Brilliant
STUDY CENTRE
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CEE KERALA ENGG. MODEL EXAM - ALL UNITS

[PHYSICS + CHEMISTRY + MATHEMATICS]

Version E1

TEST ID 211

PHYSICS

1. The angle of incidence for an equilateral prism of refractive index $\sqrt{3}$ so that the ray is parallel to the base inside the prism is

   A) 30° B) 20° C) 60° D) 45° E) 75°

2. According to Rayleigh scattering law the amount of scattering is

   A) directly proportional to wavelength of light

   B) directly proportional to square wavelength of light

   C) independent of wavelength of light

   D) inversely proportional to wavelength of light

   E) inversely proportional to fourth power of wavelength of light

3. The de Broglie wavelength and kinetic energy of a particle is $2000\,\text{Å}$ and 1 eV respectively. If its kinetic energy becomes 1 MeV, then its de Broglie wavelength is

   A) $2\,\text{Å}$ B) $1\,\text{Å}$ C) $4\,\text{Å}$ D) $10\,\text{Å}$ E) $5\,\text{Å}$

4. The work functions of two metals are 2.75 eV and 2 eV respectively. If these are irradiated by photons of energy 3 eV , the ratio of maximum momenta of the photoelectorns emitted respectively by them is

   A) 1:2 B) 1:3 C) 1:4 D) 2:1 E) 4:1

5. The maximum kinetic energy of photoelectrons

   A) depends on collector plate

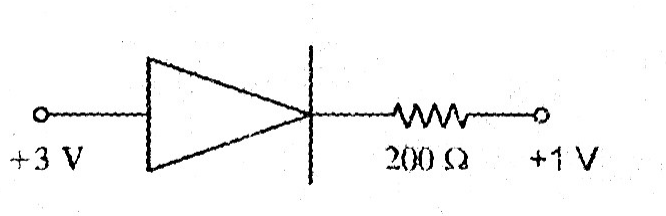
   B) is independent of emitter plate material

   C) is independent of frequency of incident radiation

   D) depends on the frequency of light source and the nature of emitter plate material

   E) depends on intensity of incident radiation

6. If an ideal junction diode is connected as shown, then the value of the current I is



   A) 0.013 A B) 0.02 A C) 0.01A D) 0.1A E) 0.2A

7. Identify the mismatched pair from the following

A) zener diode	:	voltage regulator
B) germanium doped with phosphorous	:	n-type semiconductor with phosphorous
C) semiconductor	:	band gap > 3 eV
D) pn junction diode	:	rectifier
E) silicon doped with aluminium	:	p-type semiconductor

8. In a common emitter configuration, a transistor has B = 50 and input resistance $1k\Omega$. If the peak value of a.c. input is 0.01V then the peak value of collector current is

A) 0.01μA B) 500μA C) 100μA D) 0.5μA E) 50μA

9. The radiating power of a linear antenna of length ℓ for a wavelength λ is proportional to

A) $\frac{\ell}{\lambda}$ B) $\frac{\ell^2}{\lambda^2}$ C) $\frac{\ell}{\lambda^2}$ D) $\frac{\ell^2}{\lambda}$ E) $\frac{\ell}{\sqrt{\lambda}}$

10. The quantity which has the same dimensions as that of gravitational potential is

A) latent heat B) impulse C) angular acceleration

D) specific heat capacity E) planck constant

11. The percentage error in measuring M, L and T are 1%, 1.5% and 3% respectively. Then the percentage error in measuring the physical quantity with dimensions $ML^{-1}T^{-1}$ is

A) 1% B) 3.5% C) 3% D) 4.5% E) 5.5%

12. From an elevated point P, a stone is projected vertically upwards. When the stone reaches a distance h below P, its velocity is double of its velocity at a height h above P. The greatest height attained by the stone from the point of projection P is

A) $\frac{3}{5}h$ B) $\frac{5}{3}h$ C) $\frac{7}{5}h$ D) $\frac{5}{7}h$ E) $\frac{2}{3}h$

13. Identify the wrong statement

A) Eddy currents are produced in a steady magnetic field

B) Eddy current can be minimized by using laminated core

C) Induction furnace uses eddy current to produce heat

D) Eddy current can be used to produce breaking force inmoving vehicles

E) Power meters are working on the principle of eddy currents

14. A body projected at an angle with the horizontal has a range 300m. If the time of flight is 6 s, then the horizontal component of velocity is

A) $30ms^{-1}$ B) $50ms^{-1}$ C) $40ms^{-1}$ D) $45\ ms^{-1}$ E) $30\sqrt{2}ms^{-1}$

15. A constant force F acts on a particle of mass 1 kg moving with a velocity v, for one second. The distance moved in that time is

A) 0 B) $\frac{F}{2}$ C) 2F D) $\frac{v}{2}$ E) $v+\frac{F}{2}$

16. A spacecraft of mass 100kg breaks into two when its velocity is 10^4ms^{-1}. After the break, a mass of 10kg of the space craft is left stationary. The velocity of the remaining part is

A) 10^3ms^{-1} B) $11.11\times10^3ms^{-1}$ C) $11.11\times10^2ms^{-1}$ D) 10^4ms^{-1} E) $1100ms^{-1}$

17. A particle tied to a string describes a vertical circular motion of radius r continually. If it has velocity $\sqrt{3gr}$ at the highest point then the ratio of the respective tensions in the string holding it at the highest and lowest points is

A) 4:3 B) 5:4 C) 1:4 D) 3:2 E) 1:2

18. In a uniform circular motion, the angle between the velocity and acceleration is

A) 0° B) 45° C) 60° D) 75° E) 90°

19. The potential energy of a conservative system is given by V(x) = (x^2–3x) joule, where x is measured in metre. Then its equilibrium position is at

A) 1.5m B) 2m C) 3 m D) 1m E) 5m

20. An engine pumps out water continuously through a hose with a velocity v. If m is the mass per unit length of the water jet, the rate at whih the kinetic energy is imparted to water is

A) $\frac{1}{2}mv^2$ B) $\frac{1}{2}mv^3$ C) $\frac{1}{2}m^2v^2$ D) mv^3 E) $\frac{1}{4}mv^3$

21. A body of mass 1.5kg rotating about an axis with angular velocity of 0.3 rad s^{-1} has the angular momentum of 1.8kgm^2s^{-1}. The radius of gyration of the body about an axis is

A) 2m B) 1.2m C) 0.2 m D) 1.6m E) 0.8 m

22. In a two-particle system with particle masses m_1 and m_2, the first particle is pushed towards the centre of mass through a distance d, the distance through which second particle must be moved to keep the centre of mass at the same position is

A) $\frac{m_2d}{m_1}$ B) d C) $\frac{m_1d}{(m_1+m_2)}$ D) $\frac{(m_1+m_2)d}{m_1}$ E) $\frac{m_1d}{m_2}$

23. The principle involved in the performance of a spinning-chair circus acrobat is

A) conervation of angular momentum B) conservation of linear momentum
C) conservation of energy D) principle of moments
E) work-energy principle

24. If the earth is one-fourth of its present distance from the sun, the duration of the year will be changed to

A) half of the present year B) $\frac{1^{th}}{4}$ of the present year
C) $\frac{1^{th}}{8}$ of the present year D) $\frac{7^{th}}{8}$ of the present year
E) $\frac{1^{th}}{16}$ of the present year

25. A ball falling in a lake of depth 400m has a decrease of 0.2% in its volume at the bottom. The bulk modulus of the material of the ball is (in Nm^{-2})

A) 9.8×10^9 B) 9.8×10^{10} C) 1.96×10^{10} D) 9.8×10^{11} E) 1.96×10^9

26. A ring cut with an inner radius 4.85 cm and outer radius 4.95 cm is supported horizontally from one of the pans of a balane so that it comes in ocntact with the water in a vessel. If surface tension of water is $70\times10^{-3}Nm^{-1}$, then the extra mass in the other pan required to pull the ring away from water is

A) 2g B) 3g C) 4.4g D) 15g E) 10g

27. Two spherical rain drops with radii in the ratio 1:2 fall from a great height through the atmosphere. The ratio of their momenta after they have attained terminal velocity is

A) 1:8 B) 2:1 C) 1: 32 D) 1:2 E) 1:16

28. If the temperatures of source and sink of a Carnor engine having efficiency n are each decreased by 100K, then the efficiency

A) remains constant B) becomes 1 C) becomes zero D) increases E) becomes zero

29. The electromagnetic waves travel with

A) the same speed in all media
B) the speed of sound in free space
C) the speed of light $c = 3\times10^8 ms^{-1}$ in solid medium
D) the speed of light $c = 3\times10^8 ms^{-1}$ in fluid medium
E) the speed of light $c = 3\times10^8 ms^{Ý}$ in free space

30. In a cyclic process, the amount of heat given to a system is equal to
A) net increase in internal energy B) net work done by the system
C) net decrease in internal energy D) net change in volume
E) net change in pressure

31. A particle is executing simple harmonic motion with amplitude A. When the ratio of its kinetic energy to the potential energy is $\frac{1}{4}$. Its displacement from its mean position is

A) $\frac{2}{\sqrt{5}}A$ B) $\frac{\sqrt{3}}{2}A$ C) $\frac{3}{4}A$ D) $\frac{1}{4}A$ E) $\frac{2}{5}A$

32. The ratio of amplitudes of two simple harmonic motions represented by the equations $y_1 = 5\sin\left(2\pi t + \frac{\pi}{4}\right)$ and $y_2 = 2\sqrt{2}\left(\sin 2\pi t + ccs\pi t\right)$
A) 1:1 B) 2:1 C) 5:2 D) 5:4 E) 2:5

33. The displacement of a particle in SHM is $x = 10\sin\left(2t - \frac{\pi}{6}\right)$ metre. When its displacement is 6m, the velocity of the particle (in ms^{-1}) is
A) 8 B) 24 C) 16 D) 10 E) 12

34. The bulk modulus of a liquid of density 8000 kgm^{-3} is $2\times10^9 Nm^{-2}$. The speed of sound in that liquid is (in ms^{-1})
A) 200 B) 250 C) 100 D) 350 E) 500

35. The pressure variations in the propagation of sound waves are
A) isobaric B) isochoric C) isobaric and isochoric
D) adiabatic E) isothermal

36. When a comb rubbed with dry hair attracts pieces of paper. This is because the
A) comb polarizes the piece of paper
B) comb induces a net dipole moment opposite to the direction field
C) electric field due to the comb is uniform
D) comb induces a net dipole moment perpendicular to the direction of field
E) paper acquires a net charge

37. If the electric flux entering and leaving a closed surface are 6×10^6 and 9×10^6 S.I. units respectively, the the charge inside the surface of permittivity of free space ε_0 is

A) $\varepsilon_0\times10^6$ B) $-\varepsilon_0\times10^6$ C) $-2\varepsilon_0\times10^6$ D) $3\varepsilon_0\times10^6$ E) $2\varepsilon_0\times10^6$

38. Three capacitors connected in series have an effective capacitance of $4\mu F$. If one of the capacitance is removed, the net capacitance of the capacitor increases to $6\mu F$. The removed capacitor has a capacitance of

A) $2\mu F$ B) $4\mu F$ C) $10\mu F$ D) $12\mu F$ E) $24\mu F$

39. Ten identical batteries each of emf 2V are connected in series to a 8Ω resistor. If the current in the circuit is 2A, then the internal resistance of each battery is

A) 0.2Ω B) 0.3Ω C) 0.4Ω D) 0.5Ω E) 1Ω

40. In a potentiometer wire length ℓ, a cell of emf V is balanced at a length $\frac{\ell}{3}$ from the positive end of the wire. For another cell of emf 1.5V, the balancing length becomes

A) $\frac{\ell}{6}$ B) $\frac{\ell}{2}$ C) $\frac{\ell}{3}$ D) $\frac{2\ell}{3}$ E) $\frac{4\ell}{3}$

41. The smallest resistance that can be obtained by combining 10 resistors each of resistance 10Ω is

A) 10Ω B) 0.5Ω C) 2Ω D) 20Ω E) $1\ \Omega$

42. The focal lengths of the objective and the eyepiece of the telescope are 225 cm and 5 cm respectively. The magnifying power of the telescope will be

A) 49 B) 45 C) 35 D) 60 E) 65

43. An AC source of voltage E = 20 sin 100 t is connected across a resistance 20Ω. The rms value of current in the circuit is

A) 1A B) $\frac{1}{2}$A C) $\sqrt{2}$A D) $2\sqrt{2}$A E) $\frac{1}{\sqrt{2}}$A

44. A given resistor has the following colour code of the various strips on it: Brown, black, green and silver. The value of its resistance in ohm is

A) $1.0\times10^4\pm10\%$ B) $1.0\times10^7\pm5\%$ C) $1.0\times10^6\pm10\%$

D) $1.0\times10^5\pm5\%$ E) $1.0\times10^3\pm10\%$

45. A 100 turns coil of area of cross section 200cm^2 having 2Ω resistance is held perpendicular to a magnetic field of 0.1 T. If it is removed from the magnetic field in one second, the induced charge produced in it is

A) 0.2C B) 2 C C) 0.1C D) 1 C E) 20 C

CHEMISTRY

46. 4.5g of Aluminium (at mass 27 amu) is deposited at cathode from solution by a certain quantity of electric charge. The volume of hydrogen produced at STP 0^0C and 1 atm pressure from H^+ ions in solution by the same current of electricity is passed

A) 44.8L B) 22.4L C) 11.2L

D) 5.6L E) 8.4L

47. The plot log k vs $\frac{1}{T}$ helps to calculate

A) Enthalpy of reaction

B) Rate constant of the reaction

C) Order of the reaction

D) Energy of activation as well as the frequency factor

E) Molecularity of reaction

48. aA + bB + cC $\rightarrow$ products

i) If the concentration of A is doubled, keeping [B] and [C] constant, the rate of reaction becomes double

ii) If the concentration of B is halved keeping [A] and [C] constant, the rate of reaction remain unaffected

iii) If the concentration of 'C' ismade 1.5 times, the rate of reaction becomes 2.25 times. The order of the reaction is

A) 1 B) 2.5 C) 3 D) 3.5 E) 1.5

49. In the dichromate anion

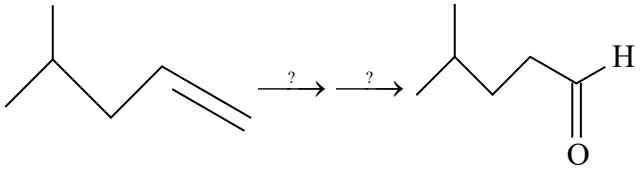
A) 4Cr – O bonds are equivalent 2 bridged Cr - O bonds are non equilateral

B) 6Cr – O bonds are equivalent, 2 bridged Cr – O bonds are equivalent

C) All Cr – O bonds are equivalent

D) All Cr – O bonds are non equivalent

E) None of these

50. 

A) $\xrightarrow[H_2O_2, NaOH]{I)\ BH_3, THF} \xrightarrow[CH_2Cl_2]{PCC}$

B) $\xrightarrow[H_2O_2, NaOH]{(II)BH_3} \xrightarrow{HIO_4}$

C) $\xrightarrow[HIO_4]{H_2O,\ H_2SO_4\ (Conc.)} \xrightarrow[CH_2Cl_2]{PCC}$

D) $\xrightarrow{HIO_4} \xrightarrow{H_3O^+}$

E) $\xrightarrow[CH_2Cl_2]{PCC} \xrightarrow[HIO_4]{H_2O,\ H_2SO_4\ (Conc.)}$

51. Ge(II) compounds are powerful reducing agent where as Pb(IV) compounds are strong oxidants This can be due to

A) Pb is more electro positive than Ge

B) Ionisation potential of Pb is less than that of Ge

C) Ionic radii of Pb^{2+} and Pb^{4+} are larger than those of Ge^{+2} and Ge^{+4}

D) More pronounced inert pair effect in lead than is Ge E) All except D

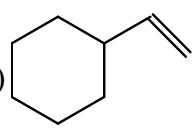
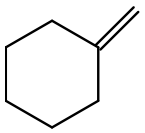
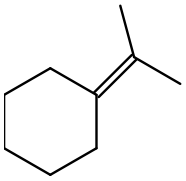
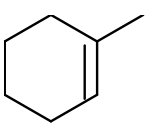
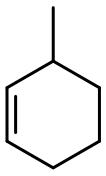
52. Which set of quantum number is correct with the theory?

A) n = 3, $\ell = 0$, m = 0, s = $+\frac{1}{2}$ B) n = 2, $\ell = 2$, m = 1; s = $-\frac{1}{2}$

C) n =1, $\ell = 0$, m = –1, s = $+\frac{1}{2}$ D) n = 3, $\ell = 2$, m = 3, s = $-\frac{1}{2}$

E) n = 3, $\ell = 0$, m = 1, s = $-\frac{1}{2}$

53. Which of the following has the most negative heat of hydrogenation ?

A)  B)  C)  D)  E) 

54. Identify the reagent from the following list, which can easily distinquish between 1-butyne and 2-butyne

A) Bromine, CCl_4 B) H_2, Lindlar catalyst

C) dilH_2SO_4, $HgSO_4$ D) Baeyer's reagent

E) Ammoniacal Cu_2Cl_2 solution

55. Match List I with List II.

List I (Biopolymer)	List II (Monomer)
a) Starch	i) Nucleotide
b) Cellulose	ii) α - glucose
c) Nucleic acid	iii) β -glucose
d) Protein	iv) α - amino acid

A) a - ii ; b - i ; c - ii ; d - iv B) a - iv ; b - ii ; c - i ; d - iii
C) a - i ; b - iii ; c - iv ; d - ii D) a - ii ; b - iii ; c - i ; d - iv
E) a - iii ; b - ii ; c - i ; d - iv

56. Which among the following are disproportionation reactions ?

a) $2Cu^{+} \rightarrow Cu^{2+} + Cu$

b) $3MnO_4^{2-} + 4H^{+} \rightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$

c) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

d) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^{+}$

A) a and b B) a, b and c C) b, c and d D) a and d E) a, b, c and d

57. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R**.
Assertion A : Butan-1-ol has higher boiling point than ethoxy ethane
Reason R : Extensive hydrogen bonding leads to stronger association of molecules.
In the light of the above statements choose the correct answer from the options given below.
A) Both **A** and **R** are correct and R is the correct explanation of **A**.
B) **A** is true but **R** is false
C) Both **A** and **R** are true but **R** is not the correct explanation of **A**.
D) **A** is false but **R** is true
E) Both **A** and **R** are false

58. Which among the following is a semiconductor ?
A) Copper B) Graphite C) Glass D) Teflon E) Silicon

59. Match list I with list II.

	List I (Technique)		List II (Application)
a)	Distillation	i)	Separation of glycerol from spentlyne
b)	Fractional distillation	ii)	Aniline - water mixture
c)	Steam distillation	iii)	Separation of crude oil fractions
d)	Distillation under reduced pressure	iv)	Chloroform - aniline

A) a - iv ; b - i ; c - ii ; d - iii B) a - iv ; b - iii ; c - ii ; d - i
C) a - ii ; b - ii ; c - iv ; d - iii D) a - ii ; b - iii ; c - i ; d - iv
E) a - iii ; b - iv ; c - ii ; d - i

60. The equilibrium,

$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$, is attained at 25^{0}C in a closed container and an inert gas He is introduced at constant volume. Which of the following statement is correct ?

A) Concentration of PCl_5,PCl_3 and Cl_2 are changed

B) More Cl_2 is formed

C) Concentration of PCl_3 is reduced

D) Partial pressure of PCl_5, PCl_3 and Cl_2 are changed

E) The equilibrium remain undisturbed

61. Which of the following pairs have different bond order ?

A) CO and N_2 B) O_2^{2-} and F_2

C) NO^- and CN^- D) H_2 and He_2^{2+} E) CN^- and N_2

62. Reductive ozonolysis of 2,3-dimethylbut-1-ene gives

A) methanoic acid and 3-methyl-2-butanone

B) methanal and 3-methyl-2-butanone

C) methanal and 2-methyl-3-butanone

D) methanoic acid and 2-methyl-3-butanone

E) methanal and 3, 3-dimethyl -2- propanone

63. Bond dissociation enthalpy of H_2, Cl_2 and HCl are 434, 242 and 431 kJmol^{-1} respectively. Enthalpy of formation of HCl is

A) 93 kJmol^{-1} B) -245 kJmol^{-1}

C) -93 kJmol^{-1} D) 245 kJmol^{-1} E) None of the above

64. Considering entropy (S) as a thermodynamic parameter, the criterion for the spontaneity of any process is

A) $\Delta S_{system} + \Delta S_{surrounding} > 0$ B) $\Delta S_{system} - \Delta S_{surrounding} > 0$

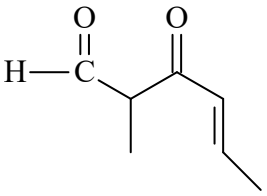
C) $\Delta S_{system} > 0$ D) $\Delta S_{surrounding} > 0$

E) $\Delta S_{system} > 0, \Delta S_{surrounding} << 0$

65. Which one of the following atoms will have the smallest size ?

A) Mg B) Na C) Be D) Li E) K

66. The IUPAC name of the compound



is .....

A) 2 Methyl- 3-Oxohex- 4- enal B) 5-formylhex-2-en-3-one

C) 5-methyl-4-oxohex-2-en-5-al D) 3-keto-2-methylhex-5-enal

E) 5-methyl-4-oxo-hex-2-en-6-al

67. When MnO_2 is fused with KOH,and an oxidising agent like KNO_3 a coloured compound is formed. The product and the colour are respectively :

A) Mn_2O_4, black B) $KMnO_4$, purple

C) Mn_2O_3, brown D) K_2MnO_4, green

E) Mn_2O_7, dark red

68. Elimination reaction of 2-bromopentane to form pent-2-ene is
i) β -elimination reaction
ii) follow Zaitsev's rule
iii) dehydrohalogenation reaction
iv) dehydration reaction
A) i, ii and iii B) i, ii and iv C) ii, iii and iv
D) i, iii and iv E) i and iii only

69. The van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is:
A) 91.3% B) 78.3% C) 100% D) 74% E) 87%

70. The rate of expression for the reaction $A + B \rightarrow$ Products is, Rate $= k[A]^{\frac{1}{2}}[B]^{3/2}$: The overall order of reaction is
A) $1/2$ B) $3/2$ C) 1 D) 2 E) 0

71. Positive carbylamine test is shown by
A) N,N-dimethylaniline B) Triethylamine C) N-methylaniline
D) Aniline E) Dimethylamine

72. Excess of copper in toxic proportionas in plants/animals can be removed by chelating with
A) EDTA B) Etane-1,2-diamine C) Oxalate ion
D) D-pencillamine E) Cupron

73. Choose the incorrectly matched pair
A) Prussian blue - $Fe_4[Fe(CN)_6]_3 . xH_2O$
B) Black - PbS
C) Violet colour - $[Fe(CN)_5NOS]^{4-}$
D) Blood red colour - $[Fe(SCN)]^{2+}$
E) Yellow - $(NH_4)_2MoO_4$

74. The correct increasing order of the acid strength of benzoic acid (I), 4-nitrobenzoic acid (II), 3, 4-dinitrobenzoic acid (III) and 4-methoxybenzoic acid (IV) is
A) I<II<III<IV B) II<I<IV<III C) IV<I<II<III
D) IV<II<I<III E) I<IV<II<III

75. Which one of the following is not expected to undergo iodoform reaction?
A) Propan-2-ol B) Propanone C) Ethanal
D) Ethanol E) Methanol

MATHEMATICS

76. $x\sqrt{1+y}+y\sqrt{1+x}=0$. Then $\frac{dy}{dx}=$
A) $\frac{1}{1+x^2}$ B) $\frac{-1}{(1+x)^2}$ C) $\frac{-x}{1+x}$ D) $\frac{2x}{(1+x)^2}$ E) $\frac{-2x}{(1+x)^2}$

77. If $x=\theta-\frac{1}{\theta}$ and $y=\theta+\frac{1}{\theta}$ then $\frac{dy}{dx}=$:
A) y/x B) x/y C) -x/y D) -y/x E) 1

78. The number of ways of selecting 9 balls from 6 red balls, 5 white balls and 5 blue balls if each selection consists of 3 balls of each colour is
A) 1000 B) 2000 C) 3000 D) 1500 E) 2500

79. The point on y axis which is equidistant from the points (2, 5) and (3, 4):
A) (2, 0) B) (0, 2) C) (0, 3) D) (0, 4) E) (3,2)

80. Points (1,2) and (-1,2) are
A) On same side of the line 4x + y - 1=0 B) On opposite side of the line 3x + 4y - 1=0
C) Collinear with (0,0) D) Collinear with (1,1) E) none of these

81. The ratio in which the join of the points (4, 8) and (3, −5) divided by the axis of x is:
A) 8 : 5 B) 5 : 8 C) 3 : 4 D) 4 : 3 E) 7:6

82. The equation of the tangent to the circle $x^2 + y^2 = 25$ at (5, 12) is :
A) 12x + 5y = 20 B) 12x − 5y = 20 C) 5x + 12y = 25 D) 5x − 12y = 25 E) 7x+12y=15

83. The circles $x^2 + y^2 + x + y = 0$ and $x^2 + y^2 + x - y = 0$ intersect at an angle of :
A) $\pi/6$ B) $\pi/4$ C) $\pi/3$ D) $\pi/2$ E) $\pi/7$

84. The value of f(0) so that the function $f(x) = \frac{1-\text{Cos}(1-\text{Cos}x)}{x^4}$ is continuous every where is:
A) 1/4 B) 1/2 C) 1/8 D) 1/10 E) 1/9

85. If θ is the semi vertical angle of a cone of maximum volume and given slant height, then $\tan\theta$ is given by
A) 2 B) 1 C) $\sqrt{2}$ D) $\sqrt{3}$ E) 3

86. At the point x = 1, the function $f(x) = \begin{cases} x^3 - 1; 1 < x < \infty \\ x - 1; -\infty < x \le 1 \end{cases}$
A) continuous and differentiable B) continuous and not differentiable
C) discontinuous and differentiable D) discontinuous and not differentiable E) None

87. If $f'(x) = \frac{1}{\left(1+x^2\right)^{3/2}}$ and f(0) = 0, then f(1) is equal to
A) $\sqrt{2}$ B) $-\frac{1}{\sqrt{2}}$ C) $+\frac{1}{\sqrt{2}}$ D) $-\sqrt{2}$ E) 1

88. An urn contains 7 green balls and 5 yellow balls. Three balls are drawn at a time. The probability that these three balls are of the same colour is:
A) 9/44 B) 31/66 C) 31/60 C) 5/66 E) 6/33

89. The probability that a non-leap year has 53 Sundays is :
A) 1/7 B) 2/7 C) 3/7 D) 4/7 E) 5/7

90. If $\bar{a}.\bar{b} = 0$ and $\bar{a} + \bar{b}$ makes an angle of 30^0 with $\bar{a}$, then
A) $|\bar{b}| = 2|\bar{a}|$ B) $|\bar{a}| = 2|\bar{b}|$ C) $|\bar{a}| = \sqrt{3}|\bar{b}|$ D) $|\bar{a}| = |\bar{b}|$ E) $|\bar{a}| = \sqrt{5}|\bar{b}|$

91. If |a|=3, |b|=1, |c|=4 and a + b + c = 0, then a.b + b.c + c. a =
A) 12 B) -12 C) 13 D) -13 E) 17

92. If $\vec{a} = 2\vec{i} + \vec{j} + \vec{k}$ and $\vec{b} = 4\vec{i} + 7\vec{j} + 3\vec{k}$ then cosine of the angle between $\vec{a}$ and $\vec{b}$ is:
A) $\frac{9}{\sqrt{111}}$ B) $\frac{11}{\sqrt{113}}$ C) $\frac{10}{\sqrt{114}}$ D) $\frac{8}{\sqrt{110}}$ E) $\frac{7}{\sqrt{114}}$

93. Let $\vec{a}$ be the vector of magnitude $\sqrt{75}$ which is perpendicular to both $2\vec{i} - \vec{j} + \vec{k}$ and $3\vec{i} + 2\vec{j} - \vec{k}$. Then $\vec{a}$ is equal to :
A) $-\vec{i} + 5\vec{j} + 7\vec{k}$ B) $7\vec{i} + 5\vec{j} + \vec{k}$ C) $\vec{i} + 5\vec{j} - 7\vec{k}$ D) $-7\vec{i} - 5\vec{j} - \vec{k}$ E) $7\vec{i} - 5\vec{j} + \vec{k}$

94. The foot of the perpendicular from (0, 2, 3) to the line $\frac{x+3}{5}=\frac{y-1}{2}=\frac{z+4}{3}$ is :

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

95. If the lines $\frac{x-1}{k}=\frac{y-2}{2}=\frac{z-3}{3}$ and $\frac{x-2}{2}=\frac{y-3}{k}=\frac{z-1}{2}$ intersect then the integral value of k is

A) –5 B) 5 C) 2 D) –2 E) –3

96. The ratio in which the line joining (2, 4, 5) (3, 5, -4) is divided by the yz plane is :

A) 2 : 3 B) 3 : 2 C) -2 : 3 D) 4 : -3 E) 1 : 2

97. The two lines $x = ay + b$, $z = cy + d$ and $x = a'y + b'$, $z = c'y + d'$ are $\perp$ to each other if

A) $\frac{a}{a_1}+\frac{c}{c_1}=1$ B) $aa' + cc' = -1$ C) $aa' + cc' = 1$ D) $\frac{a}{a'}+\frac{c}{c'}=-1$ E) $\frac{a}{a_1}-\frac{c}{c_1}=1$

98. If the line x–1=0 is the directrix of the parabola $y^2 - kx + 8 = 0$, then one of the values of k is

A) $\frac{1}{6}$ B) 8 C) 4 D) $\frac{1}{4}$ E) -8

99. Length of the major axis of the ellipse $9x^2+7y^2=63$ is

A) 3 B) 9 C) 6 D) $2\sqrt{7}$ E) $\sqrt{7}$

100. The line $4x + 6y + 9 = 0$ touches the parabola $y^2 = 4x$ at the point

A) (-3, 9/4) B) $\left(3,\frac{-9}{4}\right)$ C) $\left(\frac{9}{4},-3\right)$ D) $\left(\frac{-9}{4},-3\right)$ E) $\left(\frac{-9}{4},\frac{9}{4}\right)$

101. The line $y = 2x + c$ touch the ellipse $\frac{x^2}{16}+\frac{y^2}{4}=1$. If c is

A) $2\sqrt{37}$ B) $2\sqrt{17}$ C) $\sqrt{17}$ D) $\sqrt{31}$ E) $2\sqrt{31}$

102. The number of terms in the expansion of $\left(1+2x+x^2\right)^{20}$ is

A) 21 B) 20 C) 60 D) 41 E) 40

103. The eccentricity of a rectangular hyperbola $\frac{-x^2}{a^2}+\frac{y^2}{b^2}=1$ is given by :

A) 2 B) $\sqrt{2}$ C) 0 D) $\sqrt{3}$ E) 3

104. The complex number z, satisfying the equation $\left|\frac{i-z}{i+z}\right|=1$ lies on

A) a circle with centre (0, 0) and radius B) the x - axis
C) the y - axis D)the line y = x + 1 E) none

105. If $z(2 – i) = 3 + i$ then $z^{20} =$

A) 1 – i B) –1024 C) 1024 D) 1 + i E) 1011

106. If A = {1, 2, 3}, B = {4, 5, 6} and C = {1, 2}, then $(A – B) \times (A \cap C)$ is

A) {(1, 3), (1, 5)} B) {(2, 1), (2, 2) (2, 3)}
C) {(1, 2), (1, 3), (1, 5)} D) {(1, 1), (1, 2), (2, 1), (2, 2), (3, 1), (3, 2)
E) None of these

107. If a function f satisfies f(f(x)) = x + 1 for all real values of x and if f(0) = $\frac{1}{2}$, then f(1) is equal to

A) $\frac{1}{2}$ B) 1 C) $\frac{3}{2}$ D) 2 E) 0

108. Integrating factor of differential equation $\cos x\frac{dy}{dx} + y\sin x = 1$ is:

A) cosx B) tanx C) secx D) sinx E) $\cos^2 x$

109. The surface area of a cube is increasing at the rate of $2cm^2$/sec. When its edge is 90cm, the volume is increasing at the rate of

A) 1620 cm^3/sec B) 810cm^3/sec C) 405cm^3/sec D) 45cm^3/sec E) 15cm^3/sec

110. The maximum value of $1 + 4\sin\theta + 3\cos\theta$ is

A) –3 B) –4 C) 5 D) 6 E) 8

111. $\int \frac{dx}{\sqrt{9-4x^2}} =$

A) $\frac{1}{3}\sin^{-1}\frac{2x}{3} + c$ B) $\frac{1}{2}\sin^{-1}\frac{3x}{2} + c$ C) $\frac{1}{2}\sin^{-1}\frac{2x}{3} + c$ D) $\frac{1}{2}\cos^{-1}\frac{2x}{3} + c$ E) $\frac{1}{2}\cos^{-1}\frac{7x}{5} + c$

112. The area bounded by the semi-circle $y = \sqrt{4-x^2}$ and its diameter y = 0 is:

A) $\pi/4$ B) $\pi/2$ C) π D) 2π E) 3π

113. The area in square units bounded by the curves $y = x^3$, $y = x^2$ and the ordinates x = 1, x = 2 is

A) $\frac{17}{12}$ B) $\frac{12}{13}$ C) $\frac{2}{7}$ D) $\frac{7}{2}$ E) $\frac{13}{12}$

114. If the third term in the binomial expansion of $(1 + x)^m$ is $-\frac{1}{8}x^2$, then the rational value of 'm' is:

A) 2 B) 3 C) 1/2 D) 4 E) 6

115. The second, third and fourth terms in the expansion of $(x + a)^n$ are 240, 720 and 1080 respectively, then the value of n is:

A) 4 B) 5 C) 6 D) 10 E) 12

116. If sinx is an integrating factor of $\frac{dy}{dx} + Py = Q$, then P is

A) log sin x B) cot x C) sin x D) log cos x E) tan x

117. If m and n are respectively the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^5 + \frac{4\left(\frac{d^2y}{dx^2}\right)^3}{\left(\frac{d^3y}{dx^3}\right)} + \frac{d^3y}{dx^3} = x^2 - 1$ then:

A) m = 3, n = 3 B) m = 3, n = 1 C) m = 5, n = 3 D) m = 2, n = 3 E) m = 3, n = 2

118. If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$ then $(x + y + z)^2 =$

A) 1 B) 4 C) 3 D) 9 E) 2

119. If R is an equivalence relation on set A, then R^{-1} on A is

A) transitive B) Symmetric C) Reflexive D) Equivalence E) All the above

120. If α,β are the roots of the equation $x^2-15x+1=0$, then the value of $\left(\frac{1}{\alpha}-15\right)^{-2}+\left(\frac{1}{\beta}-15\right)^{-2}$ is

A) 225 B) 900 C) 223 D) 220 E) 200

121. The quadratic equation whose roots are $\left(\frac{\alpha}{\gamma}\right)^3$ and $\left(\frac{\beta}{\gamma}\right)^3$, where α,β,γ are roots of the equation $x^3-8=0$ is

A) $x^2+x+1=0$ B) $x^2+2x+4=0$ C) $x^2-2x+4=0$ D) $x^2-2x+1=0$ E) $x^2+2x-4=0$

122. If $A=\begin{pmatrix}0 & c & -b\\ -c & 0 & a\\ b & -a & 0\end{pmatrix}$ and $B=\begin{pmatrix}a^2 & ab & ac\\ ab & b^2 & bc\\ ac & bc & c^2\end{pmatrix}$ then $|AB|$ equals

A) 5 B) 10 C) 1 D) 0 E) –5

123. $\lim\limits_{x\to\infty}\frac{(x+1)^{10}+(x+4)^{10}+(x+9)^{10}+....+(x+100)^{10}}{x^{10}+100^{10}}$ equals

A) 100 B) 1000 C) 10 D) 10^4 E) 1

124. $\lim\limits_{x\to0}\frac{\sqrt{1-\sqrt{\cos 2x}}}{x}$ equals

A) 0 B) 1 C) –1 D) does not exist E) 2

125. $\lim\limits_{x\to0}(\cos x+\sin x)^{1/x}$ equals

A) e B) $\frac{1}{e}$ C) 1 D) 0 E) –1

126. The solution of the equation $\frac{dy}{dx}-1=\frac{1}{x-y}$ is

A) $(x-y)^2+2x=c$ B) $(x+y)^2=2x+c$

C) $(x+y)^2+2x=c$ D) $(x-y)^2=2x+c$

E) $(x+y)=3y^2+c$

127. The sum of the first three terms of a G.P is $\frac{39}{10}$ and their product is 1. Then the common ratio is

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{5}{2}$ D) $\frac{2}{5}$ E) $\frac{5}{2}$ or $\frac{2}{5}$

128. The standard deviation of 25 numbers in 11. If each of the numbers is decreased by 4, then the new standard deviation will be

A) 75 B) 7 C) 100 D) cannot be found E) 11

129. For a given distribution of marks mean is 40 and its standard deviation is 20. The coefficient of variation is

A) 20 B) 40 C) 50 D) 200 E) 60

130. If the sum of the first n natural numbers is $\frac{1}{5}$ of the sum of their squares then n =

A) 7 B) 5 C) 6 D) 8 E) 10

131. If a,b,c are p^{th}, q^{th} and r^{th} terms of a GP, then $(q-r)\log a+(r-p)\log b+(p-q)\log c$ is equal to

A) p+q+r B) pqr C) –pqr D) 0 E) p–q+r

132. $\frac{\sin^2 3A}{\sin^2 A}-\frac{\cos^2 3A}{\cos^2 A}=$

A) cos2A B) $\frac{1}{8}\cos 2A$ C) 8cos2A D) 4 cos2A E) $\frac{1}{2}\cos 2A$

133. $\int_0^{\pi}\sqrt{1+\sin x}\,dx =$

A) 2 B) $2\sqrt{2}$ C) 4 D) $\frac{1}{2}$ E) $\frac{1}{2\sqrt{2}}$

134. $\int_0^{2}[2x]$ is equal to

A) 4 B) 2 C) 3 D) 1 E) 5

135. The A.M of n observations is M. If the sum of (n – 4) observations is a then the mean of the remaining 4 observations is

A) $\frac{nM+a}{2}$ B) $nM+a$ C) $\frac{nM-a}{2}$ D) $\frac{nM+a}{4}$ E) $\frac{nM-a}{4}$

136. A bag contains 5 brown and 4 white socks. One pulls out 2 socks. The probability that they are of the same colour is

A) $\frac{5}{108}$ B) $\frac{1}{6}$ C) $\frac{4}{9}$ D) $\frac{5}{18}$ E) $\frac{1}{3}$

137. $\int\frac{(x+1)dx}{\sqrt{1+x^2}}=$

A) $\sqrt{1+x^2}+\log\left(x+\sqrt{1+x^2}\right)+c$ B) $\sqrt{1+x^2}+\tan^{-1}x+c$

C) $\sqrt{1+x^2}-\log\left[x+\sqrt{1+x^2}\right]+c$ D) $\sqrt{1+x^2}+\log(\sec x+\tan x)+c$

E) $2\sqrt{1+x^2}+\tan^{-1}x+c$

138. $\int\frac{dx}{x+x\log x}=$

A) $\log x+\log(\log x)+c$ B) $\log(1+\log x)+c$

C) $-\log(1+\log x)+c$ D) $\log x-\log(\log x)+c$

E) $2\log(1+\log x)+c$

139. $\int_0^1 \sqrt{\frac{1-x}{1+x}}\,dx =$

A) $\frac{\pi}{2}+1$ B) -1 C) $\frac{\pi}{2}-1$ D) 1 E) $\frac{\pi}{2}$

140. If $I_1 = \int_0^1 \frac{e^x dx}{x+1}$ and $I_2 = \int_0^1 \frac{xe^{x^2} dx}{x^2+1}$ then $I_2 =$

A) I_1^2 B) $2I_1$ C) $\frac{1}{2}I_1$ D) $\frac{1}{2}I_1^2$ E) $2I_1^2$

141. Area between the curves $y = \sqrt{x}$ and $x = \sqrt{y}$ in sq. units is

A) 1 B) $\frac{2}{3}$ C) $\frac{4}{3}$ D) $\frac{1}{2}$ E) $\frac{1}{3}$

142. The differential equation whose solution is $ax^2 + by^2 = 1$ where a , and b are arbitrary constants is of

A) First order second degree B) First order first degree
C) Second order first degree D) Second order second degree
E) Second order third degree

143. The solution of $x\frac{dy}{dx} = y + x\tan\left(\frac{y}{x}\right)$ is

A) $\sin\left(\frac{x}{y}\right) = cx$ B) $\sin\left(\frac{x}{y}\right) = cy$ C) $\sin\left(\frac{y}{x}\right) = cy$

D) $\sin\left(\frac{y}{x}\right) = c\left(\frac{y}{x}\right)$ E) $\sin\left(\frac{y}{x}\right) = cx$

144. If α and β are the roots of $ax^2 + bx + c = 0$ then the equation whose roots are $\frac{1}{\alpha+\beta}$ and $\frac{1}{\alpha}+\frac{1}{\beta}$ is

A) $bcx^2 + \left(ac + b^2\right)x + ab = 0$ B) $acx^2 + \left(a^2 + bc\right)x + bc = 0$

C) $abx^2 + \left(c^2 + ab\right)x + ca = 0$ D) $acx^2 + \left(a^2 + bc\right)x - bc = 0$

E) $acx^2 - \left(a^2 + bc\right)x - bc = 0$

145. If the roots of the equation $x^2 + px + q = 0$ differ from the roots of $x^2 + qx + p = 0$ by the same quantity where $p \neq q$ then $p + q =$

A) -1 B) -2 C) -4 D) 4 E) 2

146. If the second, third and sixth terms of an A.P are the consecutive terms of a GP then the common ratio of the GP is

A) 3 B) -3 C) 9 D) -9 E) $\frac{1}{3}$

147. If the system of equations $2x - y - 2z = 2$, $x - 2y + z = -4$, $x + y + \lambda z = 4$ has no solution then $\lambda =$

A) 1 B) -3 C) 3 D) 2 E) 4

148. If $\begin{vmatrix} 1+a & 1 & 1 \\ 1+b & 1+2b & 1 \\ 1+c & 1+c & 1+3c \end{vmatrix} = 0$ where a, b, c $\neq 0$ then $a^{-1} + b^{-1} + c^{-1} =$

A) 4 B) –3 C) –2 D) –1 E) –4

149. The minimum value of $2x + 3y$ subject to $x \geq 0, y \geq 0, x + y \geq 1, 2x + y \leq 3, x + 2y \leq 3$ is

A) 2 B) 3 C) $\frac{9}{2}$ D) 5 E) 7

150. If $\cos\left(2\sin^{-1} x\right) = \frac{1}{9}$ then x =

A) $\frac{2}{3}$ B) $\pm\frac{2}{3}$ C) $-\frac{2}{3}$ D) $\pm\frac{1}{3}$ E) $\pm\frac{1}{9}$

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CEE KERALA ENGG. MODEL EXAM - ALL UNITS

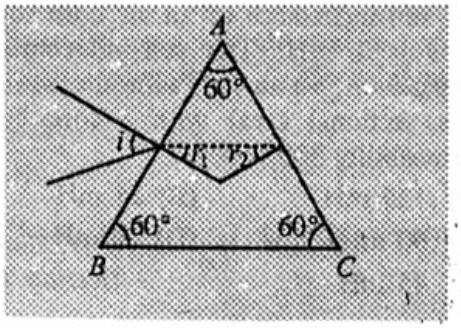
[PHYSICS + CHEMISTRY + MATHEMATICS]

TEST ID 211

PHYSICS

1. C

In case equilateral prism, angle of prism, $A = 60°$



But $r_1 + r_2 = A$

Since the ray is parallel to the base inside the prism, so $r_1 = r_2$

$\therefore \quad r_1 + r_1 = 60° \Rightarrow 2r_1 = 60° \Rightarrow r_1 = 30°$

Now, $\mu = \dfrac{\sin i}{\sin r_1}$

or $\sqrt{3} = \dfrac{\sin i}{\sin 30°} \Rightarrow \sin i = \sqrt{3} \times \sin 30°$

$= \sqrt{3} \times \dfrac{1}{2} = \dfrac{\sqrt{3}}{2}$

or $\sin i = \sin 60° \Rightarrow i = 60°$

2. E $\text{Amount of scattering} \propto \dfrac{1}{\lambda^4}$

3. A $\lambda = \dfrac{h}{\sqrt{2mK}} \Rightarrow \lambda \propto \dfrac{1}{\sqrt{K}}$

$\therefore \quad \dfrac{\lambda_1}{\lambda_2} = \sqrt{\dfrac{K_2}{K_1}}$

or $\dfrac{2000\,\mathring{A}}{\lambda_2} = \sqrt{\dfrac{1 \times 10^6\ eV}{1\ eV}} = 10^3$

$\therefore \quad \lambda_2 = \dfrac{2000}{1000} = 2\mathring{A}$

4. A

$$K_{max\,1} = h\nu - \phi_1 = 3 - 2{\cdot}75 = 0{\cdot}25 \text{ eV}$$
$$K_{max\,2} = h\nu - \phi_2 = 3 - 2 = 1 \text{ eV}$$

Now, $p = \sqrt{2mK} \Rightarrow p \propto \sqrt{K}$

$$\therefore \quad \frac{p_{max1}}{p_{max2}} = \sqrt{\frac{K_{max1}}{K_{max2}}} = \sqrt{\frac{0{\cdot}25}{1}} = \sqrt{\frac{25}{100}}$$

$$= \sqrt{\frac{1}{4}} = \frac{1}{2}$$

5. D

$$K_{max} = h\nu - \phi$$

or $K_{max} = h\nu - h\nu_0$

Maximum kinetic energy does not depend upon the intensity of incident light. It only depends on the frequency of the light source and the nature of emitter plate material.

6. C $\quad I = \frac{3-1}{200} = \frac{2}{200} = 0{\cdot}01\text{A}$

7. C In semiconductor the forbidden energy gap or band gap < 3 eV

8. B

$$I_B = \frac{0{\cdot}01}{1000} = 10^{-5}\,A$$

Now, $\beta = \frac{I_C}{I_B} \Rightarrow I_C = \beta \times I_B$

$$= 50 \times 10^{-5} = 500 \times 10^{-6}\,A$$
$$= 500\ \mu A$$

9. B $\quad P \propto \left(\frac{l}{\lambda}\right)^2$

10. A

Dimensions of Gravitational potential $= [L^2T^{-2}]$

Dimensions of Latent heat $= [L^2T^{-2}]$

Dimensions of Impulse $= [MLT^{-1}]$

Dimensions of angular acceleration $= [T^{-2}]$

Dimensions of specific heat capacity $= [L^2T^{-2}K^{-1}]$

Dimensions of Plank's constant $= [ML^2T^{-1}]$

11. E

$$x = ML^{-1}T^{-1}$$

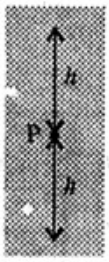
$$\text{or } \frac{\Delta x}{x} \times 100 = \left(\frac{\Delta M}{M} + \frac{\Delta L}{L} + \frac{\Delta T}{T}\right) \times 100$$

$$\text{or } \frac{\Delta x}{x} \times 100$$

$$= \frac{\Delta M}{M} \times 100 + \frac{\Delta L}{L} \times 100 + \frac{\Delta T}{T} \times 100$$

$$\frac{\Delta x}{x} \times 100 = 1\% + 1{\cdot}5\% + 3\% = 5{\cdot}5\%$$

12. B



Above point P :

$v^2 - u^2 = -2gh$

or $v^2 = u^2 - 2gh$ ...(*i*)

Below Point P

$(2v)^2 - v^2 = 4gh$

or $(2v)^2 = v^2 + 4gh$

or $(2v)^2 = u^2 - 2gh + 4gh$

or $(2v)^2 = u^2 + 2gh$ ...(*ii*)

Add eqns, (*i*) and (*ii*)

$v^2 + 4v^2 = u^2 - 2gh + u^2 + 2gh$ ...(*ii*)

or $5v^2 = 2u^2$

or $u^2 = \frac{5}{2}v^2$ ...(*iii*)

Subtracting eqn. (*i*) from (*ii*)

$4v^2 - v^2 = u^2 + 2gh - u^2 + 2gh$

or $3v^2 = 4gh$

or $v^2 = \frac{4}{3}gh$ ...(*iv*)

∴ Maximum height attained by stone,

$$H = \frac{u^2}{2g} = \frac{5v^2}{2 \times 2g} = \frac{5\left(\frac{4}{3}gh\right)}{4g}$$

$$\text{or, } H = \frac{5 \times 4gh}{3 \times 4g} = \frac{5}{3}h.$$

13. A

Eddy currents are produced in a varying magnetic field.

14. B

$$R = u \cos\theta \times t$$

$$\therefore u \cos\theta = \frac{R}{t} = \frac{300}{6} = 50 \text{ m s}^{-1}$$

15. E

$$F = ma \Rightarrow a = \frac{F}{m} = \frac{F}{1} = F$$

use, $S = ut + \frac{1}{2}at^2$

or $S = \upsilon \times 1 + \frac{1}{2} \times F \times (1)^2$

or $S = \upsilon + \frac{F}{2}$

16. B

Use law of conservation of momentum

$MV = m_1v_1 + m_2v_2$

$100 \times 10^4 = 10 \times 0 + 90 \times v_2^2$

or, $v_2 = \frac{100 \times 10^4}{90} = 11{\cdot}11 \times 10^3 \text{ m s}^{-1}$

17. C

$$T_{\text{heighest point}} = \frac{mv^2}{r} - mg = \frac{m(\sqrt{3gr})^2}{r} - mg$$

$$\left[\because V_{top} = \sqrt{3gr}\right]$$

$$T_{h.p.} = \frac{3mgr}{r} - mg = 2mg$$

Tension of lowest $pt.$, $T_{L.P.} = 2mg + 6mg$

$= 8\ mg$

$$\therefore \frac{T_{h.p.}}{T_{L.P.}} = \frac{2mg}{8mg} = \frac{1}{4}.$$

18. E

The velocity and acceleration are perpendicular to the plane of the circle in a uniform circular motion.

19. A

$$V(x) = (x^2 - 3x)$$

At equilibrium position, $\frac{dv}{dx} = 0$

or $\frac{d}{dx}(x^2 - 3x) = 0$

or $2x - 3 = 0 \Rightarrow x = \frac{3}{2} = 1{\cdot}5 \text{ m}$

20. B

Here, m = mass per unit length = $\frac{dm}{dx}$

$$K.E. = \frac{1}{2}mv^2$$

21. A

$I = MK^2$

and $L = I\omega$

or $L = MK^2\omega = 1{\cdot}5\ K^2 \times 0\ 3$

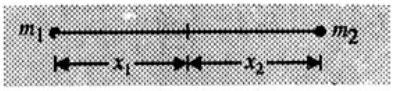
or $1{\cdot}8 = 1{\cdot}5\ K^2 \times 0{\cdot}3 \Rightarrow K^2 = \frac{1{\cdot}8}{1{\cdot}5 \times 0{\cdot}3}$

$= 4 \Rightarrow K = 2\ m$

22. E

Ist case :

$$\frac{m_1(-x_1) + m_2(x_2)}{m_1 + m_2} = 0$$



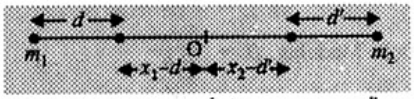
or $-m_1x_1 + m_2x_2 = 0$

or $m_1x_1 = m_2x_2$

Second case :

$$\frac{-m_1(x_1 - d) + m_2(x_2 - d)}{m_1 + m_2} = 0$$

or $-m_1x_1 + m_1d + -m_2x_2 - m_2d' = 0$



or $-m_1x_1 + m_1d + m_1x_1 - m_2d' = 0$

or $m_2d' = m_1d$ $[\because m_1x_1 = m_2x_2]$

or $d' = \frac{m_1}{m_2}d$

23. A

The principle involved in the performance of a spinning chair circus acrobat is conservation of angular momentum.

24. D

Use, $T^2 \propto R^3$

or, $\left(\frac{T_1}{T_2}\right)^2 = \left(\frac{R_1}{R_2}\right)^3 = \left(\frac{R_1}{\frac{R_1}{4}}\right)^3 = (4)^3$

or, $\frac{T_1}{T_2} = (4)^{3/2} = (2^2)^{\frac{3}{2}} = (2)^3 = 8$

or, $T_2 = \frac{T_1}{8}$.

Hence change in the duration of year

$= T_1 - \frac{T_1}{8} = \frac{7}{8}\ T_1$

25. E

$$\text{Bulk Modulus, } B = \frac{F/A}{\frac{\Delta V}{V}}$$

$$B = \frac{P}{\frac{\Delta V}{V}} = \frac{h\rho g}{\frac{\Delta V}{V}}$$

or $$B = \frac{400 \times 1 \times 10^3 \times 9{\cdot}8}{\frac{0{\cdot}2}{100}}$$

$$= 1{\cdot}96 \times 10^9 \text{ Nm}^{-2}$$

26. C The extra mass in the other pan required to pull the ring away from water is 4·4 g

27. C

$$V_T = \frac{2}{9}\frac{r^2(\rho - \sigma)g}{\eta}$$

or, $$V_T \propto r^2$$

or, $$\frac{V_{T_1}}{V_{T_2}} \propto \left(\frac{1}{2}\right)^2$$

Since, the density of rain drops are same, therefore $m \propto (r^3)$

or, $$\frac{m_1}{m_2} \propto \left(\frac{1}{2}\right)^3$$

Hence, $$\frac{p_1}{p_2} = \frac{m_1}{m_2} \times \frac{v_1}{v_2}$$

$$= \left(\frac{1}{2}\right)^3 \times \left(\frac{1}{2}\right)^2 = \frac{1}{8} \times \frac{1}{4} = \frac{1}{32}$$

28. D

$$\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100$$

$$\eta' = \left[1 - \frac{(T_2 - 100)}{(T_1 - 100)}\right] \times 100$$

$$= \left[\frac{T_1 - 100 - T_2 + 100}{T_1 - 100}\right] \times 100$$

$$= \left(\frac{T_1 - T_2}{T_1 - 100}\right) \times 100$$

Thus the efficiency increases.

29. E The electromagnetic waves travel with the speed of light = 3×10^8 ms^{-1} in free space.

30. B

The amount of heat given to a system in a cyclic process is equal to the net work done by the system.

31. A

$$K.E. = \frac{1}{2}\omega^2 m(A^2 - x^2)$$

and $$P.E. = \frac{1}{2}\omega^2 m x^2$$

But it is given that

$$\frac{K.E.}{P.E.} = \frac{1}{4}$$

$$\therefore \quad \frac{\frac{1}{2}\omega^2 m(A^2 - x^2)}{\frac{1}{2}\omega^2 m x^2} = \frac{1}{4}$$

$$\text{or} \quad \frac{A^2 - x^2}{x^2} = \frac{1}{4} \Rightarrow 4A^2 - 4x^2 = x^2$$

$$\Rightarrow \quad 5x^2 = 4A^2$$

$$\text{or} \quad x^2 = \frac{4}{5}A^2$$

$$\text{or} \quad x = \frac{2}{\sqrt{5}}A$$

32. D

$$y_1 = 5 \sin\left(2\pi t + \frac{\pi}{4}\right)$$

The standard equation is

$$y = A_1 \sin(\omega t + \phi)$$

$$\therefore \quad A_1 = 5$$

and $$y_2 = 2\sqrt{2} \sin(2\pi t + \cos 2\pi t)$$

$$A = \sqrt{(2\sqrt{2})^2 + (2\sqrt{2})^2}$$

$$= \sqrt{8 + 8} = 4$$

Hence $\frac{A_1}{A_2} = \frac{5}{4}$.

33. C

$$x = 10 \sin\left(2t - \frac{\pi}{6}\right)$$

Comparing with the standard equation which is

$x = A \sin(\omega t + \phi)$

$A = 10$, $\omega = 2$, displacement $x_1 = 6$ m.

$$\therefore \quad v = \omega \sqrt{A^2 - x_1^2} = 2\sqrt{(10)^2 - (6)^2}$$

$$= 2\sqrt{100 - 36} = 2\sqrt{64} = 2 \times 8$$

$$= 16 \text{ m s}^{-1}$$

34. E

The speed of sound in a liquid is given by

$$v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{\text{Bulk Modulus}}{\text{density}}}$$

or, $$v = \sqrt{\frac{2 \times 10^9}{8000}} = \sqrt{\frac{1}{4} \times 10^{9-3}}$$

$$= \sqrt{\frac{1}{4} \times 10^6} = \frac{10^3}{2} = 500 \text{ m s}^{-1}$$

35. D

The pressure variations in the propagation of sound waves are adiabatic.

36. A

When a comb rubbed with dry hair attracts pieces of paper, then the comb polarizes the piece of paper.

37. D

Use Gauss' law

$$\phi = \frac{q}{\epsilon_0}$$

Net electric flux $\phi = \phi_2 - \phi_1 = \frac{q}{\epsilon_0}$

$$\phi_2 - \phi_1 = 9 \times 10^6 - 6 \times 10^6 = 10^6 (9 - 6)$$

$$= 3 \times 10^6$$

$$\therefore \quad 3 \times 10^6 = \frac{q}{\epsilon_0} \quad \Rightarrow \quad q = 3 \times 10^6 \epsilon_0.$$

38. D

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

or $\frac{1}{4} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

Let C_1 is removed

then $\frac{1}{C_2} + \frac{1}{C_3} = \frac{1}{C_p} = \frac{1}{6}$

As per question $C_P = C_3$

$\therefore \frac{1}{C_1} = \frac{2}{24} = \frac{1}{12} \Rightarrow C_1 = 12\ \mu F$

39. A

$$I = \frac{nV}{nr + R}$$

or $2 = \frac{10 \times 2}{10r + 8}$

or $20r + 16 = 20 \Rightarrow$

$$r = \frac{20 - 16}{20} = \frac{4}{20} = \frac{1}{5} = 0.2\ \Omega$$

40. B

$$\frac{E_1}{E_2} = \frac{l_1}{l_2}$$

or, $\frac{V}{1.5V} = \frac{l/3}{l_2} \Rightarrow l_2 = \frac{l}{3} \times 1{\cdot}5 = \frac{l}{2}$

41. E

Smallest resistance can be obtained by connecting these resistances in parallel

i.e., $R_P = \frac{R}{n} = \frac{10}{10} = 1\Omega.$

42. B

$$M = \frac{f_o}{f_e} = \frac{225}{5} = 45\ \text{cm}.$$

43. E

$E = 20 \sin 100\, t$

The standard equation is

$E = E_0 \sin \omega t$

$\therefore$ $E_0 = 20$ and $E_{rms} = \frac{20}{\sqrt{2}}$

$$I_{rms} = \frac{E_{rms}}{R} = \frac{20}{\sqrt{2} \times 20} = \frac{1}{\sqrt{2}}$$

44. E $R = (10 \times 10^5 \pm 10\%)\ \Omega$
or $R = 1 \times 10^6 \pm 10\%\ \Omega$

45. C Here $A = 200\ cm^2 = 200 \times 10^{-4}\ m^2$
$N = 100,\ R = 2\ \Omega$
$\phi = BA\cos\theta$
$= 0{\cdot}1 \times 200 \times 10^{-4} \times \cos 0°$
$= 2 \times 10^{-3}\ Wb$
$\phi_2 = 0$
$\Delta\phi = 0 - 2 \times 10^{-3} = -2 \times 10^{-3}\ Wb$
$\therefore\ e = -\frac{N\Delta\phi}{\Delta t}$
$= \frac{-100 \times (-2 \times 10^{-3})}{1} = 0{\cdot}2\ V$
Hence, $I = \frac{e}{R} = \frac{0{\cdot}2}{2} = 0{\cdot}1\ A$
$q = It = 0{\cdot}1 \times 1 = 0{\cdot}1\ C$

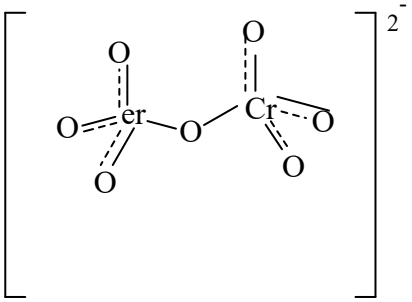
CHEMISTRY

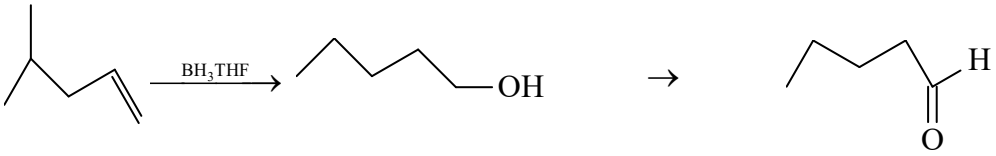
46. D Faraday second law $\frac{W_{A\ell}}{W_{H2}} = \frac{E_{A\ell}}{E_{H2}}\ \frac{4.5g}{WH_2} = \frac{9}{1}$

volume of H_2 at STP $= \frac{WH_2}{2} \times 22.42 = 5.62$

47. D $\log K = \log A - \frac{Ea}{2.303RT}$; $y = C + M\,x$

48. C Rate $\alpha[A]^1[B]^0[C]^2$ $\therefore$ order $= 3$

49. B 

50. A 

51. D

52. A

53. A

54. E $CH_3 - CH_2 - C \equiv CH \xrightarrow{+Cu_2Cl_2} CH_3 - CH_2 - C - Cu$ (red ppt)
acidic hydrogen

55. D Starch - α-glucose

Cellulose - β-glucose

Nucleic acid - Nucleotide

Protein - α-amino acid

56. A $2Cu^{+} \rightarrow Cu^{2+} + Cu$ and $3MnO_4^{2-} + 4H^{+} \rightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$ are disporportional reactions.

57. A Extensive intermolecular H-bonding is the reason for the higher boiling point of alcohol compared to ethers.

58. E Silicon is a semiconductor

59. B Distillation = Chloroform- aniline

Fractional distillation = Separatiuon of crude oil fractions

Steam distillation = Aniline - water mixture

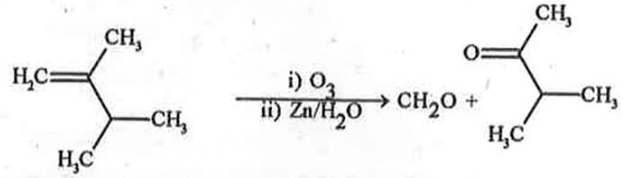
Distillation under reduced pressure = Separation of glycerol from spent lye

60. E Since decomposition of PCl_3 is carried out in a closed container. When helium gas is introduced the volume remains constant and there is no change in the partial pressure of PCl_5, PCl_3 and Cl_2. Therefore, nothing happens on introduction of helium gas at constant volume.

61. C NO^- is having the bond order =2

but CN^- is having bond order =3

62. B



2,3-dimethylbut-1-ene

63. C Given, $\Delta H_{H-H} = 434$ kJ/mol

$\Delta H_{Cl-Cl} = 242$ kJ/mol

$\Delta H_{H-Cl} = 431$ kJ/mol

$$\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \longrightarrow HCl, \Delta H_f = ?$$

$$\Delta H_f = \frac{1}{2} \times \Delta H_{H-H} + \frac{1}{2} \times \Delta H_{Cl-Cl} - \Delta H_{H-Cl}$$

$$= \frac{1}{2} \times 434 + \frac{1}{2} \times 242 - 431$$

$$= 217 + 121 - 431 = -93 \text{ kJ/mol}$$

64. A For spontaneous process, ΔS must be positive

In reversible process

$$\Delta S_{system} + \Delta S_{surrounding} = 0$$

Hence, system is present in equilibrium.

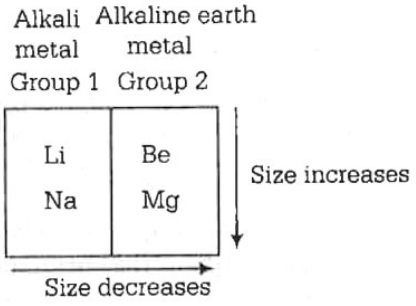
(i.e. it is not spontaneous process)

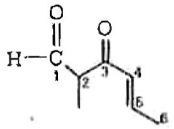
While in irreversible process

$$\Delta S_{system} + \Delta S_{surrounding} > 0$$

Hence, in the process ΔS is positive.

65. C Atomic size increases down the group and decreases in period from left to right. So, Be is smallest in size in these elements.



66. A 

—CHO group gets higher priority over >C = O and >C = C< group in numbering of principal carbon chain.

IUPAC name is 2 methyl- 3 oxohex- 4- enal

67. D

68. A The reaction is dehydro halogenation. It is a β elimination reaction and the product formed is as per Zaitsev's rule

69. E Van't Hoff factor, $i=1+(n-A)\alpha$

Here n=3

so, $2.74=1+(3-A)\alpha$

so, $\alpha=0.87$ i.e. 87%

70. D Order $= \frac{1}{2}+\frac{3}{2}=2$

71. D

72. D

73. E

74. C

75. E

MATHEMATICS

76. B

77. B

78. B Rq no. of ways $= {}^6C_3 \times {}^5C_3 \times {}^5C_3$

79. B Let A(2, 5), B (3, 4). Let P(0, y) be the reqd. point.; $PA^2 = PB^2$

80. B $3\times1+4\times2-7=4>0$

& $3\times-1+4\times2-7=-2<0$.

$\therefore$ Points lie on opposite side of the line.

81. A Let x axis divides the line joining the points at P in the ratio $m_1 : m_2$

$\therefore P = \left(\frac{3m_1+4m_2}{m_1+m_2}, \frac{-5m_1+8m_2}{m_1+m_2}\right)$; Since P is on x axis $\Rightarrow \frac{-5m_1+8m_2}{m_1+m_2} = 0 \Rightarrow \frac{m_1}{m_2} = \frac{8}{5} \therefore$ Ratio = 8:5

82. C $x \times 5 + y \times 12 = 5^2$; $5x + 12y - 25 = 0$

83. D

84. C $f(0) = \lim_{x\to 0} \frac{1-\text{Cos}(1-\text{Cos}x)}{x^4} = \lim_{x\to 0} \frac{\text{Sin}(1-\text{Cos}x)}{4x^3}.\text{Sin}x = \frac{1}{4}\lim_{x\to 0}\left[\frac{\text{Sin}(2\text{Sin}^2 x/2)}{2\text{Sin}^2 x/2}.\frac{2\text{Sin}^2 x/2}{\left(\frac{x}{2}\right)^2}.\frac{1}{4}\frac{\text{Sin}x}{x}\right] = \frac{1}{8}$

85. C Volume of cone, $V = \frac{\pi}{3}r^2h$; $\frac{dv}{dr} = 0 \Rightarrow 2\ell^2 - 3r^2 = 0$; $r = \pm\ell\sqrt{2/3}$

at $r = \ell\sqrt{2/3}$, $\frac{d^2v}{dr^2} < 0$, maxima; $h = \sqrt{\ell^2 - \frac{2}{3}\ell^2} = \frac{\ell}{\sqrt{3}}$

In ΔABC, $\tan\theta = \frac{r}{h} = \sqrt{2}$

86. B $\lim_{x\to 1^-} f(x) = \lim_{x\to 1}(x-1) = 0$ and $\lim_{x\to 1}(x^3-1) = 0$. Also $f(1) = 1 - 1 = 0$.

87. C $f(x) = \int \frac{dx}{\left(1+x^2\right)^{3/2}} + C$; Put $x = \tan\theta$; $\therefore f(x) = \sin\theta + c$; $\Rightarrow f(x) = \frac{x}{\sqrt{1+x^2}} + c$

88. A

89. A A non leap year contains 365 days. ie, 52 weeks and one day. This one day can be any one of seven days of the week.

$\therefore$ Required probability = 1/7

90. C $\bar{a}, \bar{b}, \bar{a}+\bar{b}$ from a right angled triangle $\tan 30 = \frac{|\bar{b}|}{|\bar{a}|} \Rightarrow |\bar{a}| = \sqrt{3}|\bar{b}|$

91. D We have $(a + b + c)^2 = 0$

$\Rightarrow |a|^2 + |b|^2 + |c|^2 + 2a.b + 2b.c + 2c.a = 0$; $\Rightarrow 9 + 1 + 16 + 2(a.b + b.c + c.a) = 0$

92. A $\cos\theta = \frac{8+7+3}{\sqrt{6}\sqrt{16+49+9}} = \frac{9}{\sqrt{111}}$

93. A $|\vec{a}| = \sqrt{75}$

Let $\vec{a} = x\vec{i} + y\vec{j} + 2\vec{k}$ By the given $2x - y + z = 0$

$3x + 2y - z = 0 \therefore \frac{x}{-1} = \frac{y}{5} = \frac{z}{7} = k(\text{say})$

$x = -k$, $y = 5k$, $2 = 7k$; $\vec{a} = -k\vec{i} + 5k\vec{j} + 7k\vec{k}$

$|\vec{a}| = -\sqrt{k^2 + 25k^2 + 49k^2} = \sqrt{75}$

$\Rightarrow 75k^2 = 75$; $k = \pm 1$; $k = +1\left(\textit{since we take for } |\vec{a}|\right)$

$\Rightarrow \vec{a} = -i + 5\vec{j} + 7\vec{k}$

94. C

95. C

96. A

97. B The given lines can be written as $\frac{x-b}{-a}=\frac{y}{1}=\frac{z-d}{c}$ and $\frac{x-b'}{a'}=\frac{y}{1}=\frac{z-d'}{e'}$

Two lines will be $\perp^r$ if $aa'+1+cc'=0$

98. C $y^2-K\left(x-\frac{8}{k}\right), V(8k,0)$; E_4 of directrix $x=\frac{8}{k}-\frac{k}{4}=1$; $32-k^2=4k$; $k^2+4k-32=0$

$(k+8)(k-4)=0, k=-8,4$

99. C

100. C $lx + my + n = 0$ touches the parabola $y^2 = 4ax$ at $\left(\frac{n}{l},\frac{-2am}{l}\right)$, $a = 1$, $l = 4$, $m = 6$, $n = 9$

101. B $a^2 = 16$; $b^2 = 4$; $m = 2$; $c^2 = a^2m^2 + b^2 \Rightarrow c = 2\sqrt{17}$

102. D $\left(1+2x+x^2\right)^{20}=(1+x)^{40}$

103. B

104. B $\left|\frac{i-z}{i+z}\right|=1\Rightarrow\frac{|z-i|}{|z+i|}=1\Rightarrow\frac{|x+i(y-1)|}{|x+i(y+1)|}=1\Rightarrow\frac{x^2+(y-1)^2}{x^2+(y+1)^2}$

105. B $z=\frac{3+i}{2-i}=\frac{3+i}{2-i}\frac{2+i}{2+i};=\frac{6-1+5i}{4+1}=\frac{5+5i}{5}=1+i$

$z^2=(1+i)^2=1+i^2+2i=1-1+2i=2i$; $z^{20}=(z^2)^{10}=(2i)^{10}=2^{10}i^8i^2=-2^{10}=-1024$

106. D

107. C

108. C $\frac{dy}{dx}+y\frac{\sin x}{\cos x}=\frac{1}{x}$; here $P=\frac{\sin x}{\cos x}$; $\int pdx=-\log\cos x=\log\sec x$, $I.F=e^{\int pdx}=\sec x$

109. D $S = 6x^2$ and $V = x^3 \Rightarrow \frac{dS}{dt}=12x\frac{dx}{dt}$ and $\frac{dV}{dt}=3x^2\frac{dx}{dt}$

$\Rightarrow 2=12\times 90\frac{dx}{dt}$ and $\frac{dV}{dt}=3\times 90^2\times\frac{dx}{dt}$ $\Rightarrow 90\times\frac{dx}{dt}=\frac{1}{6}$ and $\frac{dV}{dt}=3\times 90\times\left(90\times\frac{dx}{dt}\right)$

110. D

111. C

112. D $\text{Area}=2\int_0^2 ydx=2\left(\frac{x\sqrt{4-x^2}}{2}+\frac{4}{2}\sin^{-1}\frac{x}{2}\right)_0^2=2\left(2\sin^{-1}1\right)=4.\pi/2=2\pi$

113. A $y=x^2-(1); y=x^3-(2)$

114. C $\frac{m(m-1)}{2}x^2=-\frac{1}{8}x^2 \Rightarrow (2m-1)^2=0$

115. B

116. B

117. E $\left(\frac{d^2y}{dx^2}\right)^5 \frac{d^3y}{dx^3} + 4\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{d^3y}{dx^3}\right)^2 = \left(x^2 - 1\right)\frac{d^3y}{dx^3}$

118. D $x = y = z = 1$

119. E

120. C

121. D α, β, γ are 2, 2w, $2w^2$

122. D Matrix A is a skew symmetric matrix with odd order $\Rightarrow |A| = 0$

123. C

124. B

125. A

126. A

127. E Let the terms be $\frac{a}{r}, a, ar$; Product $= \frac{a}{r}.a.ar = a^3 = 1 \Rightarrow a = 1$

Sum $= \frac{a}{r} + a + ar \Rightarrow 10r^2 - 29r + 10 = 0 \Rightarrow r = \frac{5}{2} \text{or} \frac{2}{5}$

128. E

129. C $2x < 18$, $3x < -9$

130. A $\frac{n(n+1)}{2} = \frac{1}{5} \times \frac{n(n+1)(2n+1)}{6}$

131. D

132. C $E = \left(3 - 4\sin^2 A\right)^2 - \left(4\cos^2 A - 3\right)^2$

133. C $I = \int_0^{\pi} \sqrt{1 + \cos\left(\frac{\pi}{2} - x\right)}\, dx$

134. C

135. E x_1 mean of 4 observations $\Rightarrow m = \frac{a + 4x_1}{(n-4)+4}$

136. C Required $= \frac{5C_2 + 4C_2}{9C_2}$

137. A $I = \int \frac{x\, dx}{\sqrt{1+x^2}} + \int \frac{dx}{\sqrt{1+x^2}}$

138. B $I = \int \frac{abc}{x(1+\log x)} 1 + \log x = u$

139. C $I = \int_0^1 \frac{(1-x)\, dx}{\sqrt{1-x^2}}$ split

140. C Put $x^2 = u$ is I_2

141. E $A = \int_0^1 \left(\sqrt{x} - x^2\right) dx$

142. C $xy\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - y\frac{dy}{dx} = 0$

143. E $\frac{dy}{dx} = \frac{y}{x} + x\tan\left(\frac{y}{x}\right) g = vx$

144. A Sum of the roots = Sum $\frac{-\left(ac + b^2\right)}{bc}$ product = $\frac{a}{c}$

145. C $\alpha - \beta = r - \delta \Rightarrow \left(\alpha - \beta\right)^2 = \left(\gamma - \delta\right)^2$

146. A a + d, a + 2d, a + 5d are in G.P $\Rightarrow$ d = -2a

147. B |A| = 0

148. B ab + bc + ca = -3abc

149. D

150. B $\text{Sin}^{-1} x = \theta \Rightarrow n = \text{Sin}\,\theta$ E = Cos 2θ = 1 − 2Sin^{2}θ