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**OSSC ATO**  
**Previous Year Paper**  
**2016**



**ATRO – 2016 – Set – 2**  
**TP for Diploma / Degree / MCA**

**3262**

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**ATRO – 2016 – Set – 2**  
**TP for Diploma / Degree / MCA**

Time :  $1\frac{1}{2}$  hours

Full Marks : 100

Each question carries 1 mark.

Answer **all** questions, choosing the correct **one** from the alternatives suggested and **darken the appropriate circle using BLUE or BLACK BALL POINT PEN.**

1. If  $P$  is the force acting on the body,  $m$  is the mass of the body and  $a$  is the acceleration of the body, then according to Newton's second law of motion :
- (1)  $P - ma = 0$   
(2)  $P + ma = 0$   
(3)  $P \times ma = 0$   
(4)  $\frac{P}{ma} = 0$   
(5)  $P \pm ma = 0$
2. A machine having an efficiency greater than 50%, is known as :
- (1) Ideal machine  
(2) Non-reversible machine  
(3) Reversible machine  
(4) Neither reversible nor non-reversible machine  
(5) None of these
3. The term 'centroid' is :
- (1) The point of suspension  
(2) The same as centre of gravity  
(3) The point of application of the resultant of all the forces tending to cause a body to rotate about a certain axis  
 (4) The point at which the total mass of the body acts  
(5) None of these
4. A differential pulley block has larger and smaller diameters of 100 mm and 80 mm respectively. Its velocity ratio is :
- (1) 5  
(2) 10  
(3) 20  
(4) 40  
(5) 12

5. Non-coplanar concurrent force are those forces which :

- (1) Meet at one point, but their lines of action do not lie on the same plane
- (2) Do not meet at one point and their lines of action do not lie on the same plane
- (3) Meet at one point and their line of action also lie on the same plane
- (4) Do not meet at one point, but their lines of action lie on the same plane
- (5) None of these

6. The efficiency of a screw jack is maximum when (where  $\alpha$  = Helix angle and  $\phi$  = Angle of friction) :

- (1)  $\alpha = 45^\circ + \frac{\phi}{2}$
- (2)  $\alpha = 45^\circ - \frac{\phi}{2}$
- (3)  $\alpha = 90^\circ + \phi$
- (4)  $\alpha = 90^\circ - \phi$
- (5)  $\alpha = 90^\circ + \frac{\phi}{2}$

7. According to Lami's theorem :

- (1) The three forces must be equal
- (2) The three forces must be at  $120^\circ$  to each other
- (3) The three forces must be in equilibrium
- (4) If the three forces acting at a point are in equilibrium, then each force is proportional to the sine of the angle between the other two
- (5) All of these

8. The slope on the road surface generally provided on the curves is known as :

- (1) Angle by repose
- (2) Angle of banking
- (3) Angle of friction
- (4) Angle of limiting friction
- (5) None of these

9. For a self locking machine, the efficiency must be :

- (1) Greater than 50%
- (2) Less than 50%
- (3) Equal to 50%
- (4) Equal to 100%
- (5) None of these

10. A couple produces :

- (1) Translatory motion
- (2) Linear motion
- (3) Rotational motion
- (4) Combined translatory and rotational motion
- (5) None of these

11. Which of the following functions has the greatest period ?

- (1)  $f(x) = 20 \sin(2x - \pi/2)$
- (2)  $f(x) = -\sin(\pi x)$
- (3)  $f(x) = 2\sin(0.1x)$
- (4)  $f(x) = -\sin(0.1\pi x)$
- (5) None of these

12. What is the amplitude of  $f(x) = 4 \sin(x) \cos(x)$  ?

- (1) 4
- (2) 3
- (3) 2
- (4) 1
- (5) None of these

13. What is the range of the function

$$f(x) = -6\cos(\pi x - \pi/2) + 2$$

- (1)  $[-6, 6]$

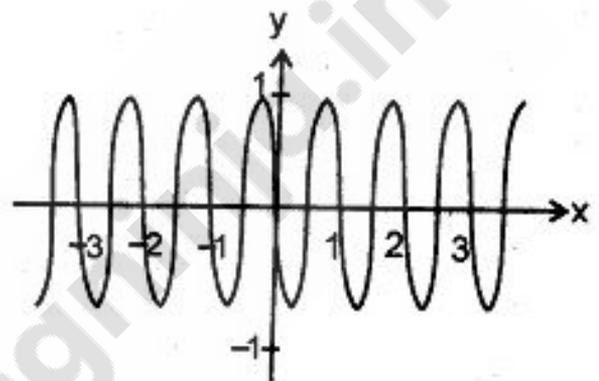
- (2)  $[-4, 8]$

- (3)  $[0, 8]$

- (4)  $[-6, 0]$

- (5) None of these

14. Which of the functions below correspond to the given graph ?



- (1)  $y = -\sin(2\pi x)$

- (2)  $y = \sin(2\pi x)$

- (3)  $y = \cos(2\pi x)$

- (4)  $y = -\sin(x)$

- (5) None of these

15. Let the closed interval  $[a, b]$  be the domain of function  $f$ . The domain of  $f(x - 3)$  is given by :

- (1) The open interval  $[a, b]$

- (2) The closed interval  $[a, b]$

- (3) The closed interval  $[a - 3, b - 3]$

- (4) The closed interval  $[a + 3, b + 3]$

- (5) None of these

16. If  $f(x) = g(u)$  and  $u = u(x)$ , then :

- (1)  $f'(x) = g'(u)$
- (2)  $f'(x) = g'(u) \cdot u'(x)$
- (3)  $f'(x) = u'(x)$
- (4)  $f''(x) = u'(x)$
- (5) None of these

17. Equations  $x = 3\cos t$  and  $y = 3\sin t$  represent equation of :

- (1) Line
- (2) Circle
- (3) Parabola
- (4) Hyperbola
- (5) None of these

18. If  $f(x) = x - 2$  and  $g(x) = \sqrt{(x^2 + 1)}$ , then  $(g \circ f)(x) = ?$

- (1)  $\sqrt{(x^2 + 1)} - 2$
- (2)  $\sqrt{(x^2) - 4x + 5}$
- (3)  $x^2 - 1$
- (4)  $x^2 - 4x + 5$
- (5) None of these

19. Determine the equation of the circle whose radius is 5, centre on the line  $x = 2$  and tangent to the line  $3x - 4y + 11 = 0$  :

- (1)  $(x - 2)^2 + (y - 2)^2 = 5$
- (2)  $(x - 2)^2 + (y + 2)^2 = 25$

(3)  $(x - 2)^2 + (y + 2)^2 = 5$

(4)  $(x - 2)^2 + (y - 2)^2 = 25$

(5) None of these

20. Find the equation of the axis of symmetry of the function  $y = 2x^2 - 7x + 5$  :

(1)  $7x + 4 = 0$

(2)  $4x + 7 = 0$

(3)  $4x - 7 = 0$

(4)  $x - 2 = 0$

(5) None of these

21. Point  $P(x, y)$  moves with a distance from point  $(0, 1)$  one-half of its distance from line  $y = 4$ . The equation of its locus is :

(1)  $2x^2 - 4y^2 = 5$

(2)  $4x^2 + 3y^2 = 12$

(3)  $2x^2 + 5y^3 = 3$

(4)  $x^2 + 2y^2 = 4$

(5) None of these

22. What is the equation of the asymptote of the hyperbola ?

$$\frac{x^2}{9} - \frac{y^2}{4} = 1$$

(1)  $2x - 3y = 0$

(2)  $3x - 2y = 0$

(3)  $2x - y = 0$

(4)  $2x + y = 0$

(5) None of these

23. Determine  $k$  so that the equation  $4x^2 + kx + 1 = 0$  will have just one real solution :

- (1) 3
- (2) 4
- (3) 5
- (4) 6
- (5) None of these

24. What is the sum of the coefficients in the expansion  $(x + y - z)^8$  ?

- (1) 0
- (2) -1
- (3) 2
- (4) 3
- (5) None of these

25. There are four balls of four different colors. Two balls are taken at a time and arranged in a definite order. For example, if a white and red balls are taken, one definite arrangement is white first, red second, and another arrangement is red first, white second. How many such arrangements are possible ?

- (1) 24

- (2) 6
- (3) 12
- (4) 36
- (5) None of these

26. How many 6-number combinations can be generated from the numbers from 1 to 42 inclusive, without repetition and with no regards to the order of the numbers ?

- (1) 850, 668
- (2) 5, 245, 786
- (3) 188, 848, 296
- (4) 31, 474, 716
- (5) None of these

27. The sum of two positive numbers is 50. What are the numbers if their product is to be the largest possible ?

- (1) 24 and 26
- (2) 28 and 22
- (3) 25 and 25
- (4) 20 and 30
- (5) None of these

28. The cost per hour of running a motor boat is proportional to the cube of the speed. At what speed will the boat run against a current of 8 km/hr in order to go a given distance most economically ?
- (1) 10 kph
  - (2) 13 kph
  - (3) 11 kph
  - (4) 12 kph
  - (5) None of these
29. Integrate  $x \cos(2x^2 + 7) dx$  :
- (1)  $(1/4) \sin(2x^2 + 7) + C$
  - (2)  $(1/4) \cos(2x^2 + 7) + C$
  - (3)  $[(\sin \theta) / 4(x^2 + 7)] + C$
  - (4)  $\sin(2x^2 + 7) + C$
  - (5) None of these
30. Evaluate the integral of  $(\cos 3A)^8 dA$  from 0 to  $\pi/6$  :
- (1)  $27\pi / 363$
  - (2)  $35\pi / 768$
  - (3)  $23\pi / 765$
  - (4)  $12\pi / 81$
  - (5) None of these
31. Which of the following equation is an exact DE ?
- (1)  $(x^2 + 1)dx - xy dy = 0$
  - (2)  $x dy + (3x - 2y) dx = 0$
  - (3)  $2xy dx + (2 + x^2) dy = 0$
  - (4)  $x^2y dy - y dx = 0$
  - (5) None of these
32. What is the solution of the first order differential equation  $y(k+1) = y(k) + 5$  ?
- (1)  $y(k) = 4 - 5/k$
  - (2)  $y(k) = 20 + 5k$
  - (3)  $y(k) = C - k$ , where C is constant
  - (4) The solution is non-existence for real values of y
  - (5) None of these
33. Find the differential equation whose general solution is  $y = C_1x + C_2e^x$  :
- (1)  $(x - 1)y'' - xy' + y = 0$
  - (2)  $(x + 1)y'' - xy' + y = 0$
  - (3)  $(x - 1)y'' + xy' + y = 0$
  - (4)  $(x + 1)y'' + xy' + y = 0$
  - (5) None of these

34. Evaluate  $\ln(2 + j3)$  :

- (1)  $1.34 + j0.32$
- (2)  $2.54 + j0.866$
- (3)  $2.23 + j0.21$
- (4)  $1.28 + j0.98$
- (5) None of these

35. A sphere having a diameter of 30 cm is cut into 2 segments. The altitude of the first segment is 6 cm. What is the ratio of the area of the second segment to that of the first ?

- (1) 4 : 1
- (2) 3 : 1
- (3) 2 : 1
- (4) 3 : 2
- (5) None of these

36. Which physical quantity has the dimensional formula that of angular velocity ?

- (1) Time
- (2) Frequency
- (3) Displacement
- (4) Acceleration
- (5) None of these

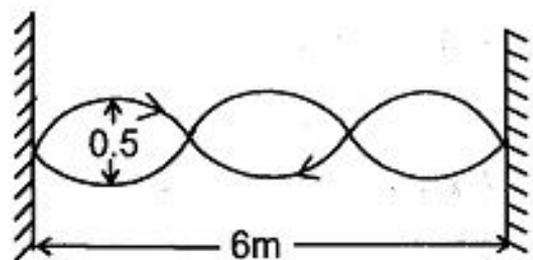
37. A ball thrown vertically upwards with a velocity of 19.6 m/sec from the top of a tower, returns to the earth in 6 sec. What is the height of the tower ?

- (1) 46.8 m
- (2) 48.6 m
- (3) 58.8 m
- (4) 54.6 m
- (5) 56.4 m

38. A force of 98 N is required to pull a body of mass 100 kg over ice. What is the coefficient of friction ?

- (1) 1.5
- (2) 0.1
- (3) 2.5
- (4) 0.4
- (5) 0.45

39. The wave pattern is established in a string as shown in the given figure. The wave component of travelling wave is :



- (1) 0.25 m
- (2) 0.5 m
- (3) 1 m
- (4) 2 m
- (5) 4 m

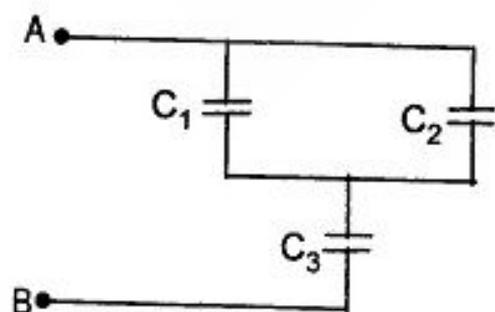
40. Sound waves are always in \_\_\_\_\_ in nature.

- (1) Longitudinal
- (2) Transverse
- (3) Standing
- (4) Electromagnetic wave
- (5) None of these

41. The coefficient of linear expansion of a certain steel is  $12 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ . Then the coefficient of cubical expansion is \_\_\_\_\_

- (1)  $12 \times 10^{-16} \text{ } ^\circ\text{C}^{-1}$
- (2)  $\frac{4\pi}{3}(12 \times 10^{-6} \text{ } ^\circ\text{C}^{-1})$
- (3)  $3 \times (12 \times 10^{-16} \text{ } ^\circ\text{C}^{-1})$
- (4) 0.00012
- (5) None of these

42. What is the resultant capacitance between the points A and B in the given figure if  $C_1 = 5 \mu\text{F}$ ,  $C_2 = 10 \mu\text{F}$  and  $C_3 = 4 \mu\text{F}$  ?



- (1)  $2.2 \mu\text{F}$

- (2)  $1.2 \mu\text{F}$

- (3)  $3.2 \mu\text{F}$

- (4)  $4.7 \mu\text{F}$

- (5)  $5.9 \mu\text{F}$

43. Velocity of sound in fluid is proportional to :

- (1)  $T^{1/2}$

- (2)  $T^{-1/2}$

- (3)  $T$

- (4)  $\frac{1}{T}$

- (5)  $T^2$

44. What will be the gravitational force of attraction between two neutrons whose centres are  $10^{-12} \text{ m}$  apart and mass of neutron is equal to  $1.67 \times 10^{-27} \text{ kg}$  ?

- (1)  $1.7 \times 10^{-40} \text{ N}$

- (2)  $1.5 \times 10^{-40} \text{ N}$

- (3)  $2.7 \times 10^{-40} \text{ N}$

- (4)  $1.8 \times 10^{-40} \text{ N}$

- (5)  $1.6 \times 10^{-40} \text{ N}$

45. For total internal reflection phenomenon, the critical angle must be \_\_\_\_\_.

- (1) equal to  $90^\circ$
- (2) less than  $90^\circ$
- (3) greater than  $90^\circ$
- (4) equal to  $180^\circ$
- (5) less than  $180^\circ$

46. The angle of projection ' $\theta$ ' = \_\_\_\_\_ for maximum range of a projectile.

- (1)  $30^\circ$
- (2)  $45^\circ$
- (3)  $60^\circ$
- (4)  $90^\circ$
- (5)  $180^\circ$

47. What is the refractive index of glass medium w. r. t. water medium for a ray going from glass to water, where refractive index of glass and water are 1.62 and 1.32 respectively ?

- (1) 0.8148

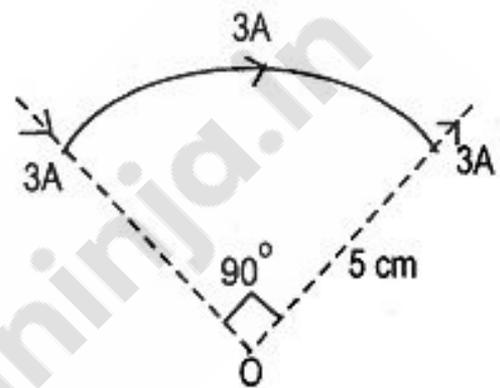
(2) 1.2273

(3) 1.8148

(4) 0.1228

(5) None of these

48. In the given fig the magnetic field at the centre 'O' of the given arc is :



(1)  $9.43 \times 10^{-6}$  T

(2)  $2.54 \times 10^{-3}$  T

(3)  $5.82 \times 10^{-7}$  T

(4)  $2.54 \times 10^{-6}$  T

(5)  $1.46 \times 10^{-4}$  T

49. The electron-volt (ev) is the unit of :

(1) Energy

(2) Charge

(3) Current

(4) Potential

(5) Capacity

50. Out of the following, which option represents the Einstein's equation of photoelectric emission ?

(1)  $\frac{1}{2}mV_{\min}^2 = h(f - f_0)$

(2)  $\frac{1}{2}mV_{\max}^2 = h(f - f_0)$

(3)  $\frac{1}{2}mV_{\min}^2 = h(f + f_0)$

(4)  $\frac{1}{2}mV_{\max}^2 = h(f + f_0)$

(5)  $\frac{1}{2}mV_{\min}^2 = h\left(\frac{f}{f_0}\right)$

51. A feather and a lead ball are dropped from rest in vacuum on the moon. The acceleration of the feather is :

(1) More than that of the lead ball

(2) Same that of the lead ball

(3) Less than that of the lead ball

(4)  $9.8 \text{ m/s}^2$

(5) Zero, since it floats in the vacuum

52. Out of the following which is not a property of laser beam ?

(1) Directionality

(2) Coherence

(3) Diachromatic

(4) Highly directional

(5) Monochromaticity

53. If a particle executes simple harmonic motion of period 8 sec and amplitude 0.40 m, then its acceleration will be :

(1)  $0.3142 \text{ m/s}^2$

(2)  $0.3142 \text{ cm/s}^2$

(3)  $0.2488 \text{ cm/s}^2$

(4)  $0.2468 \text{ m/s}^2$

(5) None of these

54. The dimensional formula for universal gas constant (R) is :

(1)  $[M^1L^{-2}T^{-2}K^{-1}]$

(2)  $[M^1L^2T^{-2}K^{-1}]$

(3)  $[M^1L^2T^{-1}K^{-1}]$

(4)  $[M^1L^{-1}T^{-2}K^{-1}]$

(5)  $[M^1L^2T^2K^{-1}]$

55. The inductance of a coil is directly proportional to :

- (1) Its strength
- (2) The number of turns
- (3) The resistance of the coil
- (4) The square of number of turns
- (5) None of these

56. A police man on duty detects a drop of 15% in the pitch of the horn of a motor car as it crosses him. If the velocity of sound is 330 m/s, the speed of the car is :

- (1) 26.4 m/s
- (2) 26.2 cm/s
- (3) 26.2 m/s
- (4) 26.4 cm/s
- (5) 26 cm

57. The force experienced by a charge particle moving inside a uniform magnetic field will be maximum by making angle \_\_\_\_\_ with magnetic field direction.

- (1)  $0^\circ$
- (2)  $60^\circ$

(3)  $90^\circ$

(4)  $180^\circ$

(5) None of these

58. In photoelectric effect the stopping potential is :

- (1) Independent of frequency of incident light
- (2) Independent of intensity of incident light
- (3) Directly proportional to intensity of incident light
- (4) Inversely proportional to frequency of incident light
- (5) None of these

59. Out of the following which one is the example of observing both longitudinal and transverse wave at a time ?

- (1) Light wave
- (2) Sound wave
- (3) Sea water
- (4) Earthquake
- (5) Motion in a string

60. In case of inferior mirage the displaced image of the real and distant object always form :
- (1) Above the real object
  - (2) At the same level of real object
  - (3) Under the real object
  - (4) Behind of real object
  - (5) None of these
61. Electromagnetic radiation with maximum wavelength is :
- (1) Ultraviolet rays
  - (2) Radio waves
  - (3) X-rays
  - (4) Infra red rays
  - (5) Alpha rays
62. The hydride ion is isoelectronic with :
- (1) He
  - (2) Li
  - (3)  $\text{Be}^+$
  - (4)  $\text{He}^+$
  - (5) None of these
63. Which of the following is not a Lewis Acid ?
- (1)  $\text{BF}_3$
  - (2)  $\text{CuSO}_4$
  - (3)  $\text{CO}_3^{2-}$
  - (4)  $\text{AlCl}_3$
  - (5)  $\text{PH}_3$
64. An oxide of a metal contains 40% oxygen. What will be its equivalent mass ?
- (1) 34
  - (2) 22
  - (3) 18
  - (4) 12
  - (5) 20
65. If 0.1 gm mole HCl is present in 1 ltr of solution, then the pH of solution is :
- (1) 7
  - (2) 0.1
  - (3) 1
  - (4) 0.01
  - (5) 8

66. Which of the following polymer can be used for lubrication and as an insulator ?

- (1) PTFE
- (2) SBR
- (3) PVC
- (4) PAN
- (5) GRS

67. CsCl crystallises in Body Centred Cubic lattice. If  $x$  is its edge length then which of the following expression is correct ?

- (1)  $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \sqrt{3}x$
- (2)  $r_{\text{Cs}^+} + r_{\text{Cl}^-} = 3x$
- (3)  $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \frac{3x}{2}$
- (4)  $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \sqrt{\frac{3x}{2}}$
- (5)  $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \sqrt{\frac{2x}{3}}$

68. Camphor is often used in molecular mass determination, because :

- (1) It is readily available
- (2) It has very high cryoscopic constant
- (3) It is volatile

(4) It is a solvent for organic substances

(5) None of these

69. Molarity of 900 gm of water is :

- (1) 50 M
- (2) 55.5 M
- (3) 5 M
- (4) 50.5 M
- (5) Can not be calculated

70. Composition of gun metal is :

- (1) Fe 80%, Sn = 10%, Cr = 10%
- (2) Fe = 50%, Ni = 21%, Al = 29%
- (3) Cu = 87%, Sn = 10%, Zn = 3%
- (4) Cu = 60 – 80%, Zn = 40 – 20%
- (5) None of these

71. Lime-soda used for water softening is a mixture of :

- (1) Quick lime and Caustic soda
- (2) Quick lime and Soda ash
- (3) Slaked lime and Caustic soda
- (4) Slaked lime and Soda ash
- (5) None of these

72. Rust is a mixture of :

- (1) FeO and Fe(OH)<sub>2</sub>
- (2) FeO and Fe(OH)<sub>3</sub>
- (3) Fe<sub>2</sub>O<sub>3</sub> and Fe(OH)<sub>3</sub>
- (4) Fe<sub>3</sub>O<sub>4</sub> and Fe(OH)<sub>3</sub>
- (5) Fe<sub>2</sub>O<sub>3</sub> and Fe(OH)<sub>2</sub>

73. Which of the following 0.1M aqueous solution is likely to have the highest boiling point ?

- (1) Na<sub>2</sub>SO<sub>4</sub>
- (2) KCl
- (3) Glucose
- (4) Urea
- (5) C<sub>2</sub>H<sub>5</sub>OH

74. Molarity of liquid HCl having density 1.17 gm/cc is :

- (1) 36.5 M
- (2) 18.25 M
- (3) 32.05 M
- (4) 42.10 M
- (5) 30.56 M

75. In lead-acid battery during charging, the cathode reaction is :

- (1) Formation of PbO<sub>2</sub>
- (2) Formation of PbSO<sub>4</sub>
- (3) Reduction of Pb<sup>2+</sup> to Pb
- (4) Decomposition of Pb at anode
- (5) None of these

76. All good gasolines have :

- (1) Higher octane number value
- (2) Higher cetane number value
- (3) Lower octane number value
- (4) Lower cetane number value
- (5) None of these

77. The time required to liberate 1 gm eq. of an element by passing 1 ampere current through its solution is :

- (1) 6.7 hours
- (2) 13.4 hours
- (3) 19.9 hours
- (4) 26.8 hours
- (5) 9.95 hours

78. Most commonly used food preservative is :

- (1) Table salt
- (2) Sugar
- (3) Vegetable oil
- (4) Sodium benzoate
- (5) All of these

79. Bakelite is obtained from Phenol by reaction with :

- (1)  $(\text{CH}_2\text{OH})_2$
- (2)  $\text{CH}_3\text{CHO}$
- (3)  $\text{HCHO}$
- (4)  $\text{HCOOH}$
- (5)  $\text{CH}_3\text{COOH}$

80. Carboxy haemoglobin which restricts transport of oxygen in blood forms due to the increase of :

- (1)  $\text{CO}_2$
- (2)  $\text{CH}_3\text{COOH}$
- (3)  $\text{CO}$
- (4)  $\text{HCHO}$
- (5)  $\text{CH}_3\text{COCH}_3$

81. Aromatic compounds must contain :

- (1)  $(4\pi + 2)n$  electrons
- (2)  $(4\pi + 2)$  electrons
- (3)  $(4n + \pi)$  electrons
- (4)  $(4n + 2)\pi$  electrons
- (5)  $(4n + 2\pi)$  electrons

82. Substance which is weakly repelled by a magnetic field is :

- (1)  $\text{O}_2$
- (2)  $\text{H}_2\text{O}$
- (3)  $\text{CrO}_2$
- (4)  $\text{Fe}_3\text{O}_4$
- (5)  $\text{ZnFe}_2\text{O}_4$

83. For which crystal anion-anion contact is valid ?

- (1)  $\text{Na I}$
- (2)  $\text{Na F}$
- (3)  $\text{Cs Br}$
- (4)  $\text{Cs I}$
- (5)  $\text{KCl}$

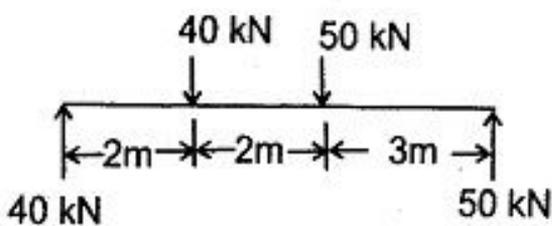
84. Alkyl halides can be represented as :

- (1)  $\text{C}_n \text{H}_{2n+1} - \text{OH}$
- (2)  $\text{C}_n \text{H}_{2n-2} - \text{X}$
- (3)  $\text{C}_n \text{H}_{2n} - \text{X}$
- (4)  $\text{C}_n \text{H}_{2n+2} - \text{X}$
- (5)  $\text{C}_n \text{H}_{2n+1} - \text{X}$

85. Monomers of BuNa – S are :

- (1) Styrene and acrylonitrile
- (2) Butadiene and styrene
- (3) Butadiene and chloroprene
- (4) Butadiene and acrylonitrile
- (5) Styrene and chloroprene

86. What is the magnitude of the parallel force systems shown in the figure ?



- (1) 70 kNm (clockwise)
- (2) Zero
- (3) 70 kNm (Anticlockwise)
- (4) 90 kN vertical force and a moments of 70 kNm (clockwise)
- (5) None of these

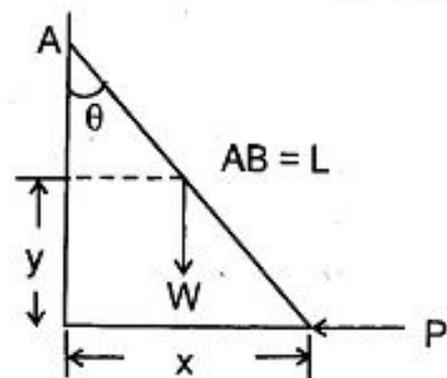
87. If two forces each of 10N act at an angle  $\theta$ , then what is their resultant ?

- (1)  $20 \cos \theta$
- (2)  $20 \cos \frac{\theta}{2}$
- (3)  $20 \cos 2\theta$
- (4)  $20 \sin \frac{\theta}{2}$
- (5)  $20 \sin 2\theta$

88. A solid sphere will be in stable equilibrium if its centre of gravity lies :

- (1) Vertically above its geometric centre
- (2) Vertically below its geometric centre
- (3) On the horizontal line through its centre
- (4) At the centre
- (5) None of these

89. A Ladder AB of weight  $W$  and length  $\ell$ , is held in equilibrium by a horizontal force  $P$  as shown in the figure. Assuming the ladder to be idealized as a homogeneous rigid bar and the surfaces to be smooth, which one of the following is correct ?



- (1)  $P = \frac{1}{2} w \tan \theta$
- (2)  $P = \frac{1}{2} w \operatorname{cosec} \theta$
- (3)  $P = \frac{1}{2} w \cos \theta$
- (4)  $P = 2w \cos \theta$
- (5)  $P = \frac{1}{2} w \cot \theta$

90. If a body of weight 100 N is hauled along a rough horizontal plane by a pull of 50 N acting at an angle of  $30^\circ$  with the horizontal, the coefficient of friction is :

- (1)  $\frac{1}{2}$
- (2)  $\frac{2}{\sqrt{3}}$
- (3)  $\frac{1}{\sqrt{3}}$
- (4)  $\sqrt{3}$
- (5)  $\frac{4}{\sqrt{3}}$

91. A block of mass  $m$  is in equilibrium on a rough inclined plane inclined at angle  $\alpha$  to the horizontal. If  $\mu$  is the coefficient of friction between the plane and the block, what is the frictional force between the block and the plane ?

- (1)  $\mu mg \sin \alpha$
- (2)  $\mu mg \cos \alpha$
- (3)  $mg \cos \alpha$
- (4)  $\mu mg \sin 2\alpha$
- (5)  $mg \sin \alpha$

92. A stone of mass  $m$  at the end of a string of length  $\ell$  is whirled in a vertical circle at a constant speed. The tension in the string will be maximum when the stone is :

- (1) At the top of the circle
- (2) Half way down from the top
- (3) Quarter way down from the top
- (4) At the bottom of the circle
- (5) None of these

93. A mass  $m_1$  with velocity  $v_1$  impacts with a mass  $m_2$  at rest. After the impact, the mass  $m_1$  comes to rest. Then the coefficient of restitution  $e$  should be :

- (1)  $e = \frac{m_1}{m_1 + m_2}$
- (2)  $e = \frac{m_1 + m_2}{m_1}$
- (3)  $e = \frac{m_2}{m_1 + m_2}$
- (4)  $e = \frac{m_1}{m_2}$
- (5)  $e = \frac{m_2}{m_1}$

94. A grinding wheel rotates at 3000 rpm. When power supply is cut off, the wheel stops completely in 10 seconds. What is the number of revolutions made by the wheel before coming to rest ?

- (1) 3000
- (2) 1000
- (3) 500
- (4) 250
- (5) 200

95. Centre of gravity of a solid circular cone from the circular base is at a distance of \_\_\_\_\_ (where  $r$  = base radius of the cone and  $h$  = altitude of the cone).

- (1)  $\frac{1}{4}r$
- (2)  $\frac{1}{4}h$
- (3)  $\frac{2}{3}h$
- (4)  $\frac{3}{8}r$
- (5)  $\frac{1}{8}h$

96. Polar moment of inertia of a circular area of diameter  $D$  is :

- (1)  $\frac{\pi}{64} D^4$
- (2)  $\frac{\pi}{8} D^4$
- (3)  $\frac{\pi}{128} D^4$
- (4)  $\frac{\pi}{32} D^4$
- (5)  $\frac{\pi}{16} D^4$

97. A car accelerates from rest to a speed of 10 m/s and the energy spent in doing this is  $E$ . If the car is further accelerated from 10 m/s to 20 m/s, what is the amount of energy to be spent further ?

- (1)  $E$
- (2)  $2E$
- (3)  $3E$
- (4)  $4E$
- (5)  $5E$

98. Two balls of equal mass and of perfectly elastic material are lying on the floor. One of the ball with velocity  $v$  is made to struck the second ball. Both the balls after impact will move a velocity :

- (1)  $v$
- (2)  $\frac{v}{2}$
- (3)  $\frac{v}{4}$
- (4)  $\frac{v}{8}$
- (5)  $0$

99. The range of a projectile is maximum, when the angle of projection is :

- (1)  $30^\circ$
- (2)  $45^\circ$
- (3)  $60^\circ$
- (4)  $90^\circ$
- (5)  $0^\circ$

100. In an ideal machine, mechanical advantage is \_\_\_\_\_ velocity ratio.

- (1) equal to
- (2) greater than
- (3) less than
- (4) cannot be determined
- (5) None of these

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