Physics

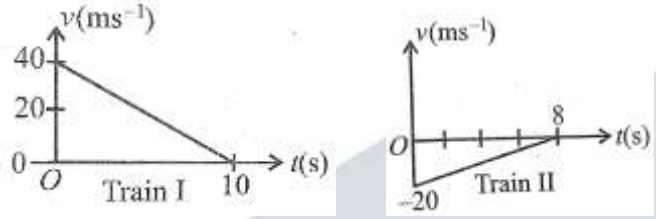
1. Match the List-I with List-II.

List-I	List - II
(A) Boltzmann constant	(I) $[ML^0T^0]$
(B) Coefficient of viscosity	(II) $[ML^{-1}T^{-1}]$
(C) Water equivalent	(III) $[MLT^{-3}K^{-1}]$
(D) Coefficient of thermal conductivity	(IV) $[ML^2T^{-2}K^{-1}]$

The correct match in the following

	A	B	C	D		A	B	C	D
(a)	III	I	II	IV	(b)	III	II	I	IV
(c)	IV	II	I	III	(d)	IV	I	II	III

2. Two trains, which are moving along different tracks in opposite directions are put on the same track by mistake. On noticing the mistake, when the trains are 300 m apart the drivers start slowing down the trains. The graphs given below show decrease in their velocities as function of time. The separation between the trains when both have stopped is



(a) 120 m (b) 20 m
(c) 60 m (d) 280 m

3. A point object moves along an arc of a circle of radius R. Its velocity depends upon the distance covered s as $v = K\sqrt{s}$, where K is a constant. If θ is the angle between the total acceleration and tangential acceleration, then

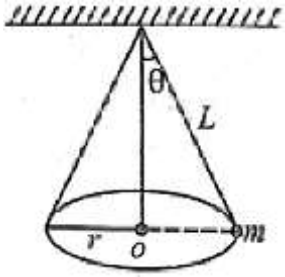
(a) $\tan\theta = \sqrt{\frac{s}{R}}$ (b) $\tan\theta = \sqrt{\frac{s}{2R}}$

(c) $\tan\theta = \frac{s}{2R}$ (d) $\tan\theta = \frac{2s}{R}$

4. A body projected from the ground reaches a point X in its path after 3 seconds and from there it reaches the ground after further 6 seconds. The vertical distance of the point X from the ground is (acceleration due to gravity = $10\ ms^{-2}$)

(a) 30 m (b) 60 m
(c) 80 m (d) 90 m

5. A particle of mass m is suspended from a ceiling through a string of length L. If the particle moves in a horizontal circle of radius r as shown in the figure, then the speed of the particle is



(a) $r\sqrt{\frac{g}{\sqrt{L^2-r^2}}}$ (b) $g\sqrt{\frac{r}{\sqrt{L^2-r^2}}}$

(c) $r\sqrt{\frac{g}{\sqrt{L^2-r^2}}}$ (d) $g\sqrt{\frac{r}{\sqrt{L^2-r^2}}}$

6. **A particle is placed at rest inside a hollow hemisphere of radius R. The coefficient of friction between the particle and the hemisphere is $\mu = \frac{1}{\sqrt{3}}$. The maximum height upto which the particle can remain stationary is**

(a) $\frac{R}{2}$ (b) $\left(1 - \frac{\sqrt{3}}{2}\right)$ R.

(c) $\frac{\sqrt{3}}{2}$R (d) $\frac{3R}{8}$

7. **A 1 kg ball moving with a speed of 6 ms^{-1} collides headon with a 0.5 kg ball moving in the opposite direction with a speed of 9 ms^{-1}. If the coefficient of restitution is $\frac{1}{3}$, then the energy lost in the collision is**

(a) 303.4 J (b) 66.7 J

(c) 33.3 J (d) 67.8 J

8. **A ball is thrown vertically down from a height of 40 m from the ground with an initial velocity v. The ball hits the ground, loses $\frac{1}{3}$rd of its total mechanical energy and rebounds back to the same height. If the acceleration due to gravity is 10 ms^{-2}, then the value of v is**

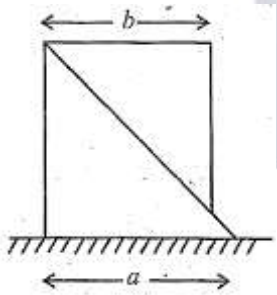
(a) 5 ms^{-1} (b) 10 ms^{-1}

(c) 15 ms^{-1} (d) 20 ms^{-1}

9. **Three identical uniform thin metal rods form the three sides of an equilateral triangle. If the moment of inertia of the system of these three rods about an axis passing through the centroid of the triangle and perpendicular to the plane of the triangle is n times. The moment of inertia of one rod separately about an axis passing through the centre of the rod and perpendicular to its length, the value of n is**

(a) 3 (b) 6 (c) 9 (d) 12

10. **Two smooth and similar right- angled prisms are arranged on a smooth horizontal plane as shown in the figure. The lower prism has a mass 3 times the upper prism. The prisms are held in an initial position as shown and are then released. As the upper prism touches the horizontal plane, the distance moved by the lower prism is**



(a) a − b (b) $\frac{a-b}{3}$

(c) $\frac{b-a}{2}$ (d) $\frac{a-b}{4}$

11. **A particle is executing simple harmonic motion with an amplitude of 2 m . The difference in the magnitudes of its maximum acceleration and maximum velocity is 4 . The time-period of its oscillation and its velocity when it is 1 m away from the mean position are respectively**

(a) 2 s, $2\sqrt{3}$ ms^{-1} (b) $\frac{7}{22}$ s, $4\sqrt{3}$ ms^{-1}

(c) $\frac{22}{7}$ s, $2\sqrt{3}$ ms^{-1} (d) $\frac{44}{7}$ s, $4\sqrt{3}$ ms^{-1}

12. **Two bodies of masses m and 9m are placed at a distance r. The gravitational potential at a point on the line joining them, where gravitational field is zero, is (G is universal gravitational constant)**

(a) $\frac{-14Gm}{r}$ (b) $\frac{-16Gm}{r}$

(c) $\frac{-12Gm}{r}$ (d) $\frac{-8Gm}{r}$

13. **When a load of 80 N is suspended from a string, its length is 101 mm . If a load of 100 N is suspended, its length is 102 mm . If a load of 160 N is suspended from it, then length of the string is (Assume the area of cross-section unchanged)**

(a) 15.5 cm (b) 13.5 cm
(c) 16.5 cm (d) 10.5 cm

14. A sphere of material of relative density 8 has a concentric spherical cavity and just sinks in water. If the radius of the sphere is 2 cm , then the volume of the cavity is

(a) $\frac{76}{3}$ cm^3 (b) $\frac{79}{3}$ cm^3
(c) $\frac{82}{3}$ cm^3 (d) $\frac{88}{3}$ cm^3

15. A hunter fired a metallic bullet of mass m kg from a gun towards an obstacle and it just melts when it is stopped by the obstacle. The initial temperature of the bullet is 300 K . If $\frac{1}{4}$ th of heat is absorbed by the obstacle, then the minimum velocity of the bullet is (Melting point of bullet $= 600$ K, Specific heat of bullet $= 0.03 calg^{-1}\,^{\circ}C^{-1}$, Latent heat of fusion of bullet $= 6 calg^{-1}$)

(a) 410 ms^{-1} (b) 260 ms^{-1}
(c) 460 ms^{-1} (d) 310 ms^{-1}

16. M kg of water at t°C is divided into two parts so that one part of mass m kg when converted into ice at 0°C would release enough heat to vapourise the other part, then $\frac{m}{M}$ is equal to (Specific heat of water $= 1 calg^{-1}$ C^{-1}Latent heat of fusion of ice $= 80 calg^{-1}$, Latent heat of steam $= 540 calg^{-1}$)

(a) $640 - t$ (b) $\frac{720-t}{640}$
(c) $\frac{640+t}{720}$ (d) $\frac{640-t}{720}$

17. A diatomic gas ($\gamma = 1.4$) does 300 J work when it is expanded isobarically. The heat given to the gas in this process is

(a) 1050 J (b) 950 J
(c) 600 J (d) 550 J

18. When the absolute temperature of the source of a Carnot heat engine is increased by 25%, its efficiency increases by 80%. The new efficiency of the engine is

(a) 12% (b) 24%
(c) 48% (d) 36%

19. A cylinder of fixed capacity 67.2 litres contains helium gas at STP. The amount of heat needed to rise the temperature of the gas in the cylinder by 20°C is ($R = 8.31$ J mol^{-1} K^{-1})

(a) 748 J (b) 374 J
(c) 1000 J (d) 500 J

20. For a certain organ pipe, three successive resonance frequencies are observed at 425,595 and 765 Hz , respectively. The length of the pipe is (speed of sound in air $= 340$ ms^{-1})

(a) 0.5 m (b) 1 m
(c) 1.5 m (d) 2 m

21. A student holds a tuning fork oscillating at 170 Hz. He walks towards a wall at a constant speed of 2 ms^{-1}. The beat frequency observed by the student between the tuning fork and its echo is (Velocity of sound $=$ 340 ms^{-1})

(a) 2.5 Hz (b) 3 Hz
(c) 1 Hz (d) 2 Hz

22. An infinitely long rod lies along the axis of a concave mirror of focal length f. The nearer end of the rod is at a distance u, ($u > f$) from the mirror. Its image will have a length

(a) $\frac{uf}{u+f}$ (b) $\frac{uf}{u-f}$
(c) $\frac{f^2}{u+f}$ (d) $\frac{f^2}{u-f}$

23. In Young's double slit experiment, red light of wavelength 6000Å is used and the nth bright fringe is obtained at a point P on the screen. Keeping the same setting, the source of light is replaced by green light

of wavelength 5000Å and now (n + 1) th bright fringe is obtained at the point P on the screen. The value of n is

(a) 4 (b) 5 (c) 6 (d) 3

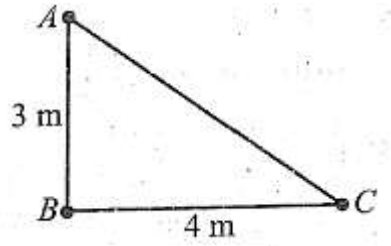
24. Two charges each of charge +10μC are kept on Y-axis at y = −a and y = +a, respectively. Another point charge −20μC is placed at the origin and given a small displacement x(x < a) along. X-axis. The force acting on the point charge is

(x and a are in metres, $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N − m^{2}C^{-2})

(a) $\frac{3.6x}{a^2}$ N (b) $\frac{2.4x^2}{a}$ N

(c) $\frac{3.6x}{a^3}$ N (d) $\frac{4.8x}{a^2}$ N

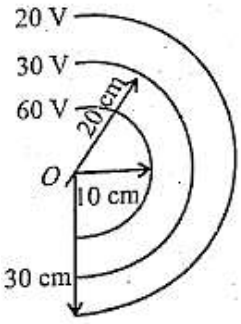
25. Three identical charges, each 2μC lie at the vertices of a right -angled triangle as shown in the figure. Forces on the charge at B due to the charges at A and C respectively are F_1 and F_2. The angle between their resultant force and F_2 is



(a) $\tan^{-1}\left(\frac{9}{16}\right)$ (b) $\tan^{-1}\left(\frac{9}{7}\right)$

(c) $\tan^{-1}\left(\frac{16}{9}\right)$ (d) $\tan^{-1}\left(\frac{7}{9}\right)$

26. The figure shows equipotential surfaces concentric at O. The magnitude of electric field at a distance r metres from O is



(a) $\frac{9}{r^2}$Vm^{-1} (b) $\frac{16}{r^2}$Vm^{-1}

(c) $\frac{2}{r^2}$Vm^{-1} (d) $\frac{6}{r^2}$Vm^{-1}

27. A region contains a uniform electric field E = (10î + 30ĵ)Vm^{-1}. A and B are two points in the field at (1, 2, 0)m and (2, 1, 3)m, respectively. The work done when a charge of 0.8 C moves from A to B in a parabolic path is

(a) 8 J (b) 80 J

(c) 40 J (d) 16 J

28. When a long straight uniform rod is connected across an ideal cell, the drift velocity of electrons in it is v. If a uniform hole is made along the axis of the rod and the same battery is used, then the drift velocity of electrons becomes

(a) v (b) > v

(c) < v (d) zero

29. In a meter bridge experiment, when a nichrome wire is in the right gap, the balancing length is 60 cm . When the nichrome wire is uniformly stretched to increase its length by 20% and again connected in the right gap, the new balancing length is nearly

(a) 61 cm (b) 31 cm
(c) 51 cm (d) 41 cm

30. A loop of flexible conducting wire lies in a magnetic field of 2.0 T with its plane perpendicular to the field. The length of the wire is 1 m . When a current of 1.1 A is passed through the loop, it opens into a circle, then the tension developed in the wire is
(a) 0.15 N (b) 0.25 N
(c) 0.35 N (d) 0.45 N

31. A charge q is spread uniformly over an isolated ring of radius R. The ring is rotated about its natural axis with an angular velocity ω. Magnetic dipole moment of the ring is
(a) $\frac{q\omega R^2}{2}$ (b) $\frac{q\omega R}{2}$
(c) $q\omega R^2$ (d) $\frac{q\omega}{2R}$

32. A magnetic dipole of moment $2.5 Am^2$ is free to rotate about a vertical axis passing through its centre. It is released from East-West direction. Its kinetic energy at the moment, it takes North-South position is $(B_H = 3 \times 10^{-5}\ T)$
(a) 50μ J (b) 100μ J
(c) 175μ J (d) 75μ J

33. A branch of a circuit is shown in the figure. If current is decreasing at the rate of $10^3 As^{-1}$, then the potential difference between A and B is

(a) 1 V (b) 5 V
(c) 10 V (d) 2 V

34. The natural frequency of an L − C circuit is 125 kHz . When the capacitor is totally filled with a dielectric material, the natural frequency decreases by 25 kHz . Dielectric constant of the material is nearly
(a) 3.33 (b) 2.12
(c) 1.56 (d) 1.91

35. Choose the correct sequence of the radiation sources in increasing order of the wavelength of electromagnetic waves produced by them.
(a) X-ray tube, Magnetron valve, Radioactive source, Sodium lamp
(b) Radioactive source, X-ray tube, Sodium lamp, Magnetron valve
(c) X-ray tube, Magnetron valve, Sodium lamp, Radioactive source
(d) Magnetron valve, Sodium lamp, X-ray tube, Radioactive source

36. A photo sensitive metallic surface emits electrons when X-rays of wavelength λ fall on it. The de-Broglie wavelength of the emitted electrons is (Neglect the work function of the surface, m is mass of the electron, h is Planck's constant, c is the velocity of light)
(a) $\sqrt{\frac{2mc}{h\lambda}}$ (b) $\sqrt{\frac{h\lambda}{2mc}}$
(c) $\sqrt{\frac{mc}{h\lambda}}$ (d) $\sqrt{\frac{h\lambda}{mc}}$

37. An electron in a hydrogen atom undergoes a transition from a higher energy level to a lower energy level. The incorrect statement of the following is
(a) Kinetic energy of the electron increases
(b) Velocity of the electron increases
(c) Angular momentum of the electron remains constant
(d) Wavelength of de-Broglie wave associated with the motion of electron decreases

38. The radius of germanium (Ge) nuclide is measured to be twice the radius of ^9_4Be. The number of nucleons in Ge will be
(a) 72 (b) 73 (c) 74 (d) 75

39. For a common-emitter transistor amplifier, the current gain is 60 . If the emitter current is 6.6 mA , then its base current is

(a) 6.492 mA (b) 0.108 mA
(c) 4.208 mA (d) 0.343 mA

40. If a transmitting antenna of height 105 m is placed on a hill, then its coverage area is

(a) 4224 km^2 (b) 3264 km^2
(c) 6400 km^2 (d) 4864 km^2

Chemistry

41. The product of uncertainty in velocity and uncertainty in position of a micro particle of mass ' m ' is not less than in which of the following?

(a) $h \times \frac{3\pi}{m}$ (b) $\frac{h}{3\pi} \times m$
(c) $\frac{h}{4\pi} \times \frac{1}{m}$ (d) $\frac{h}{4\pi} \times m$

42. An element has [Ar] $3d^1$ configuration in its +2 oxidation state. Its position in the periodic table is

(a) period-3, group-3 (b) period-3, group-7
(c) period-4, group-3 (d) period-3, group-9

43. In which of the following molecules, all bond lengths are not equal?

(a) SF_6 (b) PCl_5
(c) BCl_3 (d) CCl_4

44. In which of the following molecules, maximum number of lone pairs is present on the central atom?

(a) NH_3 (b) H_2O
(c) ClF_3 (d) XeF_2

45. Which one of the following is the kinetic energy of a gaseous mixture containing 3 g of hydrogen and 80 g of oxygen at temperature T(K) ?

(a) 3RT (b) 6RT
(c) 4RT (d) 8RT

46. A, B, C and D are four different gases with critical temperatures 304.1, 154.3, 405.5 and 126.0 K respectively. While cooling the gas, which gets liquefied first?

(a) B (b) A (c) D (d) C

47. 40 mL of x$MKMnO_4$ solution is required to react completely with 200 mL of 0.02 M oxalic acid solution in acidic medium. The value of x is

(a) 0.04 (b) 0.01
(c) 0.03 (d) 0.02

48. Given that,

$$C(s) + O_2(g) \longrightarrow CO_2(g); \Delta H^\circ = -x \text{ kJ mol}^{-1}$$
$$2CO(g) + O_2(g) \longrightarrow 2CO_2(g); \Delta H^\circ = -y \text{ kJ mol}^{-1}$$

The enthalpy of formation of CO will be

(a) $\frac{y-2x}{3}$ (b) $\frac{y-2x}{2}$
(c) $\frac{2x-y}{2}$ (d) $\frac{x-y}{2}$

49. At 400 K , in a 1.0 L vessel, N_2O_4 is allowed to attain equilibrium, $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ At equilibrium, the total pressure is 600 mm Hg , when 20% of N_2O_4 is dissociated. The value of K_p for the reaction is

(a) 50 (b) 100
(c) 150 (d) 200

50. In which of the following salts, only cationic hydrolysis is involved?

(a CH_3COONH_4 (b) CH_3COONa
(c) NH_4Cl (d) Na_2SO_4

51. Calgon is

(a) Na_2HPO_4 (b) Na_3PO_4
(c) $Na_6P_6O_{18}$ (d) NaH_2PO_4

52. Consider the following statements.

(I) Cs^+ ion is more highly hydrated than other alkali metal ions.

(II) Among the alkali metals, only lithium forms a stable nitride by direct combination with nitrogen.

(III) Among the alkali metals Li, Na, K, Rb, the metal, Rb has the highest melting point.

(IV) Among the alkali metals Li, Na, K, Rb, only Li forms peroxide when heated with oxygen.

Select the correct statement is

(a) I (b) II (c) III (d) IV

53. Assertion : $AlCl_3$ exists as a dimer through halogen bridged bonds.

Reason : $AlCl_3$ gets stability by accepting electrons from the bridged halogen.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true, but (R) is false
(d) (A) is false, but (R) is true

54. Which of the following causes "blue baby syndrome'?

(a) High concentration of lead in drinking water
(b) High concentration of sulphates in drinking water
(c) High concentration of nitrates in drinking water
(d) High concentration of copper in drinking water

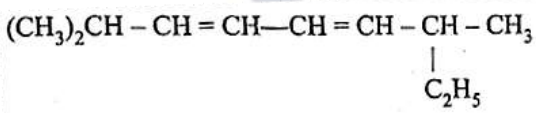
55. Which of the following belongs to the homologous series of $C_5H_8O_2N$?

(a) $C_6H_{10}O_3N$ (b) $C_6H_8O_2N_2$
(c) $C_6H_{10}O_2N_2$ (d) $C_6H_{10}O_2N$

56. In Dumas method, 0.3 g of an organic compound gave 45 mL of nitrogen at STP. The percentage of nitrogen is

(a) 16.9 (b) 18.7
(c) 23.2 (d) 29.6

57. The IUPAC name of



is

(a) 2, 7-dimethyl-3, 5-nonadiene
(b) 2, 7-dimethyl-2-ethylheptadiene
(c) 2-methyl-7-ethyl-3, 5-octadiene
(d) 1, 1-dimethyl-6-ethyl-2, 4-heptadiene

58. Match the following.

List-I (Magnetic property)	List-II (Substance)
(A) Ferromagnetic	(1) O_2
(B) Antiferromagnetic	(2) CrO_2
(C) Ferrimagnetic	(3) MnO
(D) Paramagnetic	(4) Fe_3O_4
	(5) C_6H_6

	A	B	C	D
(a)	3	2	4	1
(b)	2	3	4	1
(c)	1	3	5	4
(d)	4	2	3	5

59. The vapour pressure of pure benzene and toluene are 160 and 60 mm Hg respectively. The mole fraction of benzene in vapour phase in contact with equimolar solution of benzene and toluene is

(a) 0.073 (b) 0.027
(c) 0.27 (d) 0.73

60. 6 g of a non-volatile, non-electrolyte X dissolved in 100 g of water freezes at $-0.93^{\circ}C$. The molar mass of X in $gmol^{-1}$ is (K_f of $H_2O = 1.86\ K\ kg\ mol^{-1}$)

(a) 60 (b) 140
(c) 180 (d) 120

61. The products obtained at the cathode and anode respectively during the electrolysis of aqueous K_2SO_4 solution using platinum electrodes are

(a) O_2, H_2 (b) H_2, O_2
(c) H_2, SO_2 (d) K, SO_2

62. The slope of the graph drawn between ln k and $\frac{1}{T}$ as per Arrhenius, equation gives the value (R = gas constant, E_α = Activation energy)

(a) $\frac{R}{E_a}$ (b) $\frac{E_a}{R}$
(c) $\frac{-E_a}{R}$ (d) $\frac{-R}{E_a}$

63. Which of the following statements is not correct in respect of chemisorption?

(a) Highly specific adsorption
(b) Irreversible adsorption
(c) Multilayered adsorption
(d) High enthalpy of adsorption

64. Which of the following is a carbonate ore?

(a) Cuprite (b) Siderite
(c) Zincite (d) Bauxite

65. Which one of the following statements is not correct?

(a) O_3 is used as a germicide
(b) In $O_3, O-O$ bond length is identical with that of molecular oxygen
(c) O_3 is an oxidising agent
(d) The shape of O_3 molecule is angular

66. Which of the following reactions does not take place?

(a) $F_2 + 2Cl^- \longrightarrow 2\ F^- + Cl_2$
(b) $Br_2 + 2I^- \longrightarrow 2Br^- + I_2$
(c) $Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2$
(d) $Cl_2 + 2\ F^- \longrightarrow 2Cl^- + F_2$

67. Which of the following statements regarding sulphur is not correct?

(a) At about 1000 K , it mainly consists of S_2 molecules
(b) The oxidation state of sulphur is never less than +4 in its compounds
(c) S_2 molecule is paramagnetic
(d) Rhombic sulphur is readily soluble in CS_2

68. Which of the following reactions does not involve liberation of oxygen?

(a) $XeF_4 + H_2O \longrightarrow$
(b) $XeF_4 + O_2\ F_2 \longrightarrow$
(c) $XeF_2 + H_2O \longrightarrow$
(d) $XeF_6 + H_2O \longrightarrow$

69. Select the correct IUPAC name of $[Co(NH_3)_5(CO_3)]Cl$.

(a) Penta ammoniacarbonate cobalt (III) chloride
(b) Pentaamminecarbonatecobalt chloride
(c) Pentaamminecarbonatocobalt (III) chloride
(d) Cobalt (III) pentaamminecarbonate chloride

70. Which of the following characteristics of the transition metals is associated with their catalytic activity?

(a) Colour of hydrated ions
(b) Diamagnetic behaviour

(c) Paramagnetic behaviour
(d) Variable oxidation states

71. Observe the following polymers.

I. PḢBV II. Nylon-2-nylon-6
III. Glyptal IV. Bakelite
Biodegradable polymer(s) from the above is/are

(a) III (b) I and II
(c) IV (d) III and IV

72. Observe the following statements.

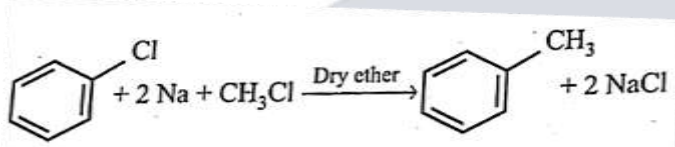
(I) Sucrose has glycosidic linkage.
(II) Cellulose is present in both plants and animals.
(III) Lactose contains D-galactose and D-glucose units.
Which of the following statements are correct?

(a) (I), (II) and (III) (b) (I) and (II)
(c)_(II) and (III) (d) (I) and (III)

73. Identify the antioxidant used in foods.

(a) Aspartame
(b) Sodium benzoate
(c) ortho-sulphobenzimide
(d) Butylated hydroxy toluene

74.



This reaction is known as

(a) Wurtz-Fittig reaction
(b) Wurtz reaction
(c) Fittig reaction
(d) Friedel-Crafts reaction

75. What is Z in the following sequence of reaction? 2-methyl-2-bromopropane $\xrightarrow[\text{Dry ether}]{Mg} X \xrightarrow{H_2O} Z$

(a) Propane (b) 2-methyl propene
(c) 2-methyl propane (d) 2-methyl butane

76. In which of the following reactions, the product is not correct?

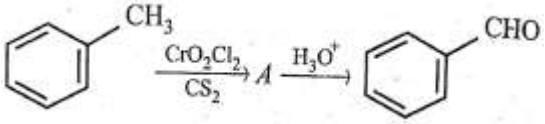
(a) $CH_3CHO \xrightarrow{LiAlH_4} CH_3CH_2OH$

(b) $CH_3COCH_3 \xrightarrow[HCl]{Zn-Hg} CH_3 - \underset{\displaystyle OH}{\underset{|}{OH}} - CH_3$

(c) $CH_3CH_2CHO \xrightarrow[(ii)KOH,Ethylene\ glycol/\Delta]{(i)H_2N-NH_2} CH_3CH_2CH_3$

(d) $CH_3CH_2CHO \xrightarrow{KMnO_4} CH_3CH_2COOH$

77. Identify the name of the following reaction.



(a) Gattermann Koch reaction
(b) Gattermann reaction
(c) Stephen reaction
(d) Etard reaction

78. What is C in the following sequence of reaction?

$CH_3OH \xrightarrow{PCl_3} A \xrightarrow{KCN} B \xrightarrow{Hydrolysis} C$

(a) CH_3CH_2OH (b) CH_3CHO

(c) CH_3COOH (d) $HOCH_2 - CH_2OH$

79. The order of basic strength of the following in aqueous solution is

(I) $C_6H_5NH_2$ (II) $(CH_3)_3\ N$

(III) NH_3 (IV) CH_3NH_2

(V) $(CH_3)_2NH$

(a) IV > I > V > III > II

(b) II > V > IV > III > I

(c) V > IV > II > III > I

(d) IV > III > V > II > I

80. Yellow dye can be prepared by a coupling reaction of benzene diazonium chloride in acidic medium with X. Identify X from the following.

(a) Aniline (b) Phenol

(c) Cumene (d) Benzene

Mathematics

81. The domain of the function $f(x) = \sqrt{\log_{0.5} x!}$ is

(a) {0,1,2,3, ... } (b) {1,2,3, ... }

(c) $(0, \infty)$ (d) {0,1}

82. If $f(x) = |x-1| + |x-2| + |x-3|, 2 < x < 3$, then f is

(a) an onto function but not one-one

(b) one-one function but not onto

(c) a bijection

(d) neither one-one nor onto

83. The greatest positive integer which divides $(n+16)(n+17)(n+18)(n+19)$, for all positive integers n, is

(a) 6 (b) 24 (c) 28 (d) 20

84. If a, b, c are distinct positive real numbers, then the value of the determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is

(a) < 0 (b) > 0

(c) 0 (d) ≥ 0

85. If x_1, x_2, x_3 as well as y_1, y_2, y_3 are in geometric progression with the same common ratio, then the points (x_1, y_1), $(x_2, y_2), (x_3, y_3)$ are

(a) vertices of an equilateral triangle

(b) vertices of a right angled triangle

(c) vertices of a right angled isosceles triangle

(d) collinear

86. The equations $x - y + 2z = 4, 3x + y + 4z = 6\ x + y + z = 1$ have

(a) unique solution

(b) infinitely many solutions

(c) no solution

(d) Two solution

87. The locus of the point representing the complex number z for which $|z+3|^2 - |z-3|^2 = 15$ is

(a) a circle (b) a parabola

(c) a straight line (d) an ellipse

88. $\frac{(1+i)^{2016}}{(1-i)^{2014}}$ is equal to

(a) $-2i$ (b) $2i$

(c) 2 (d) -2

89. If $|z_1| = 1, |z_2| = 2, |z_3| = 3$ and $|9z_1z_2 + 4z_1z_3 + z_2z_3| = 12$, then the value of $|z_1 + z_2 + z_3|$ is
(a) 3 (b) 4 (c) 8 (d) 2

90. If $1, z_1, z_2, \ldots, z_{n-1}$ are the nth roots of unity, then $(1 - z_1)(1 - z_2) \ldots (1 - z_{n-1})$ is equal to
(a) 0 (b) $n - 1$
(c) n (d) 1

91. If $12^{4+2x^2} = (24\sqrt{3})^{3x^2-2}$, then x is equal to
(a) $\pm\sqrt{\frac{13}{12}}$ (b) $\pm\sqrt{\frac{14}{5}}$
(c) $\pm\sqrt{\frac{12}{13}}$ (d) $\pm\sqrt{\frac{5}{14}}$

92. The product and sum of the roots of the equation $|x^2| - 5|x| - 24 = 0$ are respectively
(a) $-64, 0$ (b) $-24, 5$
(c) $5, -24$ (d) $0, 72$

93. The number of real roots of the equation $x^5 + 3x^3 + 4x + 30 = 0$ is
(a) 1 (b) 2 (c) 3 (d) 5

94. If the coefficients of the equation whose roots are k times the roots of the equation, $x^3 + \frac{1}{4}x^2 - \frac{1}{16}x + \frac{1}{144} = 0$ are integers, then a possible value of k is
(a) 3 (b) 12 (c) 9 (d) 4

95. The sum of all 4-digit numbers that can be formed using. the digits $2, 3, 4, 5, 6$ with-out repetition, is
(a) 533820 (b) 532280
(c) 533280 (d) 532380

96. If a set A has 5 elements, then the number of ways of selecting two subsets P and Q from A such that P and Q are mutually disjoint, is
(a) 64 (b) 128
(c) 243 (d) 729

97. The coefficient of x^4 in the expansion of $(1 - x + x^2 - x^3)^4$ is
(a) 31 (b) 30 (c) 25 (d) -14

98. If the middle term in the expansion of $(1 + x)^2n$ is the greatest term, then x lies in the interval
(a) $\left(\frac{n}{n+1}, \frac{n+1}{n}\right)$ (b) $\left(\frac{n+1}{n}, \frac{n}{n+1}\right)$
(c) $(n - 2, n)$ (d) $(n - 1, n)$

99. To find the coefficient of x^4 in the expansion of $\frac{3x}{(x-2)(x-1)}$, the interval in which the expansion is valid, is
(a) $-2 < x < \infty$ (b) $-\frac{1}{2} < x < \frac{1}{2}$
(c) $-1 < x < 1$ (d) $-\infty < x < \infty$

100. If $(1 + \tan\alpha)(1 + \tan 4\alpha) = 2, \alpha \in \left(0, \frac{\pi}{16}\right)$, then α is equal to
(a) $\frac{\pi}{20}$ (b) $\frac{\pi}{30}$ (c) $\frac{\pi}{40}$ (d) $\frac{\pi}{60}$

101. If $\cos\theta = \frac{\cos\alpha - \cos\beta}{1 - \cos\alpha\cos\beta}$, then one of the values of $\tan\frac{\theta}{2}$ is
(a) $\cot\frac{\beta}{2}\tan\frac{\alpha}{2}$ (b) $\tan\alpha\tan\frac{\beta}{2}$
(c) $\tan\frac{\beta}{2}\cot\frac{\alpha}{2}$ (d) $\tan^2\frac{\alpha}{2}\tan^2\frac{\beta}{2}$

102. The value of the expression $\frac{1+\sin 2\alpha}{\cos(2\alpha - 2\pi)\tan\left(\alpha - \frac{3\pi}{4}\right)} - \frac{1}{4}\sin 2\alpha\left[\cot\frac{\alpha}{2} + \cot\left(\frac{3\pi}{2} + \frac{\alpha}{2}\right)\right]$ is
(a) 0 (b) 1
(c) $\sin^2\frac{\alpha}{2}$ (d) $\sin^2\alpha$

103. If $\frac{1}{6}\sin\theta, \cos\theta$ and $\tan\theta$ are in geometric progression, then the solution set of θ is

(a) $2n\pi \pm \left(\frac{\pi}{6}\right)$ (b) $2n\pi \pm \left(\frac{\pi}{3}\right)$

(c) $n\pi + 1(-1)^n\left(\frac{\pi}{3}\right)$ (d) $n\pi + \left(\frac{\pi}{3}\right)$

104. If $x = \sin\left(2\tan^{-1}2\right)$ and $y = \sin\left(\frac{1}{2}\tan^{-1}\frac{4}{3}\right)$, then

(a) $x > y$ (b) $x = y$

(c) $x = 0 = y$ (d) $x < y$

105. If $\cosh(x) = \frac{5}{4}$, then $\cosh(3x)$ is equal to

(a) $\frac{61}{16}$ (b) $\frac{63}{16}$ (c) $\frac{65}{16}$ (d) $\frac{61}{63}$

106. In $\triangle ABC$ if $x = \tan\left(\frac{B-C}{2}\right)\tan\frac{A}{2}$, $y = \tan\left(\frac{C-A}{2}\right)\tan\frac{B}{2}$, and $z = \tan\left(\frac{A-B}{2}\right)\tan\frac{C}{2}$, then $(x + y + z)$ is equal to

(a) xyz (b) $-xyz$

(c) 2xyz (d) $\frac{1}{2}xyz$

107. In $\triangle ABC$, if the sides a, b, c are in geometric progression and the largest angle exceeds the smallest angle by $60°$, then cos B is equal to

(a) $\frac{\sqrt{13}+1}{4}$ (b) $\frac{1-\sqrt{13}}{4}$

(c) 1 (d) $\frac{\sqrt{13}-1}{4}$

108. In a $\triangle ABC$, if $\angle A = 90°$, then $\cos^{-1}\left(\frac{R}{r_2+r_3}\right)$ is equal to

(a) $90°$ (b) $30°$

(c) $60°$ (d) $45°$

109. The cartesian equation of the plane whose vector equation is $\gamma = (1 + \lambda - \mu)\hat{i} + (2 - \lambda)\hat{j} + (3 - 2\lambda + 2\mu)\hat{k}$ where λ, μ are scalars, is

(a) $2x + y = 5$ (b) $2x - y = 5$

(c) $2x - z = 5$ (d) $2x + z = 5$

110. For three vectors p, q and r, if $r = 3p + 4q$ and $2r = p - 3q$, then

(a) $|r| < 2|q|$ and r, q have the same direction

(b) $|r| > 2|q|$ and r, q have opposite directions

(c) $|r| < 2|q|$ and r, q have opposite directions

(d) $|r| > 2|q|$ and r, q have the same direction

111. If $a = 2\hat{i} + 3\hat{j} - 5\hat{k}$, $b = m\hat{i} + n\hat{j} + 12\hat{k}$ and $a \times b = 0$, then (m, n) is equal to

(a) $\left(\frac{-24}{5}, \frac{-36}{5}\right)$ (b) $\left(\frac{-24}{5}, \frac{36}{5}\right)$

(c) $\left(\frac{24}{5}, \frac{-36}{5}\right)$ (d) $\left(\frac{24}{5}, \frac{36}{5}\right)$

112. If $|a| = 3, |b| = 4$ and the angle between a and b is $120°$, then $|4a + 3b|$ is equal to

(a) 25 (b) 7 (c) 13 (d) 12

113. If a, b, c are non-zero vectors such that $(a \times b) \times c = \frac{1}{3}|b \| c|a, c \perp a$ and θ is the angle between the vectors b and c, then $\sin\theta$ is equal to

(a) $\frac{2\sqrt{2}}{3}$ (b) $\frac{1}{3}$

(c) $\frac{\sqrt{2}}{3}$ (d) $\frac{2}{3}$

114. If $a(\alpha \times \beta) + b(\beta \times \gamma) + c(\gamma \times \alpha) = 0$ and atleast one of the scalars a, b, c is non-zero, then the vectors α, β, γ are

(a) parallel

(b) non coplanar

(c) coplanar
(d) mutually perpendicular

115. If the mean of 10 observations is 50 and the sum of the squares of the deviations of the observations from the mean is 250 , then the coefficient of variation of those observations is

(a) 25 (b) 50 (c) 10 (d) 5

116. The variance of the first 50 even natural numbers is

(a) $\frac{833}{4}$ (b) 833

(c) 437 (d) $\frac{437}{4}$

117. 3 out of 6 vertices of a regular hexagon are chosen at a time at random. The probability that the triangle formed with these three vertices is an equilateral triangle, is

(a) $\frac{1}{2}$ (b) $\frac{1}{5}$ (c) $\frac{1}{10}$ (d) $\frac{1}{20}$

118. A speaks truth in 75% of the cases and B in 80% of the cases. Then, the probability that their statements about an incident do not match, is

(a) $\frac{7}{20}$ (b) $\frac{3}{20}$ (c) $\frac{2}{7}$ (d) $\frac{5}{7}$

119. If the mean and variance of a binomial distribution are 4 and 2 respectively, then the probability of 2 successes of that binomial variate X, is

(a) $\frac{1}{2}$ (b) $\frac{219}{256}$ (c) $\frac{37}{256}$ (d) $\frac{7}{64}$

120. In a city, 10 accidents take place in a span of 50 days. Assuming that the number of accidents follow the Poisson distribution, the probability that three or more accidents occur in a day, is

(a) $\sum_{k=3}^{\infty} \frac{e^{-\lambda}\lambda^k}{k!}, \lambda = 0.2$

(b) $\sum_{k=3}^{\infty} \frac{e^{\lambda}\lambda^k}{k!}, \lambda = 0.2$

(c) $1 - \sum_{k=0}^{3} \frac{e^{-\lambda}\lambda^k}{k!}, \lambda = 0.2$

(d) $\sum_{k=0}^{3} \frac{e^{-\lambda}\lambda^k}{k!}, \lambda = 0.2$

121. Equation of the locus of the centroid of the triangle whose vertices are $(a\cos k, a\sin k)$, $(b\sin k, -b\cos k)$ and $(1, 0)$, where k is a parameter, is

(a) $(1-3x)^2 + 9y^2 = a^2 + b^2$
(b) $(3x-1)^2 + 9y^2 = 2a^2 + 2b^2$
(c) $(3x+1)^2 + (3y)^2 = a^2 + b^2$
(d) $(3x+1)^2 + (3y)^2 = 3a^2 + 3b^2$

122. If the coordinate axes are rotated through an angle $\frac{\pi}{6}$ about the origin, then the transformed equation of $\sqrt{3}x^2 - 4xy + \sqrt{3}y^2 = 0$ is

(a) $\sqrt{3}y^2 + xy = 0$
(b) $x^2 - y^2 = 0$
(c) $\sqrt{3}y^2 - xy = 0$
(d) $\sqrt{3}y^2 - 2xy = 0$

123. If the lines $x + 3y - 9 = 0, 4x + by - 2 = 0$ and $2x - y - 4 = 0$ are concurrent, then the equation of the line passing through the point $(b, 0)$ and concurrent with the given lines, is

(a) $2x + y + 10 = 0$
(b) $4x - 7y + 20 = 0$.
(c) $x - y + 5 = 0$
(d) $x - 4y + 5 = 0$

124. The mid-point of the line segment joining the centroid and the ortho centre of the triangle whose vertices are (a, b), (a, c) and (d, c), is

(a) $\left(\frac{5a+d}{6}, \frac{b+5c}{6}\right)$ (b) $\left(\frac{a+5d}{6}, \frac{5b+c}{6}\right)$

(c) (a, c) (d) $(0,0)$

125. The distance from the origin to the image of $(1, 1)$ with respect to the line $x + y + 5 = 0$ is

(a) $7\sqrt{2}$ (b) $3\sqrt{2}$

(c) $6\sqrt{2}$ (d) $4\sqrt{2}$

126. The equation of the pair of lines joining the origin to the points of intersection of $x^2 + y^2 = 9$ and $x + y = 3$, is

(a) $x^2 + (3 - y)^2 = 9$

(b) $(3 + y)^2 + y^2 = 9$

(c) $x^2 - y^2 = 9$

(d) $xy = 0$

127. The ortho-centre of the triangle formed by the lines $x + y = 1$ and $2y^2 - xy - 6x^2 = 0$ is

(a) $\left(\frac{4}{3}, \frac{4}{3}\right)$ (b) $\left(\frac{2}{3}, \frac{2}{3}\right)$

(c) $\left(\frac{2}{3}, \frac{-2}{3}\right)$ (d) $\left(\frac{4}{3}, \frac{-4}{3}\right)$

128. Let L be the line joining the origin to the point of intersection of the lines represented by $2x^2 - 3xy - 2y^2 + 10x + 5y = 0$. If L is perpendicular to the line $kx + y + 3 = 0$, then k is equal to

(a) $\frac{1}{2}$ (b) $-\frac{1}{2}$ (c) -1 (d) $\frac{1}{3}$

129. A circle $S = 0$ with radius $\sqrt{2}$ touches the line $x + y - 2 = 0$ at $(1, 1)$. Then, the length of the tangent drawn from the point (1,2) to $S = 0$ is

(a) 1 (b) $\sqrt{2}$ (c) $\sqrt{3}$ (d) 2

130. The normal drawn at $P(-1, 2)$ on the circle $x^2 + y^2 - 2x - 2y - 3 = 0$ meets the circle at another point Q. Then, the coordinates of Q are

(a) (3,0) (b) $(-3,0)$

(c) (2,0) (d) $(-2,0)$

131. If the lines $kx + 2y - 4 = 0$ and $5x - 2y - 4 = 0$ are conjugate with respect to the circle $x^2 + y^2 - 2x - 2y + 1 = 0$, then k is equal to

(a) 0 (b) 1 (c) 2 (d) 3

132. The angle between the tangents drawn from the origin to the circle $x^2 + y^2 + 4x - 6y + 4 = 0$ is

(a) $\tan^{-1}\left(\frac{5}{13}\right)$ (b) $\tan^{-1}\left(\frac{5}{12}\right)$

(c) $\tan^{-1}\left(\frac{-12}{2}\right)$ (d) $\tan^{-1}\left(\frac{13}{2}\right)$

133. If the angle between the circles $x^2 + y^2 - 2x - 4y + c = 0$ and $x^2 + y^2 - 4x - 2y + 4 = 0$ is $60°$, then c is equal to

(a) $\frac{3\pm\sqrt{5}}{2}$ (b) $\frac{6\pm\sqrt{5}}{2}$

(c) $\frac{9\pm\sqrt{5}}{2}$ (d) $\frac{7\pm\sqrt{5}}{2}$

134. A circle S cuts three circles $x^2 + y^2 - 4x - 2y + 4 = 0$, $x^2 + y^2 - 2x - 4y + 1 = 0$ and $x^2 + y^2 + 4x + 2y + 1 = 0$ orthogonally. Then, the radius of S is

(a) $\sqrt{\frac{29}{8}}$ (b) $\sqrt{\frac{28}{11}}$

(c) $\sqrt{\frac{29}{7}}$ (d) $\sqrt{\frac{29}{5}}$

135. The distance between the vertex and the focus of the parabola $x^2 - 2x + 3y - 2 = 0$ is

(a) $\frac{4}{5}$ (b) $\frac{3}{4}$ (c) $\frac{1}{2}$ (d) $\frac{5}{6}$

136. If (x_1, y_1) and (x_2, y_2) are the end points of a focal chord of the parabola $y^2 = 5x$, then $4x_1x_2 + y_1y_2$ is equal to

(a) 25 (b) 5 (c) 0 (d) $\frac{5}{4}$

137. The distance between the focii of the ellipse $x = 3\cos\theta, y = 4\sin\theta$ is

(a) $2\sqrt{7}$ (b) $7\sqrt{2}$

(c) $\sqrt{7}$ (d) $3\sqrt{7}$

138. The equations of the latus rectum of the ellipse $9x^2 + 25y^2 - 36x + 50y - 164 = 0$ are

(a) $x - 4 = 0, x + 2 = 0$

(b) $x - 6 = 0, x + 2 = 0$

(c) $x + 6 = 0, x - 2 = 0$

(d) $x + 4 = 0, x + 5 = 0$

139. The values of m for which the line $y = mx + 2$ becomes a tangent to the hyperbola $4x^2 - 9y^2 = 36$ is

(a) $\pm\frac{2}{3}$ (b) $\pm\frac{2\sqrt{2}}{3}$

(c) $\pm\frac{8}{9}$ (d) $\pm\frac{4\sqrt{2}}{3}$

140. The harmonic conjugate of $(2, 3, 4)$ with respect to the points $(3, -2, 2), (6, -17, -4)$ is

(a) $\left(\frac{1}{2}, \frac{1}{3}, \frac{1}{4}\right)$ (b) $\left(\frac{18}{5}, -5, \frac{4}{5}\right)$

(c) $\left(\frac{-18}{5}, \frac{5}{4}, \frac{4}{5}\right)$ (d) $\left(\frac{18}{5}, -5, \frac{-4}{5}\right)$

141. If a line makes angles α, β, γ and δ with the four diagonals of a cube, then the value of $\sin^2\alpha + \sin^2\beta + \sin^2\gamma + \sin^2\delta$ is

(a) $\frac{4}{3}$ (b) $\frac{8}{3}$ (c) $\frac{7}{3}$ (d) $\frac{5}{3}$

142. If the plane $56x + 4y + 9z = 2016$ meets the coordinate axes in A, B, C, then the centroid of the $\triangle ABC$ is

(a) (12,168,224) (b) (12,168,112)

(c) $\left(12, 168, \frac{224}{3}\right)$ (d) $\left(12, -168, \frac{224}{3}\right)$

143. The value (s) of x for which the function $f(x) = \begin{cases} 1 - x, & x < 1 \\ (1 - x)(2 - x), & 1 \le x \le 2 \\ 3 - x, & x > 2 \end{cases}$

fails to be continuous is(are)

(a) 1

(b) 2

(c) 3

(d) all real numbers

144. $\lim_{x\to 0} \frac{6^x - 3^x - 2^x + 1}{x^2}$ is equal to

(a) $(\log_e 2)\log_e 3$ (b) $\log_e 5$

(c) $\log_e 6$ (d) 0

145. Define $f(x) = \begin{cases} x^2 + bx + c, & x < 1 \\ x, & x \ge 1 \end{cases}$. If $f(x)$ is differentiable at $x = 1$, then $(b - c)$ is equal to

(a) -2 (b) 0 (c) 1 (d) 2

146. If $x = a$ is a root of multiplicity two of a polynomial equation $f(x) = 0$, then

(a) $f'(a) = f''(a) = 0$

(b) $f''(a) = f(a) = 0$

(c) $f'(a) \neq 0 \neq f''(a)$

(d) $f(a) = f'(a) = 0; f''(a) \neq 0$

147. If $y = \log_2(\log_2 x)$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{\log_e 2}{x\log_e x}$ (b) $\frac{1}{\log_e(2x)^x}$

(c) $\frac{1}{(x\log_e x)\log_e 2}$ (d) $\frac{1}{x(\log_2 x)^2}$

148. The angle of intersection between the curves $y^2 + x^2 = a^2\sqrt{2}$ and $x^2 - y^2 = a^2$ is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{12}$

149. If $A > 0, B > 0$ and $A + B = \frac{\pi}{3}$, then the maximum value of $\tan A \tan B$ is

(a) $\frac{1}{\sqrt{3}}$ (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) $\sqrt{3}$

150. The equation of the common tangent drawn to the curves $y^2 = 8x$ and $xy = -1$ is

(a) $y = 2x + 1$ (b) $2y = x + 6$

(c) $y = x + 2$ (d) $3y = 8x + 2$

151. Suppose $f(x) = x(x+3)(x-2), x \in [-1, 4]$. Then, a value of c in $(-1, 4)$ satisfying $f'(c) = 10$ is

(a) 2 (b) $\frac{5}{2}$ (c) 3 (d) $\frac{7}{2}$

152. If $\int x^3 e^{5x} dx = \frac{e^{5x}}{5^4}[f(x)] + C$, then $f(x)$ is equal to

(a) $\frac{x^3}{5} - \frac{3x^2}{5^2} + \frac{6x}{5^3} - \frac{6}{5^4}$

(b) $5x^3 - 5^2x^2 + 5^3x - 6$

(c) $5^2x^3 - 15x^2 + 30x - 6$

(d) $5^3x^3 - 75x^2 + 30x - 6$

153. $\int \frac{x}{(x^2+2x+2)^2} dx$ is equal to

(a) $\frac{x^2+2}{x^2+2x+2} - \frac{1}{2}\tan^{-1}(x+1) + C$

(b) $\frac{x^2+2}{2(x^2+2x+2)} - \frac{1}{2}\tan^{-1}(x-1) + C$

(c) $\frac{x^2-2}{4(x^2+2x+2)} - \frac{1}{2}\tan^{-1}(x+1) + C$

(d) $\frac{2(x-1)}{(x^2+2x+2)} + \frac{1}{2}\tan^{-1}(x+1) + C$

154. If $\int \log(a^2 + x^2) dx = h(x) + C$, then $h(x)$ is equal to

(a) $x\log(a^2 + x^2) + 2\tan^{-1}\left(\frac{x}{a}\right)$

(b) $x^2\log(a^2 + x^2) + x + a\tan^{-1}\left(\frac{x}{a}\right)$

(c) $x\log(a^2 + x^2) - 2x + 2a\tan^{-1}\left(\frac{x}{a}\right)$

(d) $x^2\log(a^2 + x^2) + 2x - a^2\tan^{-1}\left(\frac{x}{a}\right)$

155. For $x > 0$, if $\int (\log x)^5 dx$ is equal to $x[A(\log x)^5 + B(\log x)^4 + C(\log x)^3 + D(\log x)^2 + E(\log x) + F] +$ constant, then $A + B + C + D + E + F$ is equal to

(a) -44 (b) -42 (c) -40 (d) -36

156. The area included between the parabola $y = \frac{x^2}{4a}$ and the curve $y = \frac{8a^3}{(x^2+4a^2)}$ is

(a) $a^2\left(2\pi + \frac{2}{3}\right)$ (b) $a^2\left(2\pi - \frac{8}{3}\right)$

(c) $a^2\left(\pi + \frac{4}{3}\right)$ (d) $a^2\left(2\pi - \frac{4}{3}\right)$

157. By the definition of the definite integral, the value of $\lim_{n\to\infty}\left(\frac{1}{\sqrt{n^2-1}} + \frac{1}{\sqrt{n^2-2^2}} + \cdots + \frac{1}{\sqrt{n^2-(n-1)^2}}\right)$ is equal to

(a) π (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

158. $\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \left(\frac{x+\frac{\pi}{4}}{2-\cos 2x}\right) dx$ **is equal to**

(a) $\frac{8\pi\sqrt{3}}{5}$ (b) $\frac{2\pi\sqrt{3}}{9}$

(c) $\frac{4\pi^2\sqrt{3}}{9}$ (d) $\frac{\pi^2}{6\sqrt{3}}$

159. The solution of the differential equation $(1+y^2)+(x-e^{\tan})\frac{dy}{dx}=0$**, is**

(C is an arbitrary constant)

(a) $xe^{\tan^{-1}y} = \tan^{-1}y + C$

(b) $xe^{2\tan^{-1}y} = e^{-\tan^{-1}y} + C$

(c) $2xe^{\tan^{-1}y} = e^{2\tan^{-1}y} + C$

(d) $x^2e^{\tan^{-1}y} = 4e^{2\tan^{-1}y} + C$

160. The solution of the differential equation $(2x-4y+3)\frac{dy}{dx}+(x-2y+1)=0$ **is**

(C is an arbitrary constant)

(a) $\log[(2x-4y)+3] = x-2y+C$

(b) $\log[2(2x-4y)+3] = 2(x-2y)+C$

(c) $\log[2(x-2y)+5] = 2(x+y)+C$

(d) $\log[4(x-2y)+5] = 4(x+2y)+C$