BEATS ENGINEERING

INSTITUTE OF ENGINEERING

Model Entrance Exam

(Set-1)

Instructions:

There are 100 multiple-choice questions, each having four choices of which only one choice is correct.

Date: 2080/02/20
(June-03)

Duration: 2 hours
Time: 7 AM – 9 AM

Section-A (1 marks)

1) More than one student _____ expelled.
a) was b) were c) are d) have been

2) We postponed _____ the meeting.
a) to attend b) attended c) attends d) attending

3) I _____ to Chitwan yet.
a) haven't been b) have been c) had been d) been

4) He talked about the competition as if he _____ part in it.
a) had taken b) took c) takes d) has taken

5) Please stand _____ line for the tickets.
a) at b) by c) with d) in

6) I have made a mess of all my answers.
a) use time resourcefully b) to get the advantage of
c) to confuse d) to end

7) He said, "I bought a car yesterday."
a) He said that she had bought a car the previous day.
b) He told me that he had bought a car the previous day.
c) He said that he has bought a car the previous day.
d) He said that he had bought a car the previous day.

8) Tainted (Synonym)
a) enhance b) strengthen c) defect d) disgrace

9) I have to change my approach; the competition is too good now.The word 'competition' has a stress primarily on its _____ syllable.
a) first b) second c) third d) fourth

10) Manifest (Antonym)
a) apparent b) obscure c) visible d) noticeable

11) I was blamed _____ the mistake.
a) for b) by c) with d) in

12) Transform the given sentence into negative:
"Many people want to travel the world"
a) Not many people want to travel the world.
b) Don't many people want to travel the world?
c) Many people don't want to travel the world.
d) Many people want to travel the world, isn't it?

13) $\lim_{x\to 9} \frac{x^{\frac{3}{2}} - 27}{x - 9} =$
a) 3/2 b) 9/2 c) 2/3 d) 1/3

14) If $y = \tan^{-1}(\cot x) + \cot^{-1}(\tan x)$, then $\frac{dy}{dx}$ equals:
a) 1 b) 0 c) -1 d) -2

15) The greatest value of $f(x) = x^3 - 12x^2 + 45x$ in [0,7] is:
a) 54 b) 70 c) 36 d) 58

16) $\int \frac{\sin x + \cos x}{\sqrt{1 + \sin 2x}} dx =$
a) $\log(\cos x + \sin x) + c$ b) $x + c$
c) $\log x + c$ d) $\sqrt{1 + \sin 2x} + c$

17) Both roots of the equation $ax^2 + bx + c = 0, a \neq 0$ are zero if:
a) $c = 0, b = 0$ b) $b = 0, c \neq 0$
c) $b \neq 0, c = 0$ d) $b \neq 0, c \neq 0$

18) The n^{th} term of a GP is 128 and the sum of its n terms is 255. If its common ratio is 2, then its first term is:
a) 1 b) 2 c) 3 d) 4

19) The conjugate of a complex number is $\frac{1}{i-1}$. Then the complex number is:
a) $-\frac{1}{i-1}$ b) $\frac{1}{i+1}$ c) $-\frac{1}{i+1}$ d) $\frac{1}{i-1}$

20) Everybody in a room shakes hands with everybody else. If total number of handshakes is 66, then total number of persons in the room is:
a) 11 b) 12 c) 13 d) 14

21) If $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$, then A is:
a) symmetric matrix b) skew symmetric matrix
c) singular matrix d) invertible matrix

22) The set $A = [x : x \in R, x^2 = 16 \text{ and } 2x = 6]$ equals:
a) $\emptyset$ b) [14,3,4] c) [3] d) [4]

23) If the line $3x + 4y + 5 + \lambda(x - 2y + 3)$ is horizontal, then $\lambda =$
a) -3 b) 3 c) 4 d) -4

24) The equation of tangent to the circle $(x-4)^2 + (y-7)^2 = 20$ at point (2,3) is:
a) $2x - y - 1 = 0$ b) $x + 3y - 5 = 0$ c) $x + 2y - 8 = 0$ d) $2x - y + 8 = 0$

25) If the line $x = my + k$ touches the parabola $x^2 = 4ay$, then $k =$
a) $\frac{a}{m}$ b) am c) am^2 d) $-am^2$

26) The length of latus rectum of the ellipse $5x^2 + 9y^2 = 45$ is:
a) $\frac{\sqrt{5}}{4}$ b) $\frac{\sqrt{5}}{2}$ c) $\frac{5}{3}$ d) $\frac{10}{3}$

27) A line makes α, β, γ angles with the coordinate axes. If $\alpha + \beta = 90°$, then γ is equal to:
a) 0° b) 90° c) 60° d) 45°

28) If $\sin x + \sin^2 x = 1$, then the value of $\cos^2 x + \cos^4 x$ is:
a) 1 b) 1/2 c) 2 d) 4

29) If $\sin\theta - \cos\theta = 0$ and $0 < \theta < \frac{\pi}{2}$, then θ is equal to:
a) $\frac{\pi}{2}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{6}$ d) 0

30) If $\text{cosec}^{-1} x = \sin^{-1}\frac{1}{x}$, which of the following is not the value of x?
a) $x = -\frac{1}{2}$ b) $x = \frac{3}{2}$ c) $x = -\frac{3}{2}$ d) $x = 1$

31) In ΔABC, if $\cos A = \frac{4}{5}, \cos B = \frac{3}{5}$, then a:b:c =
a) 4:3:5 b) 3:4:5 c) 5:4:3 d) 5:3:4

32) If θ is the angle between a and $\vec{b}$, then $\frac{|a \times \vec{b}|}{a.\vec{b}}$ equals:
a) $\tan\theta$ b) $-\tan\theta$ c) $\cot\theta$ d) $-\cot\theta$

33) Which of the following is not a unit of energy?
a) watt-second b) kg m sec^{-1} c) newton × metre d) joule

34) A ball is thrown vertically upwards in air. If the air resistance cannot be neglected, then the acceleration of the ball at the highest point is
a) g b) >g c) <g d) 0

35) A man in a lift will weigh more when
a) Lift accelerates upward b) Lift accelerates downward
c) Lift descents freely d) The lift going up is slowing down

36) When a mass is rotating in a plane about a fixed point, its angular momentum is directed along:

a) the radius b) the tangent to orbit
c) the line at 45° to the plane of rotation d) the axis of rotation

37) Gravitational force is required for
a) stirring of liquid b) convection
c) conduction d) diffraction and diffusion

38) Moment of inertia depends on
a) Torque b) axis of rotation
c) Angular acceleration d) Angular velocity

39) Liquid drops acquire spherical shape due to
a) gravity b) surface tension
c) viscosity d) intermolecular attraction

40) Two blocks of ice when pressed together join to form one block because:
a) of heat produced during pressing
b) of cold produced during pressing
c) melting point of ice decreases with increase in pressure
d) melting point of ice increases with increase in pressure

41) The internal energy of a gram-molecule of an ideal gas depends upon
a) pressure alone b) volume alone
c) temperature alone d) both pressure and temperature

42) Water in a pond is heated by sunlight. The temperature of water increases from top to bottom through:
a) conduction b) convection c) radiation d) all of these

43) Sound waves do not show the phenomenon of
a) refraction b) interference c) diffraction d) polarization

44) When a ray of light enters a glass slab from air
a) its wavelength decreases b) its wavelength increases
c) its frequency increases d) neither the wavelength nor frequency changes

45) If a unit charge is taken from one point to another over an equipotential surface, then
a) work is done on the charge b) work is done by the charge
c) work on the charge is constant d) no work is done

46) Eddy current is produced in
a) heated magnetic field b) non-uniform magnetic field
c) uniform magnetic field d) changing electric field

47) In NPN transistor electron moves from
a) base to emitter b) collector to emitter
c) base to collector d) emitter to base

48) The minimum wavelength of X-rays can be obtained by
a) increasing filament voltage
b) increasing potential between anode and cathode
c) increasing intensity of X-rays
d) changing target material

49) Line of force due to earth's horizontal magnetic field are:
a) concentric circles b) curved lines
c) elliptical d) parallel and straight

50) Isobars have same number of
a) electrons b) protons c) neutrons d) nucleons

51) Number of moles of solute dissolved in one kilogram of solvent is called
a) Normality b) Molarity c) Molality d) Molecularity

52) A subshell with n=6, l=2 can accommodate a maximum of
a) 12 electrons b) 14 electrons c) 10 electrons d) 6 electrons

53) In the reaction which one is reduced?

$Cr_2O_7 + H^+ + I^- \rightarrow Cr^{3+} + H_2O + I_2$

a) Cr b) H^+ c) O d) I^-

54) BF_3 is
a) Lewis acid b) Lewis base c) Bronsted acid d) Bronsted base

55) Nitrogen cannot form pentahalides because of
a) high electronegativity b) no d-orbitals
c) small size d) high electron affinity

56) In the extraction of copper from its sulphide ore, the metal is formed by the reduction of Cu_2O with
a) FeS b) CO c) Cu_2S d) SO_2

57) The solubilities of carbonates decrease down the Magnesium group due to decrease in
a) Lattice energy of solids b) Hydration energies of cation
c) Inter ionic attraction d) Enthalpy of solution formation

58) Which of the following is used in galvanizing iron sheet?
a) Zn b) Hg c) Cu d) Ni

59) The displacement of electrons of σ bond towards an electronegative atom or group of atoms is
a) mesomeric effect b) inductive effect
c) electromeric effect d) delocalization effect

60) Which of the following compounds cannot be synthesized by the Wurtz reaction?
a) Ethane b) Butane c) Hexane d) Methane

Section-B (2 marks)

Read the following passages and answer the questions given below.

When the esteemed Greek philosopher, Eudemos, became ill with a fever, the most famous physician of Rome tried every remedy but to no avail. Death was knocking at his door when Eudemos called in Galen, a young Greek physician who had recently arrived in the city.

The roman doctors attending Eudemos scoffingly asked the new-comer. "To what physician's sect do you belong?" Galen, not to be intimidated, boldly answered: " I belong to no sect, and regard as slaves those who accept as final, the teachings of Hippocrates or anyone else." He then proceeded to prescribe remedies that restored his patient to perfect health within a short time.

Galen was born in 130 AD in Pergamon, the capital of the Roman province of Asia minor, famous for its school of sculpture and for its library which rivalled that of Alexandria. Nicon, the father of Galen, was a wealthy farmer who had attained a well-rounded education in mathematics, philosophy and the natural sciences. Nicon instilled in his son a love for language and literature, and trained him in the fundamental of mathematics and the natural sciences. On the farm, the impressionable boy learned many of the secrets of animal and plant life. When he was fourteen years old, Galen was sent by his father to the best teacher in Pergamon. From reading Aristotle he received his first lessons in biology and learned that the biologist must study nature by direct observation.

61) Who tried to belittle Dr Galen?
a) his father b) his teachers c) Eudemos d) Roman physicians

62) According to Galen who is to be called a slave?
a) one who belongs to a school of thought
b) the followers of Hippocrates
c) a blind follower of any theory or therapy
d) seriously ill Roman philosopher

63) Which of the following statements about Nicon is NOT TRUE in the context of the passage?

a) He was reading at Alexandria.
b) He was a lover of literature.
c) He was a well-to-do farmer.
d) He wanted to give good education to his son.

64) Galen learned much about the secrets of nature from
a) Aristotle b) Nicon c) Eudemos d) Hippocrates

65) $\lim_{x\to 0}\frac{\sin x + \log(1-x)}{x^2} =$
a) 0 b) 1/2 c) -1/2 d) does not exist

66) If $\sin^{-1}x + \sin^{-1}y = \frac{\pi}{2}$, then $\frac{dy}{dx}$ is equal to:
a) $\frac{x}{y}$ b) $\frac{y}{x}$ c) $-\frac{x}{y}$ d) $-\frac{y}{x}$

67) If the rate of change of a sine of an angle θ is k, then rate of change of the tangent of that angle is:
a) k b) $\frac{1}{k^2}$ c) $\frac{1}{k}$ d) $\frac{1}{k^3}$

68) $\int \frac{\cos 2x - 1}{\cos 2x + 1}dx =$
a) $\tan x - x + c$ b) $x + \tan x + c$ c) $x - \tan x + c$ d) $-x - \cot x + c$

69) The area of the region bounded by $y = 2x - x^2$ and the x-axis is:
a) 8/3 b) 4/3 c) 7/3 d) 2/3

70) The third term in the expansion of $\left(x^2 - \frac{1}{x^3}\right)^n$ is independent of x, then n =
a) 2 b) 3 c) 4 d) 5

71) If the sum of infinite terms of GP is 3 and the sum of squares of these terms is $\frac{9}{2}$, then the sum of their cubes will be:
a) $\frac{108}{13}$ b) $\frac{105}{13}$ c) $\frac{103}{13}$ d) $\frac{109}{14}$

72) The value of the determinant $\begin{vmatrix} x+1 & x+2 & x+4 \\ x+3 & x+5 & x+8 \\ x+7 & x+10 & x+14 \end{vmatrix}$ is:
a) -2 b) 2 c) 4 d) 0

73) Let $f(x) = \frac{x}{1-x}, x \neq 1$, then range of f is:
a) $(-\infty,\infty)$ b) $(-1,\infty)$ c) $(-\infty,-1)$ d) $(-\infty,-1)\cup(-1,\infty)$

74) The distance between the pair of parallel lines $x^2 + 2xy + y^2 - 8ax - 8ay - 9a^2 = 0$ is:
a) 10a b) $5\sqrt{2}a$ c) $2\sqrt{5}a$ d) $\sqrt{10}a$

75) If a circle passes through the points of intersection of the co-ordinate axes with the lines $\lambda x - y + 1 = 0$ and $x - 2y + 3 = 0$. Then the value of λ is:
a) 2 b) 4 c) 6 d) 3

76) If the latus rectum of hyperbola be 8 and eccentricity be $\frac{3}{\sqrt{5}}$, then equation of hyperbola is:
a) $4x^2 - 5y^2 = 100$ b) $5x^2 - 4y^2 = 100$
c) $4x^2 - 6y^2 = 100$ d) $5x^2 - 8y^2 = 100$

77) Equation of plane parallel to the plane $x - 2y + 2z = 5$ which is at unit distance from point (1,2,3) is:
a) $x - 2y + 2z = 6$ b) $x - 2y + 2z + 3 = 0$
c) $x - 2y + 2z + 6 = 0$ d) $x - 2y + 2z = 3$

78) The smallest positive angle satisfying the equation $\sin^2\theta - 2\cos\theta + \frac{1}{4} = 0$ is:
a) $\frac{\pi}{2}$ b) $\frac{\pi}{3}$ c) $\frac{\pi}{4}$ d) $\frac{\pi}{6}$

79) In a ΔABC, if $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$ and the side a=2, the area of triangle is:
a) 1 b) 2 c) $\sqrt{3}$ d) $\frac{\sqrt{3}}{2}$

80) A body thrown upward with some velocity reaches the maximum height of 50m. Another body with double the mass thrown up with double the initial velocity will reach a maximum height of
a) 100m b) 200m c) 300m d) 400m

81) Two bodies are projected at angles θ and (90°- θ) to the horizontal with the same speed. The ratio of their time of flight is
a) 1:1 b) tan θ:1 c) 1:tan θ d) $\tan^2\theta$:1

82) A person with his hands in his pocket is skating on ice at the rate of 10 m/s and describes a circle of radius 50 m. What is his inclination to the vertical?
a) $\tan^{-1}(1/2)$ b) $\tan^{-1}(1/5)$ c) $\tan^{-1}(3/5)$ d) $\tan^{-1}(1/10)$

83) A spherical solid ball of mass 1 kg and radius 3 cm is rotating about an axis passing through its centre with an angular velocity of 50 radian/second. The kinetic energy of rotation is
a) 4500 J b) 90 J c) 910 J d) 0.45 J

84) The mass of a moon is (1/81) of earth's mass and radius is (1/4) that of the earth. If the escape velocity from the earth's surface is 11.2 km/s, what will be its value at the moon?
a) 22.4 km/s b) 11.2 km/s c) 2.5 km/s d) 8 km/s

85) A vessel contains a liquid (density 1.2 g/cc) over mercury (density 13.5 g/cc). A homogenous sphere floats with one-third of its volume immersed in mercury and the other two-third in liquid. The density of the material of the sphere in g/cc is:
a) 7.3 b) 9.4 c) 5.3 d) 14.7

86) Two marks on the glass rod 10 cm apart are found to increase their distance by 0.08 mm when the rod is heated from 0°C to 100°C. A flask made of the same glass as that of rod measures a volume of 1000 cc at 0°C. The volume it measures at 100°C in cc is
a) 1002.4 b) 1004.2 c) 1006.4 d) 1008.4

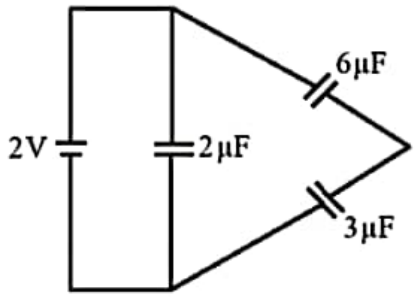
87) The molecular weight of a gas is 44. The volume occupied by 2.2 g of this gas at 0°C and 2 atmospheric pressure will be:
a) 2.8 litre b) 0.56 litre c) 5.6 litre d) 44.8 litre

88) A sound source is moving towards stationary listener with $(1/10)^{th}$ the speed of sound. The ratio of apparent to real frequency is
a) $\frac{11}{10}$ b) $\left(\frac{11}{10}\right)^2$ c) $\left(\frac{9}{10}\right)^2$ d) $\frac{10}{9}$

89) A ray of light passes from vacuum into a medium of refractive index μ, the angle of incidence is found to be double the angle of refraction. The angle of incidence is:
a) $\cos^{-1}(\mu/2)$ b) $2\cos^{-1}(\mu/2)$ c) $2\sin^{-1}(\mu)$ d) $2\sin^{-1}(\mu/2)$

90) An equiconvex lens has a power of 5 dioptre. If it is made of glass of refractive index 1.5, what is the radius of curvature of each surface?
a) 10 cm b) 20 cm c) 30 cm d) 5 cm

91) The total energy stored in the capacitor system shown in figure will be:



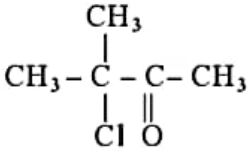
a) 8 μJ b) 16 μJ c) 2 μJ d) 4 μJ

92) A series LCR circuit with R = 20 Ω, L = 1.5 H and C = 35 μF is connected to a variable-frequency 200 V ac supply. When the frequency of the supply equals the natural frequency of the circuit, what is the average power transferred to the circuit in one complete cycle?
a) 200 W b) 1000 W c) 100 W d) 2000 W

93) The maximum K.E of the electrons emitted from metallic surface of 1.6×10^{-19} J when frequency of incident radiation is 7.5×10^{14}Hz. Calculate the minimum frequency of radiation for which electron will be emitted.
a) 5.075×10^{14}Hz b) 8.9×10^{14}Hz
c) 8.9×10^{15}Hz d) 4.99×10^{14}Hz

94) $CH_3CH_2CH_2OH \xrightarrow{\text{conc. } H_2SO_4, 170°C} X \xrightarrow{Br_2} Y \xrightarrow{\text{alc. KOH}} Z$. Identify Z in the chemical reaction.
a) $CH_3CH(OH)CH(Br)$ b) $CH_3CH(OH)CH_3$
c) $CH_3CH(OH)CH(OH)$ d) $CH_3C \equiv CH$

95) The IUPAC name of the organic compound is



a) 2-chloro-2-methyl-3-butanone b) 3-chloro-3-methyl-2-butanone
c) 3-chloro-3-dimethyl-3-propanone d) 1,1-dimethyl-1-chloro-propan-2-one

96) 4.5 g of Aluminium (atomic mass 27) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in solution by the same quantity of electric charge will be
a) 44.8 L b) 22.4 L c) 11.2 L d) 5.6 L

97) An antacid tablet containing 0.50 g of $NaHCO_3$ is dissolved in 250 ml of water. What is the molar concentration of $NaHCO_3$ in the solution?
a) 0.06 M b) 0.012 M c) 0.024 M d) 0.048 M

98) A compound having C and H has 20% hydrogen. The molecular formula of the compound is
a) C_6H_6 b) C_2H_6 c) C_2H_4 d) CH_4

99) 10 mL of 2M H_2SO_4 is mixed with 10 ml of H_2O. 10 mL mixture can neutralize _____ of 2N NaOH:
a) 20 mL b) 5 mL c) 10 mL d) 15 mL

100) Which of the following is most volatile halogen acid?
a) HCl b) HBr c) HI d) HF

Thank You!!!!!!

(May-27) **Time: 7 AM – 9 AM**

Section-A (1 marks)

1) a
2) d
3) a
4) a
5) d
6) c
7) d
8) c
9) c
10) b
11) a
12) a

13) b $\lim_{x\to 9}\frac{x^{\frac{3}{2}}-27}{x-9}$ $\left[\frac{0}{0}\ form\right]$

$= \lim_{x\to 9}\frac{\frac{3}{2}x^{\frac{1}{2}}-0}{1-0}$ $[L'hospitals\ rule]$

$= \frac{3}{2}\times(9)^{1/2} = \frac{3}{2}\times(3^2)^{\frac{1}{2}} = \frac{3}{2}\times 3 = \frac{9}{2}$

14) d $y = \tan^{-1}(\cot x) + \cot^{-1}(tanx) = \frac{\pi}{2} - \cot^{-1}(\cot x) + \frac{\pi}{2} - \tan^{-1}(\tan x) = \pi - 2x$

$\frac{dy}{dx} = -2$

15) b $f(x) = x^3 - 12x^2 + 45x$

$f'(x) = 0$

$x^2 - 8x + 15 = 0$

$(x-3)(x-5) = 0$

$x = 3, 5$

$f(0) = 0, f(7) = 70, f(3) = 54, f(5) = 50$

∴ Greatest value = 70

16) b $\int \frac{\sin x+\cos x}{\sqrt{1+\sin 2x}}dx = \int \frac{\sin x+\cos x}{\sqrt{sin^2x+cos^2x+2\sin x.\cos x}}dx = \int \frac{\sin x+\cos x}{\sqrt{(\sin x+\cos x)^2}}dx = \int dx = x + c$

17) a Sum of roots = 0 and product of roots = 0

$-\frac{b}{a} = 0$ and $\frac{c}{a} = 0$

$b = 0$ and $c = 0$

18) a Let a be the first term and l be the n^{th} term.

As given, $T_n = l = 128$ and $S_n = 255$.

$S_n = \frac{lr-a}{r-1}$

$255 = \frac{2(128)-a}{2-1}$

$a = 1$

19) c Replace i by -i. required complex number = $\frac{1}{-i-1} = \frac{-1}{i+1}$

20) b If number of persons be n, then total number of handshakes is

${}^nC_2 = 66$

$n(n-1) = 132$

$(n+11)(n-12) = 0$

$n = 12$

21) d $|A| = -1 \neq 0$

∴ A is invertible matrix.

22) a $x^2 = 16$

$x = \pm 4$

$2x = 6$

$x = 3$

There is no value of x which satisfies both the above equations.

Thus, $A = \emptyset$

23) a For horizontal line, slope = 0

$\left(\frac{3+\lambda}{4-2\lambda}\right) = 0$
$\lambda = -3$

24) c The equation of tangent to the circle
$(x-h)^2 + (y-k)^2 = a^2$ is
$XX_1 + YY_1 = a^2$
where, $X = x-h, Y = y-k$
and $X_1 = x_1 - h, Y_1 = y_1 - k$
$(x-4)(2-4) + (y-7)(3-7) = 20$
$-2(x-4) - 4(y-7) - 20 = 0$
$(x-4) + 2(y-7) + 10 = 0$
$x + 2y - 8 = 0$, whose slope $= -\frac{1}{2}$

25) a Given, $x = my + k$
$my = x - k$
$y = \frac{1}{m}x - \frac{k}{m}$
Using condition of tangency,
$-\frac{k}{m} = -a\left(\frac{1}{m}\right)^1$
$k = \frac{a}{m}$

26) d Given ellipse is:
$5x^2 + 9y^2 = 45$
$\frac{x^2}{9} + \frac{y^2}{5} = 1$
Latus Rectum $= \frac{2b^2}{a} = \frac{2.5}{3} = \frac{10}{3}$

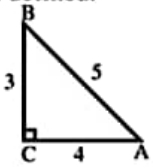
27) b $cos^2\alpha + cos^2\beta + cos^2\gamma = 1$
$cos^2\alpha + cos^2\left(\frac{\pi}{2} - \alpha\right) + cos^2\gamma = 1$
$cos^2\alpha + sin^2\alpha + cos^2\gamma = 1$
$cos^2\gamma = 0$
$\gamma = \frac{\pi}{2}$

28) a $\sin x + sin^2 x = 1$
$\sin x = 1 - sin^2 x$
$sinx = cos^2 x$
$cos^2 x + cos^4 x = cos^2 x + (cos^2 x)^2 = cos^2 x + (\sin x)^2 = cos^2 x + sin^2 x = 1$

29) b $\sin\theta - \cos\theta = 0$
$\sin\theta = \cos\theta$
$\tan\theta = 1 = \tan^{-1}\left(\frac{\pi}{4}\right)$
$\theta = \frac{\pi}{4}$

30) a For $x = -\frac{1}{2}$, $\sin^{-1}\left(\frac{1}{x}\right) = \sin^{-1}(-2)$, which is not defined.

31) b $\sin A = \sqrt{1 - cos^2 A} = \frac{3}{5}$
$\sin B = \sqrt{1 - cos^2 B} = \frac{4}{5}$
$a : b : c = \sin A : \sin B : \sin C = \frac{3}{5} : \frac{4}{5} : 1 = 3 : 4 : 5$



32) a $\frac{|\vec{a}\times\vec{b}|}{\vec{a}.\vec{b}} = \frac{ab\sin\theta}{ab\cos\theta} = \tan\theta$

33) b

34) a At highest point of motion, the acceleration of ball is equal to acceleration due to gravity, even though the ball is at rest.

35) a

36) d

37) b

38) b

39) b

40) c

41) c

42) a If liquid is heated from the top, heat energy will be transferred from top to the bottom through conduction while convection takes place from bottom to top.

43) d

44) a

45) d Work, $W = q(V_2 - V_1)$. For equipotential surface: $V_1 = V_2$
Therefore, $W = 0$

46) b

47) b

48) b

49) d Generally, magnetic lines of force due to earth's field are closed curves emerging from N-pole and ending to the S-pole. Lines of force due to earth's horizontal field are parallel and straight.

50) d Isobars have equal mass i.e., same number of nucleons (mass of proton + mass of neutron).
$_{18}Ar^{40}$, $_{19}K^{40}$, $_{20}Ca^{40+}$

51) c

52) c l=2 indicated d-subshell. It can accommodate 10 electrons.

53) a +7 -1 +3 0
$Cr_2O_7 + H^+ + I^- \longrightarrow Cr^{3+} + H_2O + I_2$
Here, 'Cr' is reduced and 'I' is oxidized.

54) a 'B' in BF_3 has electron deficient centre. So, it accepts electron i.e., electron pair acceptor – Lewis acid.

55) b Due to absence of d-orbital, Nitrogen cannot form pentahalide.

56) c

57) b Hydration energies of the cations of alkaline earth metals decreases as we go down the group because of increase in their ionic radii.

58) a

59) b

60) d In Wurtz reaction, two molecules of alkyl halide react with 2 Na-atoms to give the hydrocarbon with double C-atom.

$$R\text{–}\boxed{Cl + 2Na + Cl\text{–} R} \xrightarrow{\text{ether}} R - R + 2NaCl$$

As methane contains only one C-atom, it cannot be synthesized by this reaction.

Section-B (2 marks)

61) d

62) c

63) a

64) a

65) c $\lim_{x\to 0} \frac{\sin x + \log(1-x)}{x^2}$ $\left[\frac{0}{0}\ form\right]$

$= \lim_{x\to 0} \frac{\cos x - \frac{1}{1-x}}{2x}$ $\left[\frac{0}{0}\ form\right]$

$= \lim_{x\to 0} \frac{-\sin x - \frac{1}{(1-x)^2}}{2} = \frac{-0-1}{2} = -\frac{1}{2}$

66) c $\sin^{-1} x + \sin^{-1} y = \frac{\pi}{2}$

$\sin^{-1} y = \frac{\pi}{2} - \sin^{-1} x$

$\sin^{-1} y = \cos^{-1} x$

$y = \sin(\cos^{-1} x)$

Put $\cos^{-1} x = \theta$

$\therefore \cos\theta = x$

$y = \sin\theta = \sqrt{1 - cos^2\theta} = \sqrt{1 - x^2}$

$\therefore \frac{dy}{dx} = \frac{1}{2\sqrt{1-x^2}}(-2x) = \frac{-x}{\sqrt{1-x^2}} = -\frac{x}{y}$

67) b As given, $\frac{d}{d\theta}(\sin\theta) = k$

$\cos\theta = k$

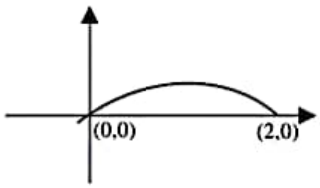
$\frac{d}{d\theta}(\tan\theta) = sec^2\theta = \frac{1}{k^2}$

68) c $\int \frac{\cos 2x - 1}{\cos 2x + 1} dx = \int \frac{-2sin^2 x}{2cos^2 x} dx = \int tan^2 x\ dx = \int (sec^2 x - 1)\, dx = -\tan x + x + c = x - \tan x + c$

69) b Given curve, $y = 2x - x^2$

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

The curve cuts x-axis at (0,0) and (2,0)



$A = \int_0^2 (2x - x^2)\,dx = \left[x^2 - \frac{x^3}{3}\right]_0^2 = \frac{4}{3}$

70) d $T_3 = T_{2+1} = {}^nC_2\,(x^2)^{n-2}\left(-\frac{1}{x^3}\right)^2 = {}^nC_2\,x^{2n-10}$

This does not contain x if

$2n - 10 = 0$

$n = 5$

71) a $a + ar + ar^2 + \cdots = 3$

$\frac{a}{1-r} = 3$

$a = 3(1-r)$ ...(1)

$a^2 + a^2r^2 + a^2r^4 + \cdots = \frac{9}{2}$

$\frac{a^2}{1-r^2} = \frac{9}{2}$

$\frac{9(1-r)^2}{1-r^2} = \frac{9}{2}$

$\frac{(1-r)(1-r)}{(1+r)(1-r)} = \frac{1}{2}$

$\frac{1-r}{1+r} = \frac{1}{2}$

On solving, $r = \frac{1}{3}$

From (1), $a = 3\left(1 - \frac{1}{3}\right) = 2$

Thus, Required sum $= \frac{a^3}{1-r^3} = \frac{8}{1-\frac{1}{27}} = \frac{108}{13}$

72) a Operate $R_2 \to R_2 - R_1, R_3 \to R_3 - R_1$

$$\begin{vmatrix} x+1 & x+2 & x+4 \\ 2 & 3 & 4 \\ 6 & 8 & 10 \end{vmatrix}$$

Operate $C_3 \to C_3 - C_2, C_2 \to C_2 - C_1$

$$\begin{vmatrix} x+1 & 1 & 3 \\ 2 & 1 & 2 \\ 6 & 2 & 4 \end{vmatrix}$$

Operate $R_3 \to R_3 - 2R_2$

$$\begin{vmatrix} x+1 & 1 & 3 \\ 2 & 2 & 2 \\ 2 & 0 & 0 \end{vmatrix} = 2\begin{vmatrix} 1 & 3 \\ 1 & 2 \end{vmatrix} = -2$$

73) d Let $y = f(x) = \frac{x}{1-x}$

$y - xy = x$

$x = \frac{y}{1+y}$

Which is defined for all $y \in R$ except $y = -1$

$\therefore R_f = (-\infty, -1) \cup (-1, \infty)$

74) b Given equation can be written as,

$x^2 + 2(1)xy + y^2 + 2(-4a)x + 2(-4a)y - 9a^2 = 0$

Required distance $= 2\sqrt{\frac{g^2 - ac}{a(a+b)}} = 2\sqrt{\frac{(-4a)^2 + 9a^2}{1(1+1)}} = 2\sqrt{\frac{25a^2}{2}} = 5\sqrt{2}a$

75) a The equation of circle through points of intersection of given lines and the coordinate axes is given by:

$(\lambda x - y + 1)(x - 2y + 3) + kxy = 0$

This represents a circle if

Coeff. of x^2 = Coeff. of y^2

i.e., $\lambda = (-1)(-2) = 2$

76) a As given, $\frac{2b^2}{a} = 8$

And $\frac{3}{\sqrt{5}} = \sqrt{1 + \frac{b^2}{a^2}}$

$\frac{9}{5} - 1 = \frac{b^2}{a^2}$

$\frac{4}{5} = \frac{2b^2}{a} \cdot \frac{1}{2a}$

$\frac{4}{5} = \frac{8.1}{2a}$
$a = 5$
And, $\frac{2b^2}{5} = 8$
$b^2 = 20$
So, Required equation is:
$\frac{x^2}{25} - \frac{y^2}{20} = 1$
$4x^2 - 5y^2 = 100$

77) a The equation of plane parallel to the given plane is $x - 2y + 2z = k$
As given, $\left|\frac{1-4+6-k}{\sqrt{1+4+4}}\right| = 1$
$|3 - k| = 3$
$k = 0,6$
$\therefore x - 2y + 2z = 6$ is the required plane.

78) b $\sin^2\theta - 2\cos\theta + \frac{1}{4} = 0$
$4\sin^2\theta - 8\cos\theta + 1 = 0$
$4 - 4cos^2\theta - 8\cos\theta + 1 = 0$
$4cos^2\theta + 8\cos\theta - 5 = 0$
$(2\cos\theta - 1)(2\cos\theta + 5) = 0$
$\cos\theta = \frac{1}{2}, \cos\theta = -\frac{5}{2}$ (not possible)
$\therefore \theta = \frac{\pi}{3}$

79) c $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$
$\frac{\cos A}{2RsinA} = \frac{\cos B}{2RsinB} = \frac{cosC}{2RsinC}$
$\cot A = \cot B = \cot C$
$A = B = C$
i.e., triangle is equilateral
$\therefore$ Area $= \frac{\sqrt{3}}{4} \times (2)^2 = \sqrt{3}$

80) b $v^2 = u^2 - 2as \Rightarrow 0 = u^2 - 2gh$
$\Rightarrow h = \frac{u^2}{2g}$
i.e., $h \propto u^2$
When velocity is doubled, maximum height becomes 4 times.
$\therefore h' = 4(50) = 200\ m$

81) b $T = \frac{2usin\theta}{g}$
$\Rightarrow \frac{T_1}{T_2} = \frac{sin\theta_1}{sin\theta_2} = \frac{sin\theta}{\sin(90°-\theta)} = tan\theta : 1$

82) b The inclination of person from vertical,
$tan\theta = \frac{v^2}{rg} = \frac{(10)^2}{50\times10} = \frac{1}{5}$
$\therefore \theta = \tan^{-1}\left(\frac{1}{5}\right)$

83) d K.E. of rotation $= \frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{2}{5}MR^2\right)\omega^2 = \frac{1}{5}MR^2\omega^2 = \frac{1}{5} \times 1 \times (3 \times 10^{-2})^2 \times (50)^2 = 0.45\ J$

84) c Escape velocity for earth,
$v_e = \sqrt{\frac{2GM_e}{R_e}}$ ------- (i)
Escape velocity for moon,
$v_m = \sqrt{\frac{2GM_m}{R_m}}$ ------ (ii)
Dividing (ii) by (i), we get,
$\frac{v_m}{v_e} = \sqrt{\frac{M_m}{M_e} \cdot \frac{R_e}{R_m}} = \sqrt{\frac{1}{81} \times 4}$
$\therefore v_m = \frac{2}{9} \times 11.2 = 2.5\ km/s$

85) c Weight of sphere = Weight of liquid displaced

$V\rho g = \frac{V}{3} \times 13.5g + \frac{2V}{3} \times 1.2g$

$\therefore \rho = \frac{13.5+2.4}{3} = 5.3$

86) a $l_t = l_0(1+\alpha t) \Rightarrow \alpha = \frac{l_t - l_0}{l_0 t} = \frac{\Delta l}{l_0 t} = \frac{0.08\times10^{-3}}{10\times10^{-3}\times100} = 8\times10^{-5}/^\circ C$

$V_t = V_0(1+3\alpha t) = 1000(1+3\times8\times10^{-5}\times100) = 1002.4\ cc$

87) b $PV = \frac{m}{M}RT$

$\Rightarrow V = \frac{mRT}{MP} = \frac{2.2\times10^{-3}\times8.3\times10^3\times273}{44\times2\times1.01\times10^5} = 0.56\ litre$

88) d $n' = \frac{v}{v-v_s}.n$

$\Rightarrow \frac{n'}{n} = \frac{v}{v-v_s} = \frac{v}{v-\frac{v}{10}} = \frac{10}{9}$

89) b $\mu = \frac{sini}{sinr}$

Given, i = 2r

$\therefore \mu = \frac{\sin(2r)}{sinr} = \frac{2sinr.cosr}{sinr} = 2cosr$

$\Rightarrow cosr = \frac{\mu}{2} \Rightarrow r = \cos^{-1}\frac{\mu}{2}$

$\therefore i = 2r = 2\cos^{-1}\frac{\mu}{2}$

90) b Focal length of lens = 1/P = 1/5 = 0.20 m = 20 cm

If R is the radius of curvature of each surface, then

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

$\therefore R = (\mu-1).2f = (1.5-1)\times2\times20 = 20\ cm$

91) a Effective Capacitance (C) = $2 + \frac{3\times6}{3+6} = 4\ \mu F$

$\therefore U = \frac{1}{2}CV^2 = \frac{1}{2}\times(4\mu F)\times(2V)^2 = 8\ \mu J$

92) d At resonance, the frequency of the supply power equals the natural frequency of the given LCR circuit.

Impedance of the circuit is given by,

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

At resonance,

$X_L = X_C$

$\therefore Z = R = 20\Omega$

Current (I) in the circuit = V/Z = 200/20 = 10 A

Hence, the average power transferred to the circuit in one complete cycle = VI

= 200 × 10

= 2000 W

93) a Min frequency = **Fehler!** = 5.075×10^{14} Hz

94) d $CH_3CH_2CH_2OH \xrightarrow{conc.H_2SO_4,170^\circ C} CH_3CH = CH_2 \xrightarrow{Br_2} CH_3 - CH(Br) - CH_2(Br) \xrightarrow{alc.KOH} CH_3 - C \equiv CH$

95) b

96) d From second law of Faraday,

$\frac{m_{Al}}{m_H} = \frac{E_{Al}}{E_H}$

$\frac{4.5}{m_H} = \frac{27/3}{1}$

$m_H = 0.5$ g

∵ Volume of 2g H_2 at STP = 22.4 L

∴ Volume of 0.5 g H_2 at STP = $\frac{22.4\times0.5}{2}$ L = 5.6 L

97) c No. of moles = 0.5/84

Molarity = $\frac{\text{No.of moles}}{\text{VOlume in litre}} = \frac{\frac{0.5}{84}}{250\times10^{-3}} = 0.024$ M

98) b H = 20%, C = (100–20)% = 80%

Atoms	%	Relative no. of atoms
C	80	$\frac{80}{12}$
H	20	$\frac{20}{1}$

i.e., C : H = $\frac{80}{12} : \frac{20}{1} = 1 : 3$

So, empirical formula is CH_3 and its molecular formula will be $(CH_3)_n$, where n = 2, 3, 4, ...

i.e., C_2H_6

99) c Normality of 2M H_2SO_4 = 4N H_2SO_4

$V_aN_a + V_wN_w = (V_a + V_w)N_{mixture}$

or, $10\times4 + 10\times0 = (10+10)\ N_{mixture}$

$N_{mixture} = 2N$

Now, $V_{mixture} \times N_{mixture} = V_bN_b$

or, $10 \times 2 = V_b \times 2$

$\therefore V_b = 10$ mL

100) a Boiling point of HF is highest due to H-bonding. For other halogen acids, boiling point increase in the order HCl<HBr<HI. Therefore, most volatile (with lowest boiling point) is HCl.

Thank You!!!!!!