clamphook

Shift 2

Tribhuvan University

2080

Full Marks: 140 **Time:** 2 hours **Pass Marks:** 56

1. The energy of a gas molecule is $E = KT$ where T is an absolute temperature. The dimensional formula of Boltzmann Constant K is:

a. $[MLT^{-2}K^{-1}]$
b. $[ML^2T^{-1}]$
c. $[ML^2T^{-1}K^{-1}]$
d. $[ML^2T^{-2}K^{-1}]$

2. The smallest radius of a circle on which a cyclist can turn if his speed is 'v' and coefficient of a static friction between tyres and road is μ is:

a. $\frac{v^2}{2g}$
b. $\frac{v^2}{\mu g}$
c. $v^2\mu g$
d. $\frac{v^2}{\mu}$

3. Suppose that the angular velocity of rotation of earth is increased. Then,as a consequence

a. There will be no change in weight anywhere on the earth
b. Weight of the object, everywhere on the earth, will increase
c. Except at poles, weight of the object on the earth will decrease
d. Weight of the object, everywhere on the earth, will decrease.

4. When the temperature of a body increases, the young's modulus of elasticity

a. Increases
b. Decreases
c. Remains same
d. Can't be predicted

5. Calculate the depth of water at which air- bubble of radius 0.4mm may remain in equilibrium (surface tension of water = 72×10^{-3}N/m and $g = 9.8m/s^2$)

a. 7.348cm
b. 0.981cm
c. 1.837cm
d. 3.674cm

6. The gas thermometers are more sensitive than liquid thermometers because

a. Gases expand more than liquids
b. Gases are easily obtained
c. Gases are much lighter
d. Gases do not easily change their states

7. The velocities of the molecules are v, 2v, 3v, 4v & 5v. The rms speed will be

a. $v\sqrt{11}$ b. $11v$

c. v d. $3.3v$

8. A biconvex lens of 8 cm and 12 cm radius of curvature of refractive index 1.5 then it's focal length will be :

a. 9.6 cm b. 10 cm

c. 5 cm d. 20 cm

9. Angle of deviation when passing through a prism is greatest for light :

a. red b. violet

c. blue d. yellow

10. A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is C then the resultant capacitance is

a. C b. nC

c. (n-1) C d. (n+1) C

11. A Lechlanche cell supplies a current of 1 amp for 1 hour. Atomic weight of Mn = 55, oxygen = 16, of zinc = 65 and $\text{ECE of hydrogen} = 1.04 \times 10^{-5}\ \text{g/Coul}$**. Then the mass of hydrogen liberated is**

a. $0.03744g$ b. $3.744g$

c. $1.217g$ d. $3.258g$

12. An electron is moving in a region where both electric and magnetic fields are present. It will gain energy from

a. Magnetic b. Electric

c. Both fields d. Neither field

13. The phase difference between the alternating current and emf is π/2. Which of the following cannot be the constituent of the circuit?

a. L,C b. L alone

c. C alone d. R,L

14. An unpolarized beam of intensity I_0 falls on a Polaroid . The intensity of emerges light is

a. I_0 b. $\frac{I_0}{2}$

c. $\frac{I_0}{4}$ d. zero

15. Speed of sound is maximum in

a. Monoatomic gas b. Diatomic gas

c. Polyatomic gas d. Equal in all

16. New nucleus after alpha particle decays, is called

a. parent nucleus b. daughter nucleus

c. decayed nucleus d. undecayed nucleus

17. Two deutron each of mass m fuse to form helium resulting in release off energy E, the mass of helium formed is

a. $m - \frac{E}{2c^2}$ b. $2m + \frac{E}{c^2}$

c. $\frac{2E}{mc^2}$ d. $2m - \frac{E}{c^2}$

18. $(A \cup B)^c$ **is equal to [IOE 2075]**

a. $A^c \cup B$ b. $A^c \cap B^c$

c. $A^c \cup B^c$ d. $A^c \cap B$

19. **If** $A = \begin{bmatrix} 1 & 2 & 3 \\ 5 & 0 & 7 \\ 6 & 2 & 5 \end{bmatrix}$ **and** $B = \begin{bmatrix} 1 & 3 & 5 \\ 0 & 0 & 2 \end{bmatrix}$**, then which of the following is defined**

a. AB b. $A'B'$

c. $B'A'$ d. A+B

20. **The value of m for which** $3x^2 + 4mx + 2 = 0, 2x^2 + 3x - 2 = 0$ **may have a common root is,**

a. $-\frac{11}{4}, \frac{7}{4}$ b. $\frac{11}{8}, -\frac{7}{4}$

c. $\frac{11}{8}, \frac{7}{4}$ d. $-\frac{11}{8}, \frac{7}{4}$

21. **A coin is tossed n times, the number of all the possible outcomes is**

a. 2^n b. $2n$

c. $C(n, 2)$ d. $P(n, 2)$

22. **If** $\tan 3\theta = \cot \theta$ **, then** θ **is**

a. $(2n+1)\frac{\pi}{8}$ b. $(2n+1)\frac{\pi}{4}$

c. $(n+2)\frac{\pi}{4}$ d. $(2n+1)\frac{\pi}{6}$

23. **The maximum value of** $f(x) = \sin x + \cos x$ **is [IOE 2077]**

a. 2 b. $\frac{1}{2}$

c. $\frac{1}{\sqrt{2}}$ d. $\sqrt{2}$

24. **In triangle ABC, Value of** $a(b^2 + c^2)\cos A + b(c^2 + a^2)\cos B + c(a^2 + b^2)\cos C$ **is [IOE 2078]**

a. $3ac^2$ b. $3a^2b$

c. $3abc$ d. $3ab^2$

25. **If** θ **is the angle between** $\overrightarrow{a}, \overrightarrow{b}$ **and** $\overrightarrow{a}.\overrightarrow{b} = \sqrt{3}\overrightarrow{a} \times \overrightarrow{b}$ **then** θ **equal to**

a. $\frac{\pi}{3}$ b. π

c. 3π d. $\frac{\pi}{6}$

26. **The equation of bisectors of** $3x^2 - 15xy + 2y^2 = 0$ **are [IOE 2076]**

a. $15x^2 + 2xy + 15y^2 = 0$ b. $-15x^2 + 2xy + 15y^2 = 0$

c. $15x^2 + 2xy - 15y^2 = 0$ d. $-15x^2 + 2xy - 15y^2 = 0$

27. **The point** (x_1, y_1) **lies inside of the circle** $x^2 + y^2 - b^2 = 0$ **if [IOE 2074]**

a. $x_1^2 + y_1^2 = b^2$ b. $x_1^2 + y_1^2 > b^2$

c. $x_1^2 + y_1^2 > 2b^2$ d. $x_1^2 + y_1^2 < b^2$

28. **The foci of the ellipse** $16\mathrm{x}^2 + 9\mathrm{y}^2 = 144$ **is :**

a. $(\pm 3, 0)$ b. $(\pm\sqrt{7}, 0)$

c. $(0, \pm\sqrt{7})$ d. $(0, \pm 5)$

29. **The area of ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ is [IOE 2075]**

a. 9π b. 36π

c. 18π d. 6π

30. **A line making angles α, β, γ with Z- axis , x –axis and y-axis respectively . Then direction cosines of lines are**

a. $\cos 2\beta, cos2\gamma, cos2\alpha$ b. $\cos^2\beta, \cos^2\gamma, \cos^2\alpha$

c. $\cos\beta, \cos\gamma, \cos\alpha$ d. $2\cos\beta, 2\cos\gamma, 2\cos\alpha$

31. **If $f(2) = 4. f'(2) = 1$ then the value of $\lim_{x\to 2} \frac{xf(2) - 2f(x)}{(x-2)}$ is equal to**

a. 1 b. 2

c. 3 d. -2

32. **If $y = \sqrt{x^2 + m^2}$, then $yy_1 =$**

a. x^2 b. m^2

c. 0 d. x

33. **If $y = \text{cosec}^2(\cot^{-1} x)$ then value of $\frac{dy}{dx}$ is [IOE 2076]**

a. $-2x$ b. -1

c. $1 + x^2$ d. $2x$

34. **Maximum value of $f(x) = \sin x + \cos x$ is**

a. $\sqrt{3}$ b. 1

c. $\frac{1}{\sqrt{2}}$ d. $\sqrt{2}$

35. **Maximum value of $\frac{\log x}{x}$ in the interval $[2, \infty)$ is**

a. 1 b. 0

c. $\log 2$ d. $\frac{1}{e}$

36. $\int \left[\frac{1}{\ln x} - \frac{1}{(\ln x)^2}\right] dx =$

a. $\frac{\ln x}{x} + c$ b. $\frac{\ln x}{x^2} + c$

c. $\frac{x}{\ln x} + c$ d. $\frac{2\ln x}{x} + c$

37. **The area of region bounded by the curves $y = x^2$ and $y = |x|$ is:**

a. 1 b. $\frac{2}{3}$

c. $\frac{4}{3}$ d. $\frac{1}{3}$

38. **Hydrolysis of aluminium carbide yields.**

a. Methane b. Ethane

c. Ethyne d. Benzene

39. **In which of the following benzene doesn't show electrophilic substitution reaction: [IOE 2078]**

a. Friedel –Craft's alkylation
b. Sulphonation
c. Nitration
d. Chlorination in sunlight

40. Catalyst used in contact process is

a. Pt
b. $\mathrm{V_2O_5}$
c. $\mathrm{Fe(OH)_3}$
d. All of the above

41. Which of the following is most stable to heat?

a. HCl
b. HBr
c. HOCl
d. HI

42. A solution of sodium metal in liquid ammonia is blue due to the presence of

a. Sodium atoms
b. Ammonium ions
c. Solvated sodium ions
d. Solvated electrons

43. The first step in the extraction of Cu from copper pyrite is

a. Reduction by carbon
b. Electrolysis of ore
c. Roasting of ore in oxygen
d. Magnetic separation

44. Iron is rendered passive by

a. $\mathrm{H_3PO_4}$
b. $\mathrm{HNO_3}$
c. $\mathrm{HClO_4}$
d. HCl

45. Which of the following has highest proton affinity?

a. $\mathrm{NH_3}$
b. $\mathrm{H_2O}$
c. $\mathrm{H_2S}$
d. $\mathrm{PH_3}$

46. The oxidation number of Iodine in $\mathrm{KI_3}$ is [IOE 2077]

a. -1
b. $+1$
c. $+\frac{1}{3}$
d. $-\frac{1}{3}$

47. Which of the following has largest radius?

a. $\mathrm{Mg^{2+}}$
b. $\mathrm{Na^{+}}$
c. $\mathrm{O_2^{-}}$
d. $\mathrm{F^{-}}$

48. Which of the following is largest [IOE 2078]

a. $\mathrm{Cl^{-}}$
b. $\mathrm{S^{2-}}$
c. $\mathrm{Na^{+}}$
d. $\mathrm{F^{-}}$

49. ..... of them described the topic very well.

a. none
b. neither
c. either
d. any

50. The number of people in the hall .....

a. have increased
b. are increasing
c. has increased
d. was increasing

51. His company is greatly sought _____.

a. for
b. after
c. out
d. at

52. He phoned her after she .....her office.

a. Had left
b. Left

c. leave
d. have left

53. 'We must write to her'. Its passive is [IOE 2074]

a. She must be written by us.
b. She has to be written.
c. She must be written to.
d. All of these.

54. The word 'loaded' is transcribed as

a. /loaded/
b. /l ^ ded /
c. /ləʊdɪd/
d. /lodd/

55. 'Either the rain stops, or they will be there all night.' This sentence is [IOE 2074]

a. Simple
b. Compound
c. Complex
d. Mixed

56. She suggested that he _____ hard. [2078]

a. study
b. studies
c. had to study
d. none

57. Her close fisted nature has always cost me. The underlined idiomatic expression is equivalent to [IOE 2074]

a. Penurious
b. Generous
c. Charitable
d. Free

58. If we ..... a camera , he would have taken the photographs. [IOE 2076]

a. had had
b. had
c. have taken
d. would have

59. They drew a circle. Its passive voice is:

a. A circle was being drawn by them.
b. A circle was drawn by them.
c. A circle have been drawn by them.
d. A circle has been drawing since morning.

60. Vidushi said, "We went for a summer trip." It's indirect speech is:

a. Vidushi said that they went for a summer trip.
b. Vidushi said that they were on a summer trip.
c. Vidushi said that they had gone for a summer trip.
d. Vidushi said they went for a summer trip.

61. A particle moving with a uniform acceleration travels 24 m and 64 m in the first two consecutive intervals of 4 sec each. Its initial velocity is

a. 1 m/s
b. 10 m/s
c. 5 m/s
d. 2 m/s

62. A body of weight 20 N, mass 2 kg is moving in vertical circular motion with the help of a string of radius 1 m and with a velocity of 2 m/s. What is the tension in the string at the lowest point?

a. 28 N
b. 20 N
c. 8 N
d. 15 N

63. A geostationary satellite orbits around the earth in a circular orbit of radius 36,000km. Then, the time period of a spy satellite orbiting a few hundred km above the earth's surface (R =6,400km) will approximately be

a. (1/2) hr
b. 1 hr
c. 2 hr
d. 4 hr

64. A small hole of an area of cross-section $2mm^2$ is present near the bottom of a fully filled open tank of height 20 m. Taking $g = 10m/s^2$ find the velocity of water through hole. [IOE 2078]

a. $10\sqrt{2}m/s$ b. $20m/s$

c. $10m/s$ d. $15m/s$

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65. Oxygen and hydrogen gases are at the same temperature and pressure. The ratio of their rms speed will be:

a. $2:1$ b. $1:4$

c. $4:1$ d. $16:1$

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66. A convex lens has a focal length f. It is cut into two parts along the dotted line as shown in the figure. The focal length of each part will be [ ]

a. $2f$ b. $\frac{f}{2}$

c. $\frac{f}{3}$ d. $\frac{3f}{2}$

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67. To form a composite 16 μF, 1000 V capacitor form a supply of identical capacitors marked 8 μ F , 250 V , we require a minimum number of n capacitors where n is:

a. 40 b. 32

c. 8 d. 2

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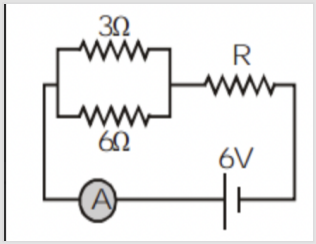
68. If the ammeter in the given circuit reads 2A, the resistance R in Ohm is :-



a. 1 b. 2

c. 3 d. 4

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69. A current in the windings on a toroid is 2A. There are 400 turns and the mean circumferential length is 40cm. If the magnetic field inside is 1T, the relative permeability is :

a. 200 b. 250

c. 400 d. 150

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70. A series AC circuit containing an inductor (20 mH), a capacitor (120 µF) and a resistor (60 Ω) is driven by an AC source of 24 V/50 Hz. The energy dissipated in the circuit in 60 s is

a. 5.65×10^3 J b. 5.65×10^2 J

c. 5.65×10^3 J d. 5.17×10^2 J

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71. A uniform string of 1 m long is fixed having mass 5×10^{-4} kg under a tension of 20 N. It is plucked at a point situated at 25 cm from one end. The frequency of vibration, in this case, will be

a. 100 Hz b. 200 Hz

c. 400 Hz d. 500 Hz

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72. The driver of a car travelling with a speed 30 m/sec toward a hills sounds a horn of frequency of 600 Hz. If

the velocity of sound in air is 330 m/sec, the frequency of reflected sound heard by the driver is:

a. 720 Hz
b. 555.5 Hz
c. 550 Hz
d. 500 Hz

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73. When x – ray tube is operated at 40 kv and 20 mA current flows then 0.8% of energy of electrons is converted into x – ray then power of x – ray

a. 8 kw
b. 80 kw
c. 0.64 w
d. 6.4 w

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74. The longest wavelength of Lyman series is 1216 $\mathring{A}$. The longest wavelength of Paschen series is [IOE 2076]

a. 911 $\mathring{A}$
b. 8208 $\mathring{A}$
c. 10944 $\mathring{A}$
d. 18761 $\mathring{A}$

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75. Find the range of function $f(x) = x^2 - 4x - 5$ [IOE 2078]

a. $(-\infty, 9)$
b. $(-\infty, 9]$
c. $[-9, \infty)$
d. $(-9, \infty)$

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76. If matrix $A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ then $A^{16} =$

a. $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$
b. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
c. $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$
d. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

---

77. If 8,2 are the roots of the equation $x^2 + \alpha x + \beta = 0$ and $3, 3$ are the roots of $x^2 - 6x + b = 0$ then the roots of the equation $x^2 + \alpha x + b = 0$ are:

a. $8, -1$
b. $2, 3$
c. $8, 3$
d. $9, 1$

---

78. A man has 10 shirts and 8 ties. The number of different outfits he can wear are [IOE 2077]

a. ${}^{10}P_5$
b. ${}^{10}C_5$
c. $10! \times 8!$
d. 80

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79. $2\log x - \log(x+1) - \log(x-1)$ is equal to

a. $x^2 + \frac{1}{2}x^4 + \frac{1}{3}x^6 + \ldots + \infty$
b. $\frac{1}{x^2} + \frac{1}{2x^4} + \frac{1}{3x^6} + \ldots + \infty$
c. $x^2 - x^4 + x^6 - \ldots + \infty$
d. None of above

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80. The general solution of the trigonometrical equation $\sin x + \cos x = 1$ is given by

a. $x = 2n\pi - \frac{\pi}{4}$
b. $x = 2n\pi - \frac{\pi}{2}$
c. $x = n\pi + (-1)^n(\frac{\pi}{4}) - \frac{\pi}{4}$
d. $x = n\pi + \frac{\pi}{4}$

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81. In a Δ ABC , 3A =4B and 2B = 3C , then the Δ is ? [IOE 2078]

a. Acute angled
b. Obtuse angled
c. Right angled
d. No triangle possible

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82. **If three vectors $\vec{A} = \vec{i} - 2\vec{j} + 3\vec{k}, \vec{B} = x\vec{j} + 3\vec{k}$ and $\vec{C} = 7\vec{i} + 3\vec{j} - 11\vec{k}$ are coplanar then value of 'x' equals to [IOE 2077]**

a. $\frac{36}{21}$ b. $-\frac{36}{21}$

c. $\frac{51}{32}$ d. $-\frac{51}{32}$

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83. **The point of intersection of the lines represented by equation $2(x+2)^2 + 3(x+2)(y-2) - 2(y-2)^2 = 0$ is :**

a. $(2, 2)$ b. $(2, -2)$

c. $(-2, 2)$ d. $(-2, -2)$

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84. **The equation of the circle passing through the origin and intercepting lengths a and b on the axes is**

a. $x^2 + y^2 + ax + by = 0$ b. $x^2 + y^2 + ax - by = 0$

c. $x^2 + y^2 - ax + by = 0$ d. $x^2 + y^2 - ax - by = 0$

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85. **The axis of parabola $2x^2 - 20x, \ddot{A}\grave{i}y + 53 = 0$ is [IOE 2075]**

a. $x = 5$ b. $y = 5$

c. $x = -5$ d. $y = -5$

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86. **The direction cosine of a line joining the points (1,3,5) and (−1,0,−1) is [IOE 2078]**

a. −2/7, −3/7, −6/7 b. 2/7, 3/7, 6/7

c. Both a and b d. 2/7, −3/7, 6/7

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87. **The value of $\lim_{x\to\infty} \sqrt{(x^2+8x+3)} - \sqrt{(x^2+4x+3)}$ is**

a. 0 b. 1

c. 2 d. Does not exist

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88. $f(x, y) = \sin(xy) + x^2 \ln(y)$ **Find f_{yx} at $(0, \frac{\pi}{2})$ [IOE 2075]**

a. 2 b. 3

c. 1 d. 0

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89. $\int_1^{-1} |1 - x| dx$ **is equal to [IOE 2078]**

a. 0 b. 1

c. -1 d. 2

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90. **On reaction with Bayer's reagent, Ethylene and Acetylene form**

a. formic acid and acetic acid b. oxalic acid and ethylene glycol

c. ethylene glycol and oxalic acid d. acetic acid and formic acid

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91. **KI and CuSO4 solution when mixed it gives**

a. $CuI_2 + K_2SO_4$ b. $Cu_2I_2 + K_2SO_4 + I_2$

c. $Cu_2I_2 + K_2SO_4$ d. $CuI_2 + K_2SO_4 + I_2$

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92. **Calcination and roasting are carried in**

a. Blast furnace b. Muffle furnace

c. Reverberatory furnace d. Open hearth furnace

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93. The electrochemical equivalent of a divalent metal is 3×10^{-4}. What is the approximate atomic mass of the metal?

a. 107.8 b. 63.6

c. 58 d. 40

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94. The total number of molecules of suphuric acid in 0.5 N H_2SO_4 of water 100 ml is [IOE 2076]

a. 6.023×10^{23} b. 3.100×10^{22}

c. 6.023×10^{22} d. 1.505×10^{22}

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95. 300 mL of 0.1 M NaOH is added to 150 mL of 0.05 M HCl. The resulting pH is: [IOE 2078]

a. 1.648 b. 1.301

c. 12.875 d. 12.699

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96. Two electrolytic cell, one containing acidified ferrous chloride and another ferric chloride are connected in series. The ratio of iron deposited at cathodes in the two cells will be

a. 3:1 b. 2:1

c. 1:1 d. 3:2

Read the passage carefully and choose the best answer to each question out of the four alternatives. ***(Questions from 97 to 100)***

Genetic variation is the cornerstone of evolution, without which there can be no natural selection, and so a low genetic diversity decreases the ability of a species to survive and reproduce, explains lead author Yoshan Moodley, Professor at the Department of Zoology, University of Venda in South Africa.

Two centuries ago, the black rhinoceros – which roamed much of sub Saharan Africa – had 64 different genetic lineages; but today only 20 of these lineages remain, says the paper. The species is now restricted to five countries, South Africa, Namibia, Kenya, Zimbabwe and Tanzania. Genetically unique populations that once existed in Nigeria, Cameroon, Chad, Eritrea, Ethiopia, Somalia, Mozambique, Malawi and Angola have disappeared. The origins of the 'genetic erosion' coincided with colonial rule in Africa and the popularity of big game hunting. From the second half of the 20th century, however, poaching for horns has dramatically depleted their population and genetic diversity, especially in Kenya and Tanzania.

97. What is important for evolution?

a. Large population b. Survival of the fittest

c. Genetic variation d. Mixing of species

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98. Sub Sharan Africa has lost how many black rhino genetic lineages in 200 years?

a. 20 b. 30

c. 64 d. 44

99. Genetically unique black rhinoceros has been lost in all of the following countries, except?

a. Nigeria
b. Malawi
c. Tanzania
d. Chad

100. From the second half of the 20th century what has caused a dramatic fall in black rhinoceros population?

a. colonial rule
b. fall in genetic diversity
c. poaching
d. big game hunting

Answer Key

1.d	2.b	3.c	4.b	5.d	6.a	7.a	8.a
9.b	10.c	11.a	12.b	13.d	14.b	15.a	16.b
17.d	18.b	19.b	20.d	21.a	22.a	23.d	24.c
25.d	26.c	27.d	28.c	29.d	30.c	31.b	32.d
33.d	34.d	35.d	36.c	37.d	38.a	39.d	40.b
41.a	42.d	43.c	44.b	45.a	46.d	47.c	48.b
49.b	50.c	51.c	52.a	53.c	54.c	55.b	56.c
57.a	58.a	59.b	60.c	61.a	62.a	63.c	64.b
65.b	66.a	67.b	68.a	69.c	70.d	71.b	72.a
73.d	74.d	75.c	76.d	77.d	78.d	79.b	80.c
81.a	82.d	83.c	84.d	85.a	86.c	87.c	88.c
89.d	90.c	91.b	92.c	93.c	94.d	95.d	96.d
97.c	98.d	99.c	100.c				

Solutions

1. d

$E = KT$

$[ML^2T^{-2}] = K[K]$

$K = [ML^2T^{-2}K^{-1}]$

2. b

$\frac{mv^2}{r} = \mu mg$

or, $r = \frac{v^2}{\mu g}$

3. c

4. b

$T \uparrow$, strain $\uparrow$

strain $\uparrow$, $Y, \downarrow$

5. d

Excess pressure, $\frac{2T}{R}$ = External pressure $(h\rho g)$

or, $\frac{(2 \times 72 \times 10^{-3})}{(0.4 \times 10^{-3})} = h \times 10^3 \times 10$

6. a

7. a

$V_{rms} = \sqrt{\frac{\sum V^2}{N}}$

$= \sqrt{\frac{V^2 + 4V^2 + 9V^2 + 16V^2 + 25V^2}{5}}$

$= v\sqrt{11}$

8. a

$\frac{1}{f} = (\mu - 1)(\frac{1}{R_1} + \frac{1}{R_2})$
$or, \frac{1}{f} = (1.5 - 1)(\frac{1}{8} + \frac{1}{12})$
$or, \frac{1}{f} = 0.5 \times \frac{5}{24}$
$\therefore f = 9.6\ cm$

9. b

Deviation produced by a prism (δ)=A (μ-1). Since μ is higher for lower wavelength . δ will be higher for light of lower wavelength i. e $\delta_{violet} > \delta_{red}$

10. c

n plates connected alternately give rise to (n – 1) capacitors connected in parallel

Resultant capacitance = (n – 1)C.

11. a

$m = zit = 1.04 \times 10^{-5} \times 1 \times 3600 = 0.03744g$

12. b

A moving charge gains energy in electric field only because in magnetic field energy remains constant.

13. d

R and L cause phase difference to lie between 0 and π/2 but never 0 and π/2 at extremities.

14. b

When unpolarized light is seen through polaroid , intensity of transmitted light decreases to 50% on account of polaristaion.

15. a

$v \propto \sqrt{\gamma}$

16. b

17. d

18. b

De morgan's law

$(A \cup\ B)^c = A^c \cap B^c$

19. b

$A_{3\times3}, A'_{3\times3}$

$B_{2\times3}, B'_{3\times2}$

AB is not defined as column of A =3 and row of B =2.

$A+B$ is not defined as A,B are not of same order.

$A'B'$ is defined as column of A' = 3 and row of B' = 3

20. d

If $ax^2+bx+c=0...(i)$ and

$a_1x^2+b_1x+c_1=0...(ii)$ have a common root then,

$(bc_1-b_1c)(ab_1-a_1b)=(ca_1-ac_1)^2$

Comparing $3x^2+4mx+2=0, 2x^2+3x-2=0$ with (i) and (ii) Then

$a=3, b=4m, c=2, a_1=2, b_1=3, c_1=-2$

$\therefore (4m\times(-2)-3\times2)(3\times3-2\times4m)=(2\times2-3\times(-2))^2$

$m=-\frac{11}{8}, \frac{7}{4}$

21. a

We know that, when a coin is tossed, we will get either head or tail.

Therefore, the number of all possible outcomes when a coin is tossed n times is 2^n.

22. a

$\tan3\theta=\cot\theta$

$\tan3\theta=\tan(\frac{\pi}{2}-\theta)$

$3\theta=n\pi+\frac{\pi}{2}-\theta$

$\theta=(2n+1)\frac{\pi}{8}$

23. d

The maximum value of $f(x)=a\sin x+b\cos x$ is $\sqrt{a^2+b^2}$

Maximum value = $\sqrt{1^2+1^2}=\sqrt{2}$

24. c

25. d

$\overrightarrow{a}.\overrightarrow{b}=\sqrt{3}\overrightarrow{a}\times\overrightarrow{b}$

$ab\cos\theta=\sqrt{3}ab\sin\theta$

$\cot\theta=\sqrt{3}$

$\theta=\frac{\pi}{6}$

26. c

Comparing $3x^2 - 15xy + 2y^2 = 0$ with $ax^2 + 2bxy + by^2 = 0$

$a = 3, h = -\frac{15}{2}$ and $b = 2$

equation of bisectors: $h(x^2 - y^2) = (a - b)xy$

or, $-\frac{15}{2}(x^2 - y^2) = (3 - 2)xy$ i.e., $15x^2 + 2xy - 15y^2 = 0$

27. d

It will lies inside if

$\sqrt{(x_1 - 0)^2 + (y_1 - 0)^2} < r$

$\sqrt{x_1^2 + y_1^2} < b$

$x_1^2 + y_1^2 < b^2$

28. c

$16\mathrm{x}^2 + 9\mathrm{y}^2$ = 144

$\frac{\mathrm{x}^2}{9} + \frac{\mathrm{y}^2}{16} = 1$

$e = \sqrt{1 - \frac{a^2}{b^2}} = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4}$

Foci = $(0, \pm be) = (0, \pm 4 \times \frac{\sqrt{7}}{4}) = (0, \pm\sqrt{7})$

29. d

Equation of the ellipse : $\frac{x^2}{4} + \frac{y^2}{9} = 1\ a^2 = 4, b^2 = 9$

area of ellipse $(A) = \pi$ a b

$= \pi.2.3 = 6\pi\mathrm{sq.}$ units

30. c

A line making angles α, β, γ with Z- axis , x –axis and y- axis respectively . Then direction cosines of lines are $\cos\beta, \cos\gamma, \cos\alpha$

31. b

$\lim_{x \to 2} \frac{xf\,(2) - 2f\,(x)}{(x - 2)} (0/0)$

Using L Hospital Rule:

$= \lim_{x \to 2} \frac{f(2) - 2f'(x)}{1} (0/0)$

$= f(2) - 2f'(2)$

$= 2$

32. d

$y = \sqrt{x^2 + m^2}$

$y_1 = \frac{1}{2\sqrt{x^2 + m^2}} \cdot 2x = \frac{x}{\sqrt{x^2 + m^2}}$

then $yy_1 = \sqrt{x^2+m^2} \cdot \dfrac{x}{\sqrt{x^2+m^2}}$

$$yy_1 = x$$

33. d

$y = \text{cosec}^2(\cot^{-1} x) = [\text{cosec}(\cot^{-1} x)]^2 =$
$[\text{cosec}\, \text{cosec}^{-1}(\sqrt{1+x^2})]^2 = 1 + x^2$ Hence, $\dfrac{dy}{dx} = 2x$

34. d

Maximum of $a\cos x + b\sin x$ is $\sqrt{a^2+b^2}$

So, Maximum = $\sqrt{1^2+1^2} = \sqrt{2}$

35. d

$$y = \frac{\log x}{x}$$

$$\frac{dy}{dx} = \frac{x\dfrac{1}{x} - \log x}{x^2}$$

$$\log x - 1 = 0$$

$$\log x = 1$$

$$x = e$$

$$y = \frac{\log e}{e} = \frac{1}{e}$$

36. c

Solution:

Put $\ln x = t \quad \Rightarrow x = e^t \rightarrow dx = e^t dt$

$$\therefore I = \int \left(\frac{1}{t} - \frac{1}{t^2}\right) e^t dt = e^t \cdot \frac{1}{t} + c = \frac{x}{\ln x} + c$$

37. d

$$\begin{aligned}\text{Area bounded (A)} &= 2\int (\mathrm{y_1 - y_2})\,\mathrm{dx} \\ &= 2\int_0^1 \left(\mathrm{x - x^2}\right)\mathrm{dx} \\ &= \left[\frac{\mathrm{x^2}}{2} - \frac{\mathrm{x^3}}{3}\right]_0^1 \\ &= 2\left(\frac{1}{2} - \frac{1}{3}\right) \\ &= \frac{1}{3}\text{sq. units}\end{aligned}$$

38. a

39. d

$\mathrm{Cl_2}$ is added to the benzene ring in presence of sunlight to give benzene hexachloride. It is a free radical reaction.
In this reaction electrophilic addition reaction takes place. Thus it is not an example of electrophilic substitution reaction.

$$\mathrm{C_6H_6 + 3\,Cl_2 \xrightarrow{h\nu} C_6H_6Cl_6}$$

40. b

Vanadium oxide is the catalyst used in the contact process.

41. a

Out of HCl, HBr and HI, HCl is thermally most stable due to high bond dissociation energy. HOCI is a highly unstable compound.

42. d

When sodium metal is dissolved in liquid ammonia to form coloured solution. Dilute solutions are bright blue in colour due to the presence of solvated electrons.

$$\mathrm{Na} + (\mathrm{x} + \mathrm{y})\ \mathrm{NH_3} \longrightarrow [\mathrm{Na(NH_3)}_x\ ]^+ + [\mathrm{e(NH_3)}_y]^-$$

43. c

First step in the extraction of copper is the roasting of sulphide ore i.e. copper (i) sulphide.

$$2\,\mathrm{Cu_2S} + 3\,\mathrm{O_2} \xrightarrow{\text{Heat}} 2\,\mathrm{Cu_2O} + 2\,\mathrm{SO_2}$$

44. b

Iron is the metal which is rendered passive with concentrated nitric acid. Iron readily dissolves in dilute nitric acid and the concentrated acid forms a metal oxide layer that protects the bulk of the metal from further oxidation. The formation of this protective layer is called as passivation.

45. a

As ammonia is strongest base among given compounds, so it has highest affinity for hydrogen ions.

46. d

$$\mathrm{KI_3} \longrightarrow \mathrm{K^+} + 3\,\mathrm{I^-}$$

$$\text{i.e., } 1 + 3 \times x = 0 \Rightarrow x = -\frac{1}{3}$$

47. c

For iso-electronic species more the positive charge, smaller the ionic radii.

For iso-electronic species more negative charge, bigger the ionic radii

48. b

$\mathrm{Cl^-}$ and $\mathrm{S^{2-}}$ are isoelectronic species with 18 electrons while $\mathrm{Na^+}$ and $\mathrm{F^-}$ are isoelectronic with 10 electrons. $\mathrm{Na^+}$ and $\mathrm{F^-}$ are smaller in size due to lower shell. Among $\mathrm{Cl^-}$ and $\mathrm{S^{2-}}$; $\mathrm{S^{2-}}$ is larger size because of higher negative charge.

49. b

50. c

51. c

52. a

53. c

54. c

55. b

56. c

57. a

58. a

59. b

60. c

61. a

Distance travelled in 4 sec: $24 = 4u + \frac{1}{2}a \times 16$... (i)

Distance travelled in total 8 sec: $88 = 8u + \frac{1}{2}a \times 64$... (ii)

After solving (i) and (ii), we get u = 1 m/s.

62. a

At the lowest point, the body experiences centrifugal force and the weight in the same direction, opposite to the direction of tension in the string.

Centrifugal force can be calculated as $\frac{mv^2}{r} = 8N$.

Hence the tension = weight + centrifugal force = 28 N.

63. c

64. b

$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20m/s$

65. b

$\frac{\bar{C}_{H_2}}{\overline{C}_{O_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$

66. a

$f = \frac{R}{2(\mu - 1)}$

$f' = \frac{R}{(\mu - 1)}$

$f' = 2f$

67. b

$\frac{1}{2}C_1V_1^2 = n \times \frac{1}{2}C_2V_2^2$

$\frac{1}{2}16 \times 1000^2 = n \times \frac{1}{2} \times 8 \times 250^2$

$n = 32$

68. a

69. c

70. d

71. b

72. a

$f^1 = \frac{v + v_o}{v - v_s} \times f = \frac{330 + 30}{300 - 30} \times 600 = 720$Hz

73. d

$P = 0.8\%$ of 1 V

$= \frac{0.8}{100} \times 20 \times 10^{-3} \times 40 \times 10^{3} = 6.4w$

74. d

For Lyman series, $\frac{1}{1216} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$...(i)

For Paschen series, $\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{4^2}\right)$ ... (ii)

Dividing Equation (i) equation (ii)

$$\frac{\lambda}{1216} = \frac{3}{4} \times \frac{144}{7} = 18761\mathring{A}$$

75. c

f(x) = x^2-4x-5, quadratic function,

Domain (the values if x) is all real numbers.

To find range we should draw a graph or to write an equation in vertex
form.

f(x) = x^2-4x+4-4-5

f(x) = $(x-2)^2$-9

Point (-2,-9) is the vertex of the parabola, and it is a minimum because a parabola has positive sign in front of x^2, so it is looking up. Minimum value of y = -9

Range(the values of y) is [-9, ∞)

76. d

$$A^2 = A.A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}.$$

$$A^{16} = (A^2)^8 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}^8 = \begin{bmatrix} (-1)^8 & 0 \\ 0 & (-1)^8 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

77. d

From 1^{st} equation, sum of the roots $= -\alpha$ i.e. $8 + 2 = -\alpha \quad \Rightarrow \alpha = -10$

From 2^{nd} equation product of the roots $= b$ i.e. $3 \times 3 = b \Rightarrow b = 9$

The 3^{rd} equation now becomes $x^2 - 10x + 9 = 0\ x = 1, 9$

78. d

He can choose any one shirt out of 10 shirts and other one tie out of 8 ties for a unique outfit.

∴ total number of outfits = 10 × 8 = 80

79. b

$2\log x - \log(1+x) - \log(x-1)$

$= 2\log x - [\log(1+x) - \log(x-1)]$

$= 2\log x - [\log(x^2-1)]$

$= \log x^2 - \log(x^2-1)$

$$= \log\left(\frac{x^2}{x^2-1}\right)$$

$$= -\log\left(\frac{x^2-1}{x^2}\right)$$

$$= -\log\left(1-\frac{1}{x^2}\right)$$

$$= \frac{1}{x^2}+\frac{1}{2x^4}+\frac{1}{3x^6}+\ldots\ldots$$

80. c

$\sin x+\cos x=1$

Dividing by $\sqrt{1^2+1^2}=\sqrt{2}$

$$\frac{1}{\sqrt{2}}\sin x+\frac{1}{\sqrt{2}}\cos x=\frac{1}{\sqrt{2}}$$

$$\cos\frac{\pi}{4}\sin x+\sin\frac{\pi}{4}\cos x=\frac{1}{\sqrt{2}}$$

$$\sin(\frac{\pi}{4}+x)=\sin\frac{\pi}{4}$$

$$\frac{\pi}{4}+x=n\pi+(-1)^n\frac{\pi}{4}$$

$$x=n\pi+(-1)^n\frac{\pi}{4}-\frac{\pi}{4}$$

81. a

$3A=4B=6C=x$

$A=\frac{x}{3},B=\frac{x}{4},C=\frac{x}{6}$

$A+B+C=\pi$

$\frac{x}{3}+\frac{x}{4}+\frac{x}{6}=\pi$

$x=240^\circ$

$A=80^\circ$

$B=60^\circ$

$C=40^\circ$

82. d

For coplanar vectors, $\begin{vmatrix}1 & -2 & 3\\ 0 & x & 3\\ 7 & 3 & -11\end{vmatrix}=0$

Expanding along second row,

$$x\begin{vmatrix}1 & 3\\ 7 & -11\end{vmatrix}+(-3)\begin{vmatrix}1 & -2\\ 7 & 3\end{vmatrix}$$

$-32x+51=0$

$x=-\frac{51}{32}$

83. c

$2(x+2)^2+3(x+2)(y-2)–2(y-2)^2=0$

$2(x+2)^2+4(x+2)(y-2)-(x+2)(y-2))-2(y-2)^2=0$

$2(x+2)[(x+2)+2(y-2)]-(y-2)[x+2+2(y-2)]=0$

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

$(x+2y-2)(2x+4-y+2)=0$

$(x+2y-2)(2x-y+6)=0$

The lines are $x+2y-2=0$ and $2x-y+6=0$

$x+2y-2=0$ = $2x+4y-4=0$ ...(i)

and

$2x-y+6=0$ .. (ii)

Subtracting (ii) from (i)

$5y-10=0$

$y=2$

When y=2;

$2x-2+6=0$ in (ii)

$x=-2$

84. d

Circle passes through (0,0), (a,0) and (0,b).

Let center be (x,y).

$(x-0)^2+(y-0)^2=(x-a)^2+(y-0)^2=(x-0)^2+(y-b)^2$

Taking first two:

$x^2+y^2=x^2-2ax+a^2+y^2$

$a(a-2x)=0\rightarrow x=\frac{a}{2}$

Taking first and third:

$x^2+y^2=x^2+y^2-2by+b^2$

$b(b-2y)=0\rightarrow y=\frac{b}{2}$

center is $(\frac{a}{2},\frac{b}{2})$

$x^2+y^2=r^2$

$$r^2 = \frac{a}{2}^2 + \frac{b}{2}^2 = \frac{a^2+b^2}{4}$$

The equation of a circle is:

$$(x - \frac{a}{2})^2 + (y - \frac{b}{2})^2 = \frac{a^2+b^2}{4}$$

$$x^2 - ax + \frac{a^2}{4} + y^2 - by + \frac{b^2}{4} = \frac{a^2+b^2}{4}$$

$$\mathrm{x^2 + y^2 - ax - by = 0}$$

85. a

$2x^2 - 20x - y + 53 = 0$

$2(x^2 - 10x) - y + 53 = 0$

Or, $2(x-5)^2 = y - 3$

i.e., $(x-5)^2 = \frac{1}{2}(y-3)$

comparing this with $(x-h)^2 = 4a(y-k) \rightarrow h = 5$ so, axis $x = h$ i.e., $x = 5$

86. c

87. c

$\lim_{x\to\infty} \sqrt{(x^2+8x+3)} - \sqrt{(x^2+4x+3)}$

$\lim_{x\to\infty} (\sqrt{(x^2+8x+3)} - \sqrt{(x^2+4x+3)}) \frac{\sqrt{(x^2+8x+3)} + \sqrt{(x^2+4x+3)}}{\sqrt{(x^2+8x+3)} + \sqrt{(x^2+4x+3)}}$

$\lim_{x\to\infty} \frac{(x^2+8x+3) - (x^2+4x+3)}{\sqrt{(x^2+8x+3)} + \sqrt{(x^2+4x+3)}}$

$\lim_{x\to\infty} \frac{4x}{\sqrt{(x^2+8x+3)} + \sqrt{(x^2+4x+3)}}$

$\lim_{x\to\infty} \frac{4x}{x(\sqrt{(1+\frac{8}{x}+\frac{3}{x^2})} + \sqrt{(1+\frac{4}{x}+\frac{3}{x^2})}}$

$\frac{4}{2} = 2$

88. c

$f_y = x\cos(xy) + \frac{x^2}{y}$

$f_{yx} = \cos(xy) - xy\sin(xy) + \frac{2x}{y}$

Put $(x, y) = (0, \frac{\pi}{2})$

$= 1$

89. d

90. c

Reaction of Baeyer's reagent with alkyne:

$$\mathrm{CH{\equiv}CH \longrightarrow COOH{-}COOH}$$

Reaction of Baeyer's reagent with alkene:

$$\mathrm{CH_2{=}CH_2 + H_2O + O \xrightarrow{Bayer's\ reagent} OH{-}CH_2{-}CH_2{-}OH}$$

91. b

There is an interesting redox reaction which occurs when the iodide ion will reduce the copper(II) ion to copper(I) while iodide itself is oxidized to elemental iodine. Like most copper(I) compounds, CuI is insoluble in water.

$$\mathrm{4\,KI\,(aq) + 2\,CuSO_4(aq) \longrightarrow Cu_2I_2\,(s) + I_2\,(s) + 2\,K_2SO_4\,(aq)}$$

92. c

The process of calcination and roasting is carried out in reverberatory furnace.

93. c

Eq mass of the metal= $96500Z = 96500 \times 3 \times 10^{-4} = 28.95$

atomic mass $= 2 \times 28.95 = 57.90$

94. d

We have, $\frac{W}{E} = \frac{NV}{1000}$

Or, $\frac{W}{49} = \frac{0.5 \times 100}{1000}$

$W = 2.45g$

Number of molecules = no. of moles $\times N_A = \frac{2.45}{98} \times 6.023 \times 10^{23} = 1.505 \times 10^{23}$

95. d

$N_1V_1 - N_2V_2 = NV$

$300 \times 0.1 - 150 \times 0.05 = 450 \times N$

$N = 0.05N \rightarrow M = 0.05M$

$\mathrm{pOH} = -\log\left[\mathrm{OH^-}\right] = -\log 0.05 = 1.3010$

$\mathrm{pH} = 14 - \mathrm{pOH} = 14 - 1.301 = 12.698$

96. d

$$\frac{\text{wt of } \mathrm{Fe^{+2}}}{\mathrm{E_1}} = \frac{\text{wt of } \mathrm{Fe^{+3}}}{\mathrm{E_2}}$$

$$\frac{\text{wt of } \mathrm{Fe^{+2}}}{\text{wt of } \mathrm{Fe^{+3}}} = \frac{M/2}{M/3} = \frac{3}{2}$$

97. c

98. d

99. c

100. c