 & 56-60 carry one mark each*
4. *Q. 26-55 & 61-65 carry two marks each*
5. *Q. 1-25 & 56-60, 1/3 marks deducted for each wrong answer*
6. *Q. 26-51 & 61-65, 2/3 marks deducted for each wrong answer*
7. *linked answer questions 52-55, 2/3 marks deducted for wrong answer of 52 & 54.*
8. *Q 53 & 55, there is no negative marking, but marks will be awarded for these questions if the first part is correct*

***Syllabus:***

***Thermal, Fluid mechanics, Heat transfer, Theory of machines, Machine Design, Production, Mathematics and General aptitude***

**Q.1 – Q.25 Carry One Mark Each**

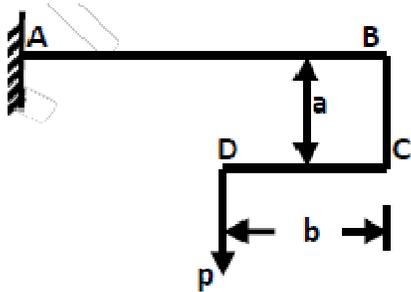
- A singular matrix of third order with all real entries has an Eigen value  $\omega$ , where  $\omega$  is the cube root of unity, the other two Eigen values can be

(A)  $1, \omega^2$                       (B)  $1, -\omega^2$                       (C)  $0, \omega^2$                       (D)  $0, -\omega^2$
- $\int_{-i}^{+i} \frac{dz}{z}$  is

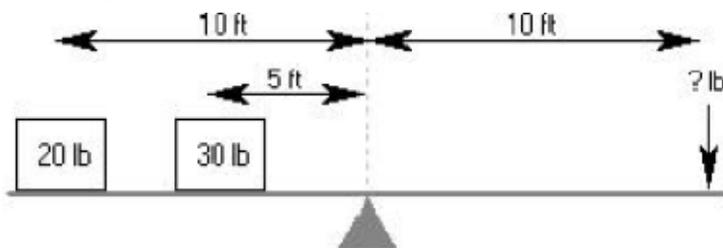
(A)  $2\pi$                       (B)  $\pi i$                       (C)  $0$                       (D) None
- The directional derivative of  $\phi = xy^2 + yz^3$  at point  $(2, -1, 1)$  in the direction of the normal to the surface  $x \log z - y^2 = -4$  at  $(-1, 2, 1)$  is

(A)  $\frac{9}{\sqrt{17}}$                       (B)  $\frac{15}{\sqrt{17}}$                       (C)  $9$                       (D)  $15$
- The inverse Laplace transform of  $\frac{s}{s^2 - 2s + 2}$  is

(A)  $e^t(\cos t + \sin t)$                       (B)  $e^t(\cos t - \sin t)$   
 (C)  $e^{-t}(\cos t + \sin t)$                       (D)  $e^{-t}(\cos t - \sin t)$
- A structural member ABCD is loaded as shown in the given figure. The shearing force at any section on the length BC of the member is



- (A)  $0$                       (B)  $P$                       (C)  $\frac{Pa}{b}$                       (D)  $\frac{Pb}{a}$
- The weight required to balance the lever is



- (A) 25lbs                      (B) 30lbs                      (C) 35lbs                      (D) 40lbs
7. The ratio of bulk modulus to shear modulus for poisson's ratio of 0.25 will be  
(A) 3/2                      (B) 5/2                      (C) 1                      (D) 5/3
8. A piece of ice slides down a  $45^\circ$  incline in twice the time it takes to slide down a frictionless  $45^\circ$  incline. The coefficient of friction between the ice and incline is  
(A) 1/3                      (B) 1/2                      (C) 2/3                      (D) 3/4
9. Which gas power cycle operating in a close system consisting of four processes during which work alone is transferred during two processes and heat alone is transferred during the other two processes?  
(A) Atkinson cycle      (B) Carnot cycle      (C) Diesel cycle      (D) Otto cycle
10. A heat engine of 18% efficiency rejects 180kJ of heat to the sink, heat supplied and work output respectively (in kJ) are  
(A) 212.4, 32.4      (B) 219.5, 39.5      (C) 32.4, 212.4      (D) 39.5, 219.5
11. In a boiler, feed water supplied per hour is 205 kg while coal fired per hour is 23 kg. Net enthalpy rise per kg of water is 145 kJ for conversion to steam. If the calorific value of coal is 2050 kJ/kg, then the boiler efficiency will be  
(A) 78%                      (B) 74%                      (C) 63%                      (D) 59%
12. A jet of water issues from a nozzle with a velocity of 20 m/s and it impinges normally on a flat plate moving away from it at 10 m/s. If the cross-sectional area of the jet is  $0.02 \text{ m}^2$  and the density of water is taken as  $1000 \text{ kg/m}^3$ , then the force developed on the plate will be  
(A) 10N                      (B) 100 N                      (C) 1000N                      (D) 2000N
13. An inclined manometer, inclined at  $30^\circ$  to horizontal, measures the pressure differential between two locations of a pipe carrying water. If the manometric liquid is mercury (specific gravity 13.6) and the manometer showed a level difference of 20 cm, then the pressure head difference of water between the two tapping's will be  
(A) 1.26 m                      (B) 1.36 m                      (C) 2.52 m                      (D) 2.72 m
14. An activity has three time estimates as 12, 18 and 30. Which of the following pair shows the correct value for expected time of activity and variance?  
(A) 13, 9                      (B) 19, 4                      (C) 19, 9                      (D) 13, 4
15. Design of shafts of brittle materials is based on  
(A) Guest's Theory      (B) Rankine's Theory      (C) St. Venant Theory      (D) Von Mises Theory
16. Arrange the following in ascending order in terms of their conductivities  
I - copper                      II - silver                      III - wood                      IV - mild steel  
(A) IV < III < II < I      (B) III < IV < II < I      (C) III < IV < I < II      (D) IV < III < I < II
17. The inner and outer surface area of a sphere are  $20 \text{ cm}^2$  and  $45 \text{ cm}^2$  respectively. The thickness of sphere is 15 cm and thermal conductivity is  $120 \text{ W/cm-K}$ . The thermal resistance of the sphere will be

- (A)  $2.77 \times 10^{-3}$       (B)  $3.846 \times 10^{-3}$       (C)  $4.167 \times 10^{-3}$       (D)  $6.25 \times 10^{-3}$
18. A composite wall consists of three different materials having thermal conductivities K, 2K, and 4K respectively the temperature drop across different materials will be in the ratio  
 (A) 1: 1: 1    (B) 1: 2: 4    (C) 4: 2: 1    (D) 2: 4: 1
19. A fin will be effective only when biot number is  
 (A)  $< 1$                       (B)  $> 1$                       (C)  $= 1$                       (D) Infinite
20. Stroke of a shaping machine is 250 mm. it makes 30 cutting strokes per minute. Overall average speed of operation is  
 (A) 3.75 m/min                      (B) 5.0 m/min                      (C) 7.5 m/min                      (D) 15 m/min
21. To reduce the consumption of synthetic resins, the ingredient added is  
 (A) accelerator                      (B) elastomer                      (C) modifier                      (D) filler
22. In MIG welding, the metal is transferred in the form of  
 (A) A fine spray of metal    (B) Molten drops                      (C) Weld pool                      (D) Molecules
23. Match the **list I** with **list II**:

**List I**

**List II**

- |   |                              |     |  |
|---|------------------------------|-----|--|
| E | Biot number                  | I   | Shape factor determination                                     |
| F | Laplace equation             | II  | Heat conduction equation under steady state condition          |
| G | Poisson equation             | III | Fin designing  |
| H | Hottel's cross string Method | IV  | Heat conduction equation under steady state and no heat source |

- (A) E – I, F – II, G – III, H – IV                      (B) E – II, F – III, G – IV, H – I  
 (C) E – III, F – IV, G – II, H – I                      (D) E – IV, F – II, G – III, H – I

24. A hydraulic turbine is running at 125 r.p.m. and the turbine has an overall efficiency of 90% under the discharge of  $12\text{m}^3/\text{sec}$ . What will be the specific speed of turbine if power developed by turbine is 750KW  
 (A) 100                      (B) 200                      (C) 300                      (D) 400
25. Choose the correct statement from the following  
 I Runner is a part of turbine  
 II Impeller is a part of reaction turbine  
 III Draft tube is a part of reaction turbine  
 IV Cavitations phenomenon can occur anywhere i.e. either at inlet or outlet of rotor  
 V Specific speed of turbine is given as  $\frac{N\sqrt{P}}{H^{3/4}}$  where N,P and H has usual meaning

- (A) I, III and IV only      (B) II, IV and V only      (C) I, II and III only      (D) All are true

**Q.26 – Q.55 Carry One Mark Each**

26. If  $A \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix} =$  then  $A^5 - 4A^4 - 7A^3 + 11A^2 - A - 10I$  is equal to

- (A)  $-A + 5I$       (B)  $-A + 25I$       (C)  $A + 25I$       (D)  $A + 5I$

27. If  $u = \log_e \left( \frac{x^m + y^m}{x^n + y^n} \right)$ , then

(A)  $X \frac{\partial u}{\partial x} + Y \frac{\partial u}{\partial y} = m - n$       (B)  $X \frac{\partial u}{\partial x} + Y \frac{\partial u}{\partial y} = (m - n)u$

(C)  $X \frac{\partial u}{\partial x} - Y \frac{\partial u}{\partial y} = m - n$       (D)  $X \frac{\partial u}{\partial x} - Y \frac{\partial u}{\partial y} = (m - n)u$

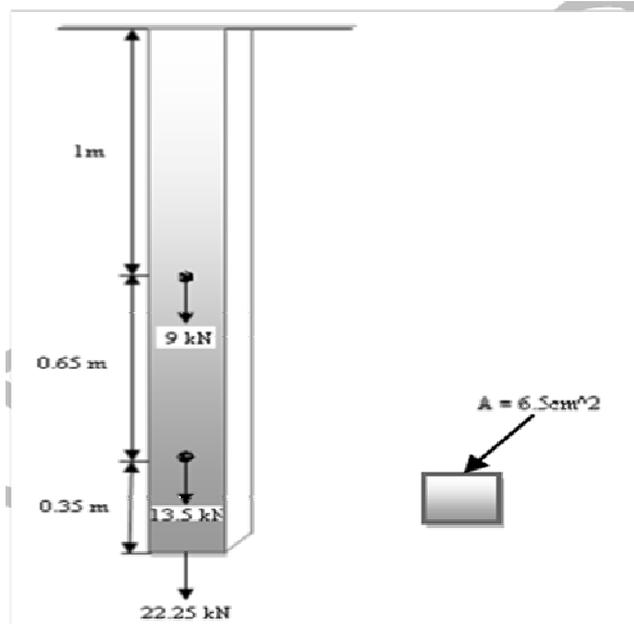
28. If  $x^2 \frac{dy}{dx} + 2xy = \frac{2 \ln x}{x}$  and  $y(1) = 0$  then what is the value of  $y(e)$ ?

- (A)  $e$       (B)  $1$       (C)  $1/e$       (D)  $1/e^2$

29. Let  $X$  has the density function  $f(X) = 0.75(1 - x^2)$  if  $-1 \leq x \leq 1$  and zero otherwise. The value of  $x$  such that  $p(X < x) = 0.95$

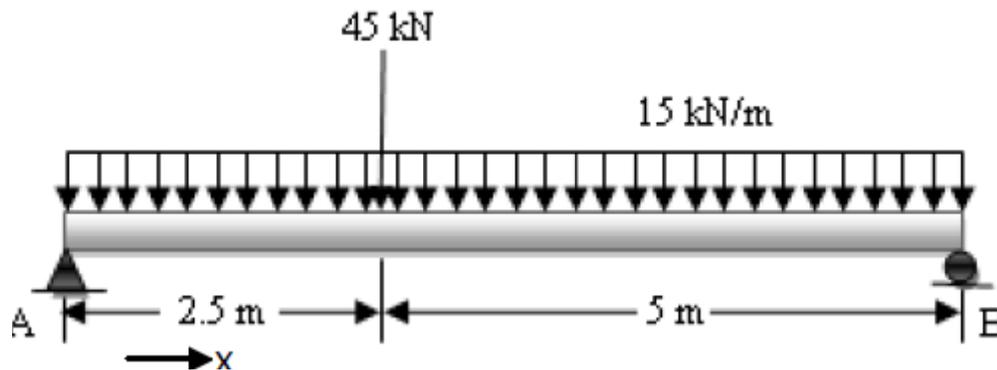
- (A)  $0.35$       (B)  $0.29$       (C)  $0.73$       (D)  $0.86$

30. A steel bar of  $c/s$  area of  $6.5 \text{ cm}^2$  as shown is suspended vertically. 3 concentric downward loads are applied to the bar.  $22.25 \text{ kN}$  at the lower end,  $13.5 \text{ kN}$  at  $0.35 \text{ m}$  above the lower end and  $9 \text{ kN}$  at  $1 \text{ m}$  above the lower end. The modulus of elasticity of the steel is  $210 \text{ GPa}$ . What is the total change in the length of the bar?



- (A) 0.19 mm      (B) 0.56 mm      (C) 0.66 mm      (D) 0.98 mm

31. For the beam shown, where does the maximum moment occur?



- (A) 2.5 m from A      (B) 2.75 m from A      (C) 3.25 m from A      (D) 3.5 m from A

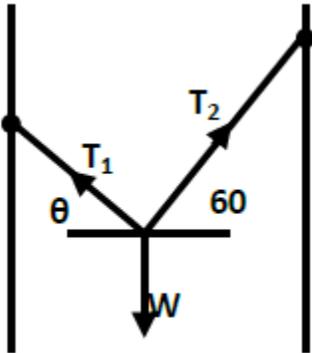
32. Which of the following stresses are associated with the tightening of a nut on a stud?

1. Tensile stress due to stretching of the stud
2. Bending stress of stud
3. Transverse shear stresses across the threads
4. Torsional shear stresses in threads due to frictional resistance

Select the correct answers:

- (A) 1, 2 & 3      (B) 1, 2 & 4      (C) 2, 3 & 4      (D) 1, 3 & 4

33. A weight  $W$  is supported by two cables as shown in the given figure. The tension in the cable making angle  $\theta$  will be the minimum when the value of  $\theta$  is



- (A)  $0^\circ$       (B)  $60^\circ$       (C)  $45^\circ$       (D)  $30^\circ$

34. Following data were obtained during the test of a four-stroke diesel engine. Diameter of piston = 125mm

Area of indicator diagram =  $450\text{mm}^2$

Length of indicator diagram = 75mm

Spring number = 1.5 bar/mm

If the engine develops 5KW indicated power then what will be average speed of the piston

- (A) 54.32m/s      (B) 108.65m/s  
(C) 81.48m/s      (D) none of these

35. Hot oil with a capacity rate of  $2000\text{W/K}$  flows through a double pipe heat exchanger. It enters at  $425^\circ\text{C}$  and leaves at  $350^\circ\text{C}$  whereas cold fluid enters at  $25^\circ\text{C}$  and leaves at  $200^\circ\text{C}$ . If the overall heat transfers co-efficient is  $800\text{W/m}^2\text{K}$  then what will be the ratio of heat exchanger area when it is used as parallel flow to counter flow arrangement

- (A) 0.937      (B) 0.735      (C) 0.689      (D) 1.067

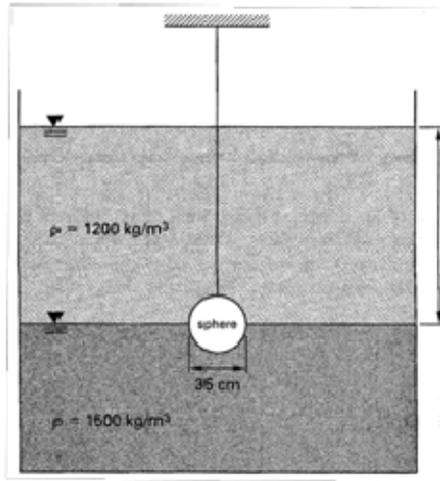
36. A reversible engine taking heat at  $300^\circ\text{C}$  and rejecting heat at room temp  $25^\circ$  and produced work is being used for operating reversible cold storage at  $5^\circ\text{C}$ . find the heat transfer ratio taken by heat engine and cold storage

- (A) 6.6712      (B) 1.7844      (C) 0.1498      (D) 0.1383

37. Argon gas (molecular weight of 40) is compressed in a closed system from 100 kPa and  $30^\circ\text{C}$  to 500 kPa and  $170^\circ\text{C}$ . For argon, the specific heat at constant pressure ( $C_p$ ) is  $0.520\text{kJ/kg.K}$ , and the specific heat at constant volume ( $C_v$ ) is  $0.312\text{kJ/kg.K}$ . What is the specific entropy change?

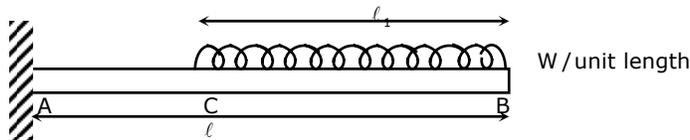
- (A)  $-10.0\text{kJ/kg.K}$       (B)  $-0.14\text{kJ/kg.K}$       (C)  $0.37\text{kJ/kg.K}$       (D)  $10.5\text{kJ/kg}$

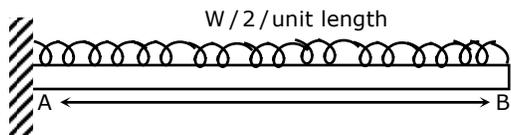
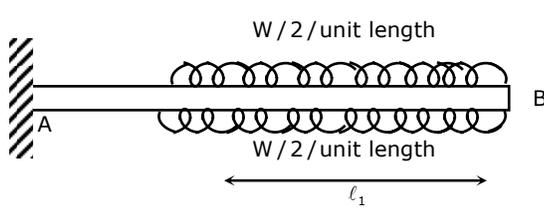
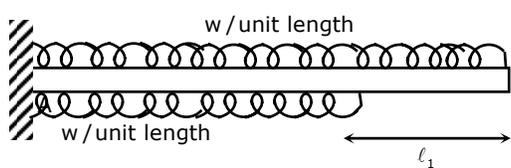
38. A 35 cm diameter solid sphere ( $\rho = 4500 \text{ kg/m}^3$ ) is suspended by a cable as shown. Half of the sphere is in one fluid ( $\rho = 1200 \text{ kg/m}^3$ ) and the other half of the sphere is in another ( $\rho = 1500 \text{ kg/m}^3$ ). What is the tension in the cable?



- (A) 297 N    (B) 593 N    (C) 694 N    (D) 826 N
39. A wall is constructed of 25 mm thick white pine boards and insulated with 75 mm thick fiberglass insulation. The thermal conductivities of the two materials are 0.11 W/m.K and 0.048 W/m.K, respectively. On a given day, the internal and external temperatures are 22°C and -10°C, respectively. What is the rate of heat loss per unit area of wall in W/m<sup>2</sup>?
- (A) 6.7 (B) 18    (C) 25 (D) 35
40. How long will it take to form a thickness of 4cm of ice on the surface of the lake when the air temperature is -6 °C. (K of ice = 1.675 W/mK,  $\rho = 920 \text{ kg/m}^3$  L = 335 kJ/kg)
- (A) 5.39 h    (B) 6.81h    (C) 6.97 h    (D) 7.21 h
41. What will be the machine time to rough-bore, to second rough-bore, and to finish bore a soft cast-iron cylinder whose diameter is 200 mm and length of bore is 250 mm? The feed and spindle speeds are as follows:
1. Rough-bore 27 r.p.m., 6 mm feed
  2. Second rough-bore 48 r.p.m., 3 mm feed
  3. Finish-bore 48 r.p.m., 1 mm feed
- (A) 1.5 min    (B) 1.7 min    (C) 5.2 min    (D) 8.5 min
42. A 500 mm thick slab is cold rolled. The roll diameter is 800 mm and  $\mu = 0.08$ , then what is the maximum possible reduction in thickness?
- (A) 10.24 mm    (B) 0.5 mm    (C) 2.56 mm    (D) 7 mm

43. The notch sensitivity factor and fatigue notch factor of Ti alloy in fatigue study are 0.75 and 1.3 respectively, then the stress concentration factor of Ti alloy is  
 (A) 1.25                      (B) 1.35                      (C) 1.40                      (D) 1.50
44. A thin cylindrical shell when subjected to an internal pressure changes its length by 5% and diameter by 3%. If the original volume of cylindrical shell is  $75 \text{ cm}^3$  then what will be the change in volume of shell due to internal pressure.  
 (A)  $9.75 \text{ cm}^3$                       (B)  $1.5 \text{ cm}^3$                       (C)  $6 \text{ cm}^3$                       (D)  $8.25 \text{ cm}^3$
45. Which of the following diagram will give the same value of deflection and slope at the free end for the cantilever beam as shown



- (A) 
- (B) 
- (C) 

(D) None of these

46. Mohr's circle for a sphere subjected to internal pressure will be  
 (A) straight line                      (B) point                      (C) circle of unit radius                      (D) ellipse
47. Which machining processes are used for gear manufacture?  
 1. Form milling                      2. Broaching  
 3. Roll forming                      4. Hobbing

Select the correct answer

- (A) 1, 2 & 3 (B) 1, 3 & 4 (C) 1, 2 & 4 (D) 2, 3 & 4

**Common Data for Questions 48 and 49**

The minimum pressure and temperature in an Otto cycle are 100 kPa and  $27^{\circ}\text{C}$ . The amount of heat added to the air per cycle is 1500 kJ/kg. Compression ratio = 8 For air:  $C_v = 0.72 \text{ kJ/kg K}$ , and  $\gamma = 1.4$

48. The specific work of the cycle is

- (A) 847 kJ/kg (B) 687 kJ/kg (C) 1027 kJ/kg (D) None of these

49. The thermal efficiency of the cycle is

- (A) 36.4 % (B) 46.4 % (C) 56.4 % (D) None of these

**Common Data for Questions 50 and 51**

A cantilever 4m long is carrying a load of 5kN at free end and 7kN at a distance of 1.5m from the free end. The flexural rigidity for the beam is  $2 \times 10^8$

50. What will be the value of slope at the free end?

- (A)  $2.27 \times 10^{-2} \text{ rad}$  (B)  $2.27 \times 10^{-3} \text{ rad}$  (C)  $2.27 \times 10^{-4} \text{ rad}$  (D)  $2.27 \times 10^{-5} \text{ rad}$

51. What should be the value of gradually varying load applied to the cantilever beam producing same amount of slope at the free end. Assume other parameter as it is.

- (A) 17.025 N/m (B) 170.25 N/m (C) 17.025 kN/m (D) 170.25 kN/m

**Linked Answer Questions: Q.52 to 55 carry two marks each**

In a mechanical vibrating system, the measurement shows that it has mass of 8.8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.94 N/mm. If the vibrating system has a dashpot attached which exerts a force of 44 N when the mass has a velocity of 1m/s.

52. The logarithmic decrement for the above system is

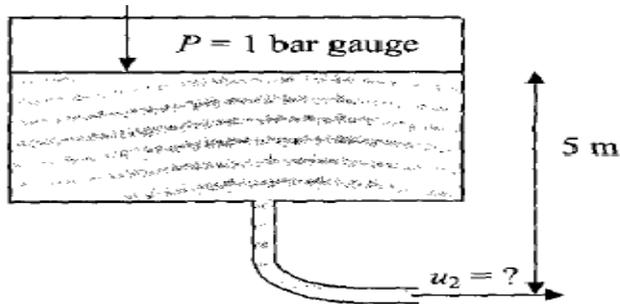
- (A) 0.607 (B) 0.407 (C) 0.807 (D) None of the these

53. The ratio of two consecutive amplitudes is

- (A) 1.48 (B) 1.68 (C) 1.82 (D) 1.92

**Statement for Linked Answer Questions Q.54 & 55**

Petrol of density  $737 \text{ kg/m}^3$  flows from a tank under a positive pressure of 1 bar gauge through a pipe of 3 cm diameter and discharges to atmosphere at a point 5m below the level in the tank, as shown in figure below. The liquid level is kept constant via an inflow of the petrol that is controlled to match the outflow. Viscosity effects are negligible.



54. The velocity of the petrol exiting the pipe is  
(A) 13.6 m/s (B) 19.2 m/s (C) 27.2 m/s (D) None of these
55. The momentum force exerted by jet of petrol is  
(A) 192 N (B) 261 N (C) 272 (D) None of these

**General Aptitude Questions: Question 56 to 60 carry one mark each Complete the Blank**

56. A child should not be \_\_\_\_\_ as being either very shy or over aggressive.  
(A) Instructed  
(B) Intoned  
(C) Refrained  
(D) Categorized
57. We never believed that he would resort to \_\_\_\_\_ in order to achieve his goal; we always regarded him as a \_\_\_\_\_.  
(A) Charm ; insincere (B) Logic ; honorable  
(C) Subterfuge ; honest (D) Necromancy ; pietistic
58. How many key strokes are needed to type numbers from 1 to 1000?  
(A) 3001 (B) 2893 (C) 2704 (D) 2890
59. In the following question find the pair of words in the options that hold same relationship as the pair in the question.  
CONFIRMED: INVETERATE  
(A) Knowledge : Supposed (B) Financial : bankrupt  
(C) Immature : callow (D) Credible : incredible
60. Which of the following is an antonym to following word  
OBSEQUIIOUS  
(A) Servile (B) First (C) Fawning (D) Supercilious

**General Aptitude Questions: Question 61 to 65 carry two marks each**



61. But man is not destined to vanish. He can be killed, but he cannot be destroyed, because his soul is deathless and his spirit is irrepressible. Therefore, though the situation seems dark in the context of the confrontation between the superpowers, the silver lining is provided by amazing phenomenon that the very nations which have spent incalculable resources and energy for the production of deadly weapons are desperately trying to find out how they might never be used. They threaten each other, intimidate each other and go to the brink, but before the total hour arrives they withdraw from the brink.

The main point from the author's view is that

- (A) Man's soul and spirit cannot be destroyed by superpowers.
- (B) Man's destiny is not fully clear or visible.
- (C) Man's soul and spirit are immortal.
- (D) Human society will survive despite the serious threat of total annihilation.

62. Quantity A: Time to travel 95 miles at 50 miles per hour

Quantity B: Time to travel 125 miles at 60 miles per hour

- (A) Quantity A is greater
- (B) Quantity A equals Quantity B
- (C) Quantity B is greater
- (D) Relationship Indeterminate

63. A rectangle is 14 cm long and 10 cm wide. If the length is reduced by  $x$  cms and its width is increased by  $x$  cms so as to make it a square then its area changes by :

- (A) 4
- (B) 144
- (C) 12
- (D) 2

64.  $(\frac{1}{4})^3 + (\frac{3}{4})^3 + 3 * (\frac{1}{4}) * (\frac{3}{4}) * (\frac{1}{4} + \frac{3}{4}) = ?$

- (A)  $\frac{1}{64}$
- (B)  $\frac{27}{64}$
- (C)  $\frac{49}{64}$
- (D) 1

65. Refer to the following table:

Store    From 1977 to 1978    From 1978 to 1979

P +10 -10

Q -20 +9

R +5 +12

S -7 -15

T +17 -8

PERCENT CHANGE IN DOLLAR AMOUNT OF SALES IN CERTAIN RETAIL STORES FROM 1977 TO 1979. In 1979, for which of the stores was the dollar amount of sales greater than that of any of the others shown?

- (A) P
- (B) Q
- (C) R
- (D) It cannot be determined from the information given.

**Answer Keys & Explanation**

1	C	11	C	21	D	31	B	41	D	51	C	61	D
2	B	12	D	22	A	32	A	42	C	52	A	62	C
3	B	13	B	23	D	33	B	43	C	53	B	63	A
4	A	14	D	24	D	34	C	44	B	54	B	64	D
5	A	15	B	25	B	35	A	45	B	55	A	65	D
6	C	16	B	26	D	36	C	46	C	56	D		
7	D	17	D	27	C	37	B	47	C	57	C		
8	D	18	C	28	D	38	C	48	A	58	B		
9	D	19	A	29	D	39	B	49	C	59	C		
10	B	20	D	30	B	40	B	50	D	60	D		

1. **[Ans. C]** Eigen values exists in complex conjugate So,  $\omega^2$  will be an Eigen Value. Also, Matrix is singular So 0 will be an Eigen value

2. **[Ans. B]**

$$\int_{-i}^{+i} \frac{dz}{z} = [Inz]_{-i}^{+i} = In(+i) - In(-i) = \ln(e^{i\frac{\pi}{2}}) - \ln(e^{-i\frac{\pi}{2}})$$

$$= \frac{i\pi}{2} - \left(-\frac{i\pi}{2}\right) = \pi i$$

3. **[Ans. B]**

Surface  $x \log y - y^2 = -4$

vector normal to this surface at point (-1, 2, 1)

$$\nabla(x \log z - y^2)|_{-1,2,1} = \log z \vec{i} - 2y \vec{j} + \frac{x}{z} \vec{k} \Big|_{-1,2,1}$$

$$= -4 \vec{j} - \vec{k}$$

$$\phi = x y^2 + y z^3$$

$$\nabla \phi = y^2 \vec{i} + (2xy + z^3) \vec{j} + 3 y z^2 \vec{k}$$

$$\nabla \phi|_{2,-1,1} = \vec{i} - 3 \vec{j} - 3 \vec{k}$$

So, Direction derivative of  $\phi$  in the direction of vector

$$-4 \vec{j} - \vec{k}$$

$$(\vec{i} - 3 \vec{j} - 3 \vec{k}) \frac{(-4 \vec{j} - \vec{k})}{\sqrt{4^2 + 1}} = \frac{15}{\sqrt{17}}$$

4. **[Ans. A]**

$$L^{-1} \left\{ \frac{s}{(s-1)^2 + 21} \right\} = L^{-1} \left[ \frac{s-1}{(s-1)^2 + 11} + \frac{1}{(s-1)^2 + 11} \right]$$

$$= e^t \cos t + e^t \sin t$$

5. **[Ans. A]**

Bar BC is subjected to pure bending moment only. Hence, shear force is zero.

6. **[Ans. C]**

$$20 \times 10 + 30 \times 5 = P \times 10 \text{ So, } P = 35 \text{ lbs}$$

7. **[Ans. D]**

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

$$E = 3K(1-2\nu)$$

$$2G(1.25) = 3K(0.5)$$

$$K/G = \frac{2.5}{1.5} = 5/3$$

8. **[Ans. D]**

$$\text{Distance travelled by the block on smooth plane} = \frac{1}{2} \times (g \sin \theta) \times (t)^2$$

$$\text{Distance travelled by the block on rough plane} = \frac{1}{2} \times (g \sin \theta - \mu \cos \theta) \times (2t)^2$$

Equating the above equations,

$$\frac{1}{2} \times (g \sin \theta) \times (t)^2 = \frac{1}{2} \times (g \sin \theta - \mu \cos \theta) \times (2t)^2$$

$$1 - (1-\mu) \times 4$$

$$\mu = \frac{3}{4}$$

9. **[Ans. D]**

Otto Cycle has two isochoric process and two isentropic process.

10. **[Ans. B]**

11. **[Ans. C]**

12. **[Ans. D]**

$$\text{Force on the plate} = \rho A(V-u)(V-u) = 1000 * 0.02 * (10)^2 = 2000N$$

13. **[Ans. B]** Since manometer shows 20 cm and this inclined at  $30^\circ$

$$\text{Verticle level of mercury} = 20 \sin 30^\circ = 10 \text{ cm}$$

$$\text{Difference in pressure} = \frac{10}{100} \times 13.6 = 13.6m$$

15. **[Ans. B]**

18. **[Ans. C]**

19. **[Ans. A]**

20. **[Ans. D]**

Total no. of strokes= 30 cutting+30 non cutting strokes=60

$$\text{Average speed of operation} = \frac{250}{1000} \times 60 = 15m / \text{min}$$

21. **[Ans. D]**

22. **[Ans. A]**

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Publisher : iGATE

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