

PHYSICS

- A simple pendulum has a period T inside a lift, when it is stationary. The lift is accelerated upwards with constant acceleration a . The period
 - decreases
 - increases
 - remains same
 - becomes infinite
- 90 dB sound is x times more intense than 40 dB sound, then x is
 - 5
 - 50
 - 10^5
 - 500
- A star is moving away from the earth with speed v . Change in wavelength $d\lambda$ observed on earth is
 - $\lambda v/c$
 - $\lambda v/(c + v)$
 - $\lambda c/(c + v)$
 - $\lambda c/v$
- An open pipe emits a fundamental frequency n when it emits the 3rd harmonic, then the pipe can accommodate
 - 2 nodes, 2 anti-nodes
 - 3 nodes, 4 anti-nodes
 - 3 nodes, 3 anti-nodes
 - 1 node, 2 anti-nodes
- In an adiabatic process,
 - temperature remains constant
 - pressure remains constant
 - volume remains constant
 - there is no transfer of heat
- Carnot heat engine takes 300 J of heat from a source at 627°C and gives some part of it to sink at 27°C . Work done by engine in one cycle is
 - 200 J
 - 300 J
 - 150 J
 - 120 J
- 15/16 th of a radioactive sample disintegrates in 2 h . Mean life of radioactive sample is approximately
 - 30 min
 - 43 min
 - 21 min
 - 15 min
- Clear images of soft tissues can be well studied using
 - MRI
 - X-rays
 - ultrasonics
 - IR rays
- Particles which are not composite and hence truly elementary are
 - mesons
 - protons
 - neutrons
 - leptons
- A logic gate whose output will be in logic 0 state only, when all inputs are in logic 1 state is called
 - AND
 - OR
 - NOR
 - NAND
- n-type and p-type semiconductors can be obtained by doping pure silicon, respectively with
 - arsenic, phosphorous
 - indium, aluminium
 - phosphorous, indium
 - aluminium, boron
- In a CE amplifier, $\beta = 50$, $R_L = 4\text{k}\Omega$, $R_i = 500\Omega$. Power gain of the amplifier is
 - 2×10^4
 - 2×10^2
 - 2×10^3
 - 2×10^1
- Electrons are excited from $n = 1$ to $n = 4$ state. During downward transitions, possible number of spectral lines observed in Balmer series is

- (a)4 (b)3
(c)2 (d)1

14. IR region lies between

- (a) radiowaves and microwave regions
(b) microwaves and visible
(c) visible and UV region
(d) UV rays and X-ray region

15. A proton and an alpha particle are subjected to same potential difference V. Their de-Broglie wavelengths $\lambda_p, \lambda_\alpha$ will be in the ratio

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

16. Raman shift depends on

- (a) incident wavelength
(b) incident intensity
(c) resolving power of the spectrograph used
(d) molecular energy levels of the scatterer

17. ${}_6\text{C}^{14}$ and ${}_7\text{N}^{15}$ are the examples of

- (a) isotopes (b) isobars
(c) isotones (d) mirror nuclei

18. In an interference experiment, intensity ratio at the bright to dark fringe is 9:1. Amplitudes of interfering waves are in the ratio

- (a) 3:1 (b) 9:1
(c) 2:1 (d) 4:1

19. In Young's double slit experiment, 1st dark fringe occurs directly opposite to a slit.

Wavelength of light used is

- (a) d^2/D (b) d/D
(c) D^2/d (d) $2d^2/D$

20. Newton's ring pattern in reflected system, viewed under white light consists of

- (a) equally spaced bright and dark bands with central dark spot
(b) equally spaced bright and dark bands with central white spot
(c) a few coloured rings with central dark spot
(d) a few coloured rings with central white spot

21. It is difficult to observe diffraction in case of light waves, because

- (a) light waves can travel through vacuum
(b) speed of light is more
(c) light waves are transverse in nature
(d) wavelength of light is small

22. A calcite crystal is placed over a dot on a paper sheet and the crystal is rotated. On viewing through the calcite one sees,

- (a) a single stationary dot
(b) two stationary dots
(c) two dots rotating about one another
(d) one dot rotating about the other stationary dot sometimes coinciding with it

23. Critical angle of the medium is 45° . Polarising angle of incidence at the surface of the medium is

- (a) 45° (b) 38°
(c) 22.5° (d) 54.7°

24. If only 2% of the main current is to be passed through a galvanometer of resistance G, then the resistance of shunt should be

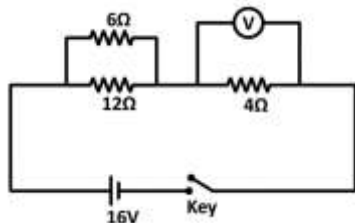
- (a)G/50 (b)G/49
(c)50 G (d)49G
25. A small current carrying loop of area A behaves like a tiny magnet of magnetic moment M . Current in the loop is
(a)MA (b)A/M
(c) A^2M (d)M/A
26. Two concentric circular coils, each having 10 turns with radii 0.2 m and 0.4 m carry currents 0.2 A and 0.3 A respectively in opposite directions. Magnetic field at the centre is
(a) $(2/3)\mu_0$ (b) $(5/4)\mu_0$
(c) $(1/4)\mu_0$ (d) $(1/6)\mu_0$
27. Material of permanent magnet has
(a)high retentivity and high coercivity
(b)low retentivity and high coercivity
(c)low retentivity and low coercivity
(d)high retentivity and low coercivity
28. Power factor of a series L – C – R circuit is
(a)R (b)Z/R
(c)R/Z (d)RZ
29. An inductor 1 H is connected across 220 V , 50 Hz supply. Peak value of current is approximately
(a)0.5 A (b)0.7 A
(c)1 A (d)1.4 A
30. Plane polarised light is passed through an analyser and the intensity of emerging light is reduced by 75%. Optical vibrations make an angle θ with the axis of analyser, then θ is
(a) 60° (b) 45°
(c) 30° (d) 58°
31. A charge 10nC is situated in a medium of relative permittivity 10 . The potential due to this charge at a distance of 0.1 m is
(a)900 V (b)90 V
(c)9 V (d)0.09 V
32. Dielectric constant of a metal is
(a)zero (b)infinite
(c)finite (d)unpredictable
33. Distance between the two point charges is increased by 20%. Force of interaction between the charges
(a)increases by 10% (b)decreases by 20%
(c)decreases by 17% (d)decreases by 31%
34. Potential energy of 2 charge 10 nC each separated by a distance of 0.09 m in air is
(a) $10\mu\text{ J}$ (b)1 mJ
(c)10 mJ (d)10 J
35. A metal plate of thickness $d/2$ is introduced in between the plates of a parallel plate air capacitor with plate separation of d , then capacity
(a)decreases 2 times (b)increases 2 times
(c)remains same (d)becomes zero
36. Specific resistance of a conductor material increases with
(a)increase with area of cross-section
(b)decrease in length
(c)decrease in area of cross-section
(d)increases with temperature
37. The resistance of mercury at 4.2 K is
(a)infinity

- (b) greater than at lab temperature
- (c) same as that of lab temperature
- (d) almost zero

38. Temperature coefficient of resistance of platinum is $4 \times 10^{-3}/K$ at $20^\circ C$. Temperature at which increase in resistance of platinum is 10% its value at $20^\circ C$ is

- (a) $25^\circ C$
- (b) $70^\circ C$
- (c) $45^\circ C$
- (d) $100^\circ C$

39. Ideal voltmeter connected as shown reads



- (a) 16 V
- (b) 12 V
- (c) 4 V
- (d) 8 V

40. When a charged particle moves perpendicular to a uniform magnetic field, then

- (a) its momentum changes and total energy is same
- (b) Both momentum and its total energy remain the same
- (c) Both momentum and its total energy will change
- (d) total energy changes but momentum remains same

41. 0.04 m of glass contains the same number of waves as 0.05 m of water, when monochromatic light passes through them normally. Refractive index of water is $4/3$. Refractive index of glass is

- (a) $5/3$
- (b) $5/4$
- (c) $5/2$
- (d) $4/5$

42. Critical angle will be maximum, when light travels from

- (a) glass to air
- (b) glass to water
- (c) water to air
- (d) diamond to air

43. A ray of light incident on one face of an equilateral prism at 60° enters and leaves the prism symmetrically. Refractive index of the prism material is

- (a) 1.5
- (b) 1.62
- (c) 1.73
- (d) 1.8

44. In the spectrum of visible light produced by a prism dispersion is

- (a) uniform throughout the spectrum
- (b) maximum in the middle decreases on either sides
- (c) maximum towards yellow
- (d) maximum towards violet

45. Convex lens of focal length f made of glass of refractive index 1.5 is immersed in water of refractive index $4/3$. Focal length is

- (a) f
- (b) greater than f
- (c) less than f
- (d) $-f$

46. Two co-axial lenses of power + 4D and - 2D are placed in contact. The focal length of combination is

- (a) 0.5 m
- (b) 0.25 m
- (c) 0.16 m
- (d) -0.5 m

47. Eddy currents are produced in a material, when it is

- (a) heated
- (b) placed in a time varying magnetic field
- (c) placed in an electric field
- (d) placed in a uniform magnetic field

48. Transformer works on 220 V and its efficiency is 80%. If output power is 8 kW , primary current is approximately
 (a)35 A (b)18 A
 (c)22 A (d)45 A
49. Quality factor of a series L-C-R circuit decreases from 3 to 2. Resonant frequency is 600 Hz . Change in bandwidth is
 (a)zero (b)100 Hz increase
 (c)100 Hz decrease (d)300 Hz increase
50. A stone dropped from the top of the tower reaches ground in 4 s . Height of the tower is ($g = 10 \text{ m/s}^2$)
 (a)20 m (b)40 m
 (c)60 m (d)80 m
51. Liquid crystal phase which are more close to the solid than to liquid is
 (a)Nematic (b)Smectic
 (c)Lyotropic (d)Cholesteric
52. If the earth shrinks in its size (radius) mass remaining the same, the value of g on its surface will
 (a)increase (b)decrease
 (c)remains same (d)reduce to zero
53. Two rods of same area of cross-section and lengths and conductivities K_1 and K_2 are connected in series. Then in steady state, conductivity of the combination is
 (a) $(K_1 + K_2)/(K_1 K_2)$ (b) $2K_1 K_2/(K_1 + K_2)$
 (c) $(K_1 + K_2)/2$ (d) $K_1 K_2/(K_1 + K_2)$
54. The square of the resultant of two equal forces acting at a point is equal to three times their product. Angle between them is
 (a) 30° (b) 45°
 (c) 60° (d) 90°
55. With the addition of impurities, surface tension of a liquid
 (a)increases
 (b)decreases
 (c)remains constant
 (d)may increase or decrease depending on impurities
56. Viscosity decreases with increase in temperature is the reason for
 (i) hot water moving faster than cold water.
 (ii) more viscous oils are used in motorcars during summer than in winter
 (a)Only (i) is correct (b)Only (ii) correct
 (c)Both are correct (d)Both are incorrect
57. Moment of momentum of an electron revolving in second Bohr orbit of hydrogen is
 (a) $2\pi h$ (b) $h/2\pi$
 (c) h/π (d) $2h/3\pi$
58. The existence of excitation and ionisation energies in an atom is an evidence for
 (a)stability of an atom
 (b)electrical neutrality of an atom
 (c)small size of the atom
 (d)stationary orbits in an atom
59. Work function of a photosensitive metal is 3 eV . The wavelength of incident radiations which can just eject photoelectrons from the metal is
 (a)600 nm (b)510 nm
 (c)414 nm (d)378 nm
60. Three identical capacitors are first connected in series and then in parallel. The ratio of effective capacitances in the two cases is

- (a) 9: 1 (b) 3: 1
(c) 1: 3 (d) 1: 9

CHEMISTRY

61. A nitrogen containing organic compound gave an oily liquid on heating with bromine and potassium hydroxide solution. On shaking the product with acetic anhydride, an antipyretic drug was obtained. The reactions indicate that the starting compound is
(a) acetamide (b) nitrobenzene
(c) aniline (d) benzamide
62. The silver salt of a fatty acid on refluxing with an alkyl halide gives an
(a) ether (b) amine
(c) acid (d) ester
63. Pick out the one which does not belong to the family
(a) ptyalin (b) lipase
(c) pepsin (d) cellulose
64. Which of the following is wrongly matched?
(a) Decomposition of H_2O_2 - first order reaction.
(b) Combination of H_2 and Br_2 to give HBr - zero order reaction.
(c) Saponification of $CH_3COOC_2H_5$ - second order reaction.
(d) Hydrolysis of CH_3COOCH_3 - pseudo unimolecular reaction.
65. The diameter of colloidal particle ranges from
(a) 10^3 m to 10^{-3} m (b) 10^{-3} m to 10^{-6} m
(c) 10^{-6} m to 10^{-9} m (d) 10^{-9} m to 10^{-12} m
66. The number of 2p electrons having spin quantum number $s = -1/2$ are
(a) 2 (b) 3
(c) 6 (d) 0
67. Pick out the alkane which differs from the other members of the group.
(a) 2-methyl butane
(b) 2, 2-dimethyl butane
(c) 2, 2-dimethyl propane
(d) Pentane
68. 56 g of nitrogen and 8 g of hydrogen gas are heated in a closed vessel. At equilibrium 34 g of ammonia are present. The equilibrium number of moles of nitrogen, hydrogen and ammonia are respectively
(a) 1, 1, 2 (b) 2, 1, 2
(c) 1, 2, 2 (d) 2, 2, 1
69. A process is taking place at constant temperature and pressure. Then,
(a) $\Delta H = 0$ (b) $\Delta S = 0$
(c) $\Delta H = \Delta E$ (d) $\Delta H = T\Delta S$
70. In a galvanic cell, the electrons flow from
(a) anode to cathode through the external circuit.
(b) cathode to anode through the external circuit.
(c) anode to cathode through the solution.
(d) cathode to anode through the solution.
71. On treating a mixture of two alkyl halides with sodium metal in dry ether, 2-methyl propane was obtained. The alkyl halides are
(a) chloromethane and chloroethane
(b) chloromethane and 1-chloropropane
(c) 2-chloropropane and chloromethane
(d) 2-chloropropane and chloroethane

72. Which of the following statements about benzyl chloride is incorrect?
- It is a lachrymatory liquid and answers Beilstein's test.
 - It gives a white precipitate with alcoholic silver nitrate.
 - It is less reactive than alkyl halides.
 - It can be oxidised to benzaldehyde by boiling with copper nitrate solution.
73. The main product obtained when a solution of sodium carbonate reacts with mercuric chloride is
- HgCO_3
 - $\text{HgCO}_3, \text{Hg}(\text{OH})_2$
 - $\text{Hg}(\text{OH})_2$
 - $\text{HgCO}_3, \text{HgO}$
74. In the electrothermal process, the compound displaced by silica from calcium phosphate is
- phosphorus
 - phosphorus pentoxide
 - calcium phosphide
 - phosphine
75. The enthalpy of combustion of methane at 25°C is 890 kJ. The heat liberated when 3.2 g of methane is burnt in air is
- 890 KJ
 - 178 kJ
 - 445 kJ
 - 278 kJ
76. The pressure and temperature of 4dm^3 of carbon dioxide gas are doubled. Then, the volume of carbon dioxide gas would be
- 4dm^3
 - 8dm^3
 - 2dm^3
 - 3dm^3
77. 4 g of copper was dissolved in concentrated nitric acid. The copper nitrate solution on strong heating gave 5 g of its oxide. The equivalent weight of copper is
- 12
 - 20
 - 23
 - 32
78. In the manufacture of ammonia by the Haber's process, $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) + 92.3 \text{ kJ}$, which of the following conditions is unfavourable?
- Reducing the temperature
 - Removing ammonia as it is formed
 - Increasing the temperature
 - Increasing the pressure
79. The chemical equilibrium of a reversible reaction is not influenced by
- concentration of the reactants
 - temperature
 - pressure
 - catalyst
80. Cumene process is the most important commercial method for the manufacture of phenol. Cumene is
- vinyl benzene
 - propyl benzene
 - 1-methyl ethyl benzene
 - ethyl benzene
81. A solution contains 1.2046×10^{24} hydrochloric acid molecules in one dm^3 of the solution. The strength of the solution is
- 4 N
 - 8 N
 - 6 N
 - 2 N
82. Nuclear theory of the atom was put forward by
- Neils Bohr
 - J.J. Thomson
 - Rutherford
 - Aston

83. In acetylene molecule, the two carbon atoms are linked by
 (a) three σ -bonds
 (b) three π -bonds
 (c) one σ -bond and two π -bonds
 (d) two σ -bonds and one π -bond
84. The enthalpy of the reaction, $\text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g})$ is ΔH_1 and that of $\text{H}_2(\text{g}) + 1/2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$ is ΔH_2 . Then
 (a) $\Delta H_1 > \Delta H_2$
 (b) $\Delta H_1 = \Delta H_2$
 (c) $\Delta H_1 < \Delta H_2$
 (d) $\Delta H_1 + \Delta H_2 = 0$
85. A radioactive isotope decays at such a rate that after 192 minutes only $\frac{1}{16}$ of the original amount remains. The half-life of the radioactive isotope is
 (a) 12 min
 (b) 24 min
 (c) 32 min
 (d) 48 min
86. The reagent which does not give acid chloride on treating with a carboxylic acid is
 (a) SOCl_2
 (b) PCl_3
 (c) PCl_5
 (d) Cl_2
87. Among the halogens, the one which is oxidised by nitric acid is
 (a) chlorine
 (b) bromine
 (c) fluorine
 (d) iodine
88. The metal which does not form ammonium nitrate by reaction with dilute nitric acid is
 (a) Pb
 (b) Mg
 (c) Al
 (d) Fe
89. The elements with atomic numbers 9, 17, 35, 53, 85 are all
 (a) heavy metals
 (b) light metals
 (c) noble gases
 (d) halogens
90. In the electrolytic method of obtaining aluminium from purified bauxite, cryolite is added to the charge in order to
 (a) dissolve bauxite and render it conductor of electricity.
 (b) lower the melting point of bauxite.
 (c) minimise the heat loss due to radiation.
 (d) protect aluminium produced from oxygen.
91. Which of the following is not an amphoteric substance?
 (a) H_2O
 (b) NH_3
 (c) HNO_3
 (d) HCO_3^-
92. When 50 cm^3 of $0.2 \text{ N H}_2\text{SO}_4$ is mixed with 50 cm^3 of 1 N KOH , the heat liberated is
 (a) 573 kJ
 (b) 573 J
 (c) 11.46 kJ
 (d) 57.3 kJ
93. An artificial radioactive isotope gave $\frac{14}{7}\text{N}$ after two successive β -particle emissions. The number of neutrons in the parent nucleus must be
 (a) 5
 (b) 7
 (c) 9
 (d) 14
94. Stainless steel does not rust because
 (a) nickel present in it, does not rust
 (b) iron forms a hard chemical compound with chromium present in it
 (c) chromium and nickel combine with iron
 (d) chromium forms an oxide layer and protects iron from rusting
95. Which of the following combinations can be used to synthesise ethanol?
 (a) CH_3MgI and $\text{CH}_3\text{COOC}_2\text{H}_5$

- (b) CH_3MgI and HCHO
 (c) CH_3MgI and CH_3COCH_3
 (d) CH_3MgI and $\text{C}_2\text{H}_5\text{OH}$
96. The reaction, $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ is carried out in a 1dm^3 vessel and 2dm^3 vessel separately. The ratio of the reaction velocities will be
 (a) 4 : 1 (b) 8 : 1
 (c) 1 : 8 (d) 1 : 4
97. In a mixture of acetic acid and sodium acetate the ratio of concentrations of the salt to the acid is increased ten times. Then the pH of the solution
 (a) decreases ten fold (b) increases ten fold
 (c) increases by one (d) decreases by one
98. When a mixture of methane and oxygen is passed through heated molybdenum oxide, the main product formed is
 (a) methanol (b) methanal
 (c) methanoic acid (d) ethanal
99. Benzene can be obtained by heating either benzoic acid with X or phenol with Y. X and Y are respectively
 (a) zinc dust and sodium hydroxide
 (b) soda lime and copper
 (c) zinc dust and soda lime
 (d) soda lime and zinc dust
100. An organic compound is boiled with alcoholic potash. The product is cooled and acidified with HCl. A white solid separate out. The starting compound may be
 (a) ethyl acetate (b) methyl acetate
 (c) ethyl benzoate (d) ethyl formate
101. In qualitative analysis, in order to detect second group basic radical, H_2S gas is passed in the presence of dilute HCl to
 (a) decrease the dissociation of H_2S
 (b) increase the dissociation of salt solution
 (c) increase the dissociation of H_2S
 (d) decrease the dissociation of salt solution
102. Aluminium displaces hydrogen from dilute HCl, whereas silver does not. The emf of a cell prepared by combining Al/Al^{3+} and Ag/Ag^+ is 2.46 V. The reduction potential of silver electrode is +0.80 V. The reduction potential of aluminium electrode is
 (a) 3.26 V (b) -1.66 V
 (c) +1.66 V (d) -3.26 V
103. The first fraction obtained during the fractionation of petroleum is
 (a) gasoline (b) diesel oil
 (c) hydrocarbon gases (d) kerosene oil
104. Which of the following compounds gives trichloromethane on distilling with bleaching powder?
 (a) Ethanol (b) Methanol
 (c) Methanal (d) Phenol
105. Benzoin is
 (a) α -hydroxy aldehyde
 (b) α -hydroxy ketone
 (c) compound containing an aldehyde and a ketonic group
 (d) α, β - unsaturated acid
106. The velocity constant of a reaction at 290 K was found to be $3.2 \times 10^{-3} \text{ s}^{-1}$. When the temperature is raised to 310 K, it will be about

- (a) 9.6×10^{-3} (b) 1.28×10^{-2}
(c) 6.4×10^{-3} (d) 3.2×10^{-4}

107. Select the pK_a value of the strongest acid from the following.

- (a) 2.0 (b) 4.5
(c) 1.0 (d) 3.0

108. Pick out the unsaturated fatty acid from the following

- (a) oleic acid (b) palmitic acid
(c) stearic acid (d) lauric acid

109. Nylon is not a

- (a) copolymer
(b) homopolymer
(c) condensation polymer
(d) polyamide

110. The coaltar fraction which contains phenol is

- (a) heavy oil (b) light oil
(c) middle oil (d) green oil

111. The compounds A and B are mixed in equimolar proportion to form the products, $A + B \rightleftharpoons C + D$. At equilibrium, one-third of A and B are consumed. The equilibrium constant for the reaction is

- (a) 2.5 (b) 0.25
(c) 0.5 (d) 4.0

112. In froth floatation process for the purification of ores, the particles of ore float because

- (a) they are insoluble
(b) they bear electrostatic charge
(c) their surface is not easily wetted by water
(d) they are light

113. Which of the following statements about amorphous solids is incorrect?

- (a) There is no orderly arrangement of particles.
(b) They are rigid and incompressible.
(c) They melt over a range of temperature.
(d) They are anisotropic.

114. Hydrogen diffuses six times faster than gas A. The molar mass of gas A is

- (a) 24 (b) 36
(c) 72 (d) 6

115. Dulong and Petit's law is valid only for

- (a) gaseous elements
(b) solid elements
(c) metals
(d) non-metals

116. Identify the gas which is readily adsorbed by activated charcoal

- (a) H_2 (b) O_2
(c) N_2 (d) SO_2

117. If the distance between Na^+ and Cl^- ions in sodium chloride crystal is x pm, the length of the edge of the unit cell is

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

118. Which of the following statements is incorrect?

- (a) In $K_4[Fe(CN)_6]$ the ligand has satisfied both primary and secondary valencies of ferrous ion.

- (b) In $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$, the ligand has satisfied only the secondary valency of copper.
 (c) In $\text{K}_3[\text{Fe}(\text{CN})_6]$, the ligand has satisfied only the secondary valency of ferric ion.
 (d) In $\text{K}_3[\text{Fe}(\text{CN})_6]$, the ligand has satisfied both primary and secondary valencies of ferric ion.

119. 2-acetoxy benzoic acid is used as an

- (a) antiseptic (b) antipyretic
 (c) antimalarial (d) antidepressant

120. A nucleoside on hydrolysis gives

- (a) an aldopentose and a heterocyclic base
 (b) an aldopentose and orthophosphoric acid
 (c) a heterocyclic base and orthophosphoric acid
 (d) an aldopentose, a heterocyclic base and orthophosphoric acid

MATHEMATICS

121. If $A = \{a, b, c\}$, $B = \{b, c, d\}$ and $C = \{a, d, c\}$, then $(A - B) \times (B \cap C) =$

- (a) $\{(a, c), (a, d), (b, d)\}$ (b) $\{(c, a), (d, a)\}$
 (c) $\{(a, b), (c, d)\}$ (d) $\{(a, c), (a, d)\}$

122. The function $f: X \rightarrow Y$ defined by $f(x) = \sin x$ is one-one but not onto if X and Y are respectively, is equal to

- (a) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ and $[-1, 1]$ (b) $\left[0, \frac{\pi}{2}\right]$ and $[-1, 1]$
 (c) $[0, \pi]$ and $[0, 1]$ (d) $\mathbb{R}$ and $\mathbb{R}$

123. If $\log_4 2 + \log_4 4 + \log_4 16 + \log_4 x = 6$, then $x =$

- (a) 32 (b) 8
 (c) 4 (d) 64

124. If $S_n = \frac{1}{6 \cdot 11} + \frac{1}{11 \cdot 16} + \frac{1}{16 \cdot 21} + \dots$ to n terms, then $6 S_n =$

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

125. The remainder obtained when $(1!)^2 + (2!)^2 + (3!)^2 + \dots + (100!)^2$ is divided by 10^2 is

- (a) 14 (b) 17
 (c) 28 (d) 27

126. If $(p \wedge \sim r) \rightarrow (\sim p \vee q)$ is false, then the truth values of p, q and r are respectively

- (a) T, F and T (b) F, T and T
 (c) F, F and T (d) T, F and F

127. If α, β and γ are the roots of the equation $x^3 - 8x + 8 = 0$, then $\Sigma \alpha^2$ and $\Sigma \frac{1}{\alpha\beta}$ are respectively is equal to

- (a) 16 and 0 (b) -16 and 0
 (c) 16 and 8 (d) 0 and -16

128. The gcd of 1080 and 675 is

- (a) 125 (b) 225
 (c) 135 (d) 145

129. If $a \mid (b + c)$ and $a \mid (b - c)$, where $a, b, c \in \mathbb{N}$, then

- (a) $c^2 \equiv a^2 \pmod{b^2}$ (b) $a^2 \equiv b^2 \pmod{c^2}$
 (c) $a^2 + c^2 = b^2$ (d) $b^2 \equiv c^2 \pmod{a^2}$

130. If a, b and $c \in \mathbb{N}$, which one of the following is not true?

- (a) $a \mid b$ and $a \mid c \Rightarrow a \mid b + c$
 (b) $a \mid b + c \Rightarrow a \mid b$ and $a \mid c$
 (c) $a \mid b$ and $b \mid c \Rightarrow a \mid c$
 (d) $a \mid b$ and $a \mid c \Rightarrow a \mid 3b + 2c$

131. If $2A + 3B = \begin{bmatrix} 2 & -1 & 4 \\ 3 & 2 & 5 \end{bmatrix}$ and $A + 2B = \begin{bmatrix} 5 & 0 & 3 \\ 1 & 6 & 2 \end{bmatrix}$, then $B =$
- (a) $\begin{bmatrix} 8 & 1 & 2 \\ 1 & 10 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 8 & 1 & -2 \\ -1 & 10 & -1 \end{bmatrix}$
- (c) $\begin{bmatrix} 8 & 1 & 2 \\ -1 & 10 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} 8 & -1 & 2 \\ -1 & 10 & -1 \end{bmatrix}$
132. If $O(A) = 2 \times 3$, $O(B) = 3 \times 2$, and $O(C) = 3 \times 3$, which one of the following is not defined?
- (a) $C(A + B')$ (b) $C(A + B')'$
- (c) BAC (d) $CB + A'$
133. If $A = \begin{bmatrix} 1 & -3 \\ 2 & k \end{bmatrix}$ and $A^2 - 4A + 10I = A$, then $k =$
- (a) 1 or 4 (b) 4 and not 1
- (c) -4 (d) 0
134. The value of $\begin{vmatrix} x+y & y+z & z+x \\ x & y & z \\ x-y & y-z & z-x \end{vmatrix} =$
- (a) 0 (b) $(x + y + z)^3$
- (c) $2(x + y + z)^3$ (d) $2(x + y + z)^2$
135. On the set Q of all rational numbers the operation $*$ which is both associative and commutative is given by $a * b =$
- (a) $2a + 3b$ (b) $ab + 1$
- (c) $a^2 + b^2$ (d) $a + b + ab$
136. In the group $G = \{1, 5, 7, 11\}$ under multiplication modulo 12, the solution of $7^{-1} \times (x \times_{12} 11) = 5$ is $x =$
- (a) 11 (b) 7
- (c) 1 (d) 5
137. A subset of the additive group of real numbers which is not a sub group, is
- (a) $(Q, +)$ (b) $(N, +)$
- (c) $(Z, +)$ (d) $(\{0\}, +)$
138. If $\mathbf{p} = \hat{i} + \hat{j}$, $\mathbf{q} = 4\hat{k} - \hat{j}$ and $\mathbf{r} = \hat{i} + \hat{k}$, then the unit vector in the direction of $3\mathbf{p} + \mathbf{q} - 2\mathbf{r}$ is
- (a) $\hat{i} + 2\hat{j} + 2\hat{k}$ (b) $\frac{1}{3}(\hat{i} - 2\hat{j} + 2\hat{k})$
- (c) $\frac{1}{3}(\hat{i} - 2\hat{j} - 2\hat{k})$ (d) $\frac{1}{3}(\hat{i} + 2\hat{j} + 2\hat{k})$
139. If $\mathbf{a}$ and $\mathbf{b}$ are the two vectors such that $|\mathbf{a}| = 3\sqrt{3}$, $|\mathbf{b}| = 4$ and $|\mathbf{a} + \mathbf{b}| = \sqrt{7}$, the angle between $\mathbf{a}$ and $\mathbf{b}$ is
- (a) 150° (b) 30°
- (c) 60° (d) 120°
140. If $\mathbf{a}$ is vector perpendicular to both $\mathbf{b}$ and $\mathbf{c}$, then
- (a) $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = 0$ (b) $\mathbf{a} \times (\mathbf{b} \times \mathbf{c}) = 0$
- (c) $\mathbf{a} \times (\mathbf{b} + \mathbf{c}) = 0$ (d) $\mathbf{a} + (\mathbf{b} + \mathbf{c}) = 0$
141. If the area of the parallelogram with $\mathbf{a}$ and $\mathbf{b}$ as two adjacent sides is 15 sq units, then the area of the parallelogram having $3\mathbf{a} + 2\mathbf{b}$ and $\mathbf{a} + 3\mathbf{b}$ as two adjacent sides in sq units is
- (a) 45 (b) 75
- (c) 105 (d) 120
142. The locus of the point which moves such that the ratio of its distances from two fixed points in the plane is always a constant $k (< 1)$ is
- (a) circle (b) straight line
- (c) ellipse (d) hyperbola

143. If the lines $x + 3y - 9 = 0$, $4x + by - 2 = 0$ and $2x - y - 4 = 0$ are concurrent, then $b =$
 (a) 0 (b) 1
 (c) 5 (d) -5
144. The lines represented by $ax^2 + 2hxy + by^2 = 0$ are perpendicular to each other if
 (a) $h = 0$ (b) $h^2 = ab$
 (c) $a + b = 0$ (d) $h^2 = a + b$
145. The equation of the circle having $x - y - 2 = 0$ and $x - y + 2 = 0$ as two tangents and $x + y = 0$ as a diameter is
 (a) $x^2 + y^2 = 1$
 (b) $x^2 + y^2 = 2$
 (c) $x^2 + y^2 - 2x + 2y - 1 = 0$
 (d) $x^2 + y^2 + 2x - 2y + 1 = 0$
146. If the length of the tangent from any point on the circle $(x - 3)^2 + (y + 2)^2 = 5r^2$ to the circle $(x - 3)^2 + (y + 2)^2 = r^2$ is 16 units, then the area between the two circles in sq units is
 (a) 16π (b) 256π
 (c) 4π (d) 32π
147. The circles $ax^2 + ay^2 + 2g_1x + 2f_1y + c_1 = 0$ and $bx^2 + by^2 + 2g_2x + 2f_2y + c_2 = 0$ ($a \neq 0$ and $b \neq 0$) cut orthogonally if
 (a) $g_1g_2 + f_1f_2 = c_1 + c_2$
 (b) $bg_1g_2 + af_1f_2 = bc_1 + ac_2$
 (c) $g_1g_2 + f_1f_2 = bc_1 + ac_2$
 (d) $2(g_1g_2 + f_1f_2) = bc_1 + ac_2$
148. The equation of the common tangent of the two touching circles, $y^2 + x^2 - 6x - 12y + 37 = 0$ and $x^2 + y^2 - 6y + 7 = 0$ is
 (a) $x + y + 5 = 0$ (b) $x + y - 5 = 0$
 (c) $x - y + 5 = 0$ (d) $x - y - 5 = 0$
149. The equation of the parabola with vertex at $(-1, 1)$ and focus $(2, 1)$ is
 (a) $y^2 - 2y - 12x + 13 = 0$
 (b) $y^2 - 2y - 12x + 11 = 0$
 (c) $x^2 + 2x - 12y + 13 = 0$
 (d) $y^2 - 2y - 12x - 11 = 0$
150. The equation of the line which is tangent to both the circle $x^2 + y^2 = 5$ and the parabola $y^2 = 40x$ is
 (a) $2x + y + 5 = 0$ (b) $2x - y - 5 = 0$
 (c) $2x - y + 5 = 0$ (d) $2x - y \pm 5 = 0$
151. $x = 4(1 + \cos\theta)$ and $y = 3(1 + \sin\theta)$ are the parametric equations of
 (a) $\frac{(x-4)^2}{16} + \frac{(y-3)^2}{9} = 1$
 (b) $\frac{(x-4)^2}{16} - \frac{(y-3)^2}{9} = 1$
 (c) $\frac{(x+4)^2}{16} + \frac{(y+3)^2}{9} = 1$
 (d) $\frac{(x-3)^2}{9} + \frac{(y-4)^2}{16} = 1$
152. If the distance between the foci and the distance between the directrices of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ are in the ratio 3:2, then $a:b$ is
 (a) 2:1 (b) 1:2
 (c) $\sqrt{3}:\sqrt{2}$ (d) $\sqrt{2}:1$
153. The ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ and the hyperbola $\frac{x^2}{25} - \frac{y^2}{16} = 1$ have in common
 (a) centre and vertices only

- (b)centre, foci and vertices
(c)centre, foci and directrices
(d)centre only

154. If $\sec\theta = m$ and $\tan\theta = n$, then $\frac{1}{m} \left[(m+n) + \frac{1}{(m+n)} \right] =$

- (a)mn (b)2n
(c)2 m (d)2

155. The value of $\frac{\sin 85^\circ - \sin 15^\circ}{\cos 65^\circ} =$

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

156. From an aeroplane flying, vertically above a horizontal road, the angles of depression of two consecutive stones on the same side of the aeroplane are observed to be 30° and 60° respectively. The height at which the aeroplane is flying in km, is

- (a)2 (b) $\frac{2}{\sqrt{3}}$
(c) $\frac{\sqrt{3}}{2}$ (d) $\frac{4}{\sqrt{3}}$

157. If the angles of a triangle are in the ratio 3: 4: 5, then the sides are in the ratio

- (a)3: 4: 5 (b) $2: \sqrt{3}: \sqrt{3} + 1$
(c) $\sqrt{2}: \sqrt{6}: \sqrt{3} + 1$ (d) $2: \sqrt{6}: \sqrt{3} + 1$

158. If $\cos^{-1}x = \alpha$, ($0 < x < 1$) and $\sin^{-1}(2x\sqrt{1-x^2}) + \sec^{-1}\left(\frac{1}{2x^2-1}\right) = \frac{2\pi}{3}$, then $\tan^{-1}(2x) =$

- (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$
(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

159. If $a > b > 0$, then the value of $\tan^{-1}\left(\frac{a}{b}\right) + \tan^{-1}\left(\frac{a+b}{a-b}\right)$ depends on

- (a)neither a nor b (b)a and not b
(c)b and not a (d)both a and b

160. Which one of the following equations has no solution?

- (a) $\sqrt{3}\sin\theta - \cos\theta = 2$
(b) $\cos\theta + \sin\theta = \sqrt{2}$
(c) $\operatorname{cosec}\theta \cdot \sec\theta = 1$
(d) $\operatorname{cosec}\theta - \sec\theta = \operatorname{cosec}\theta \cdot \sec\theta$

161. The complex number $\frac{(-\sqrt{3}+3i)(1-i)}{(3+\sqrt{3}i)(i)(\sqrt{3}+\sqrt{3}i)}$, when represented in the Argand diagram lies

- (a)on the X-axis (Real axis)
(b)on the Y-axis (Imaginary axis)
(c)in the first quadrant
(d)in the second quadrant

162. If $2x = -1 + \sqrt{3}i$, then the value of $(1 - x^2 + x)^6 - (1 - x + x^2)^6 =$

- (a)0 (b)64
(c)-64 (d)32

163. The modulus and amplitude of $(1 + i\sqrt{3})^8$ are respectively

- (a)256 and $\frac{8\pi}{3}$ (b)2 and $\frac{2\pi}{3}$
(c)256 and $\frac{2\pi}{3}$ (d)256 and $\frac{\pi}{3}$

164. The value of $\lim_{x \rightarrow 0} \frac{5^x - 5^{-x}}{2x} =$

- (a) $2\log 5$ (b)1
(c)0 (d) $\log 5$

165. Which one of the following is not true always?

- (a) If a function $f(x)$ is continuous at $x = a$, then $\lim_{x \rightarrow a} f(x)$ exists.
 (b) If $f(x)$ and $g(x)$ are differentiable at $x = a$, then $f(x) + g(x)$ is also differentiable at $x = a$.
 (c) If $f(x)$ is continuous at $x = a$, then it is differentiable at $x = a$.
 (d) If $f(x)$ is not continuous at $x = a$, then it is not differentiable at $x = a$.

166. If $y = 1 + \frac{1}{x} + \frac{1}{x^2} + \frac{1}{x^3} + \dots \infty$ with $|x| > 1$, then $\frac{dy}{dx} =$

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

167. If $f(x)$ and $g(x)$ are two functions with $g(x) = x - \frac{1}{x}$ and $f \circ g(x) = x^3 - \frac{1}{x^3}$, then $f'(x) =$

- (a) $3x^2 + \frac{3}{x^4}$ (b) $1 + \frac{1}{x^2}$
 (c) $3x^2 + 3$ (d) $3x^2 - 3$

168. The derivative of $a^{\sec x}$ w.r.t. $a^{\tan x}$ ($a > 0$) is

- (a) $a^{\sec x - \tan x}$ (b) $\sin x a^{\sec x - \tan x}$
 (c) $\sin x a^{\tan x - \sec x}$ (d) $\sec x a^{\sec x - \tan x}$

169. If $\sin(x+y) + \cos(x+y) = \log(x+y)$, then $\frac{d^2 y}{dx^2} =$

- (a) 1 (b) -1
 (c) 0 (d) $-\frac{y}{x}$

170. If $f(x)$ is a function such that $f''(x) + f(x) = 0$ and $g(x) = [f(x)]^2 + [f'(x)]^2$ and $g(3) = 8$, then $g(8) =$

- (a) 8 (b) 3
 (c) 0 (d) 5

171. If the curve $y = 2x^3 + ax^2 + bx + c$ passes through the origin and the tangents drawn to it at $x = -1$ and $x = 2$ are parallel to the X-axis, then the values of a, b and c are respectively,

- (a) 3, -12 and 0 (b) -3, 12 and 0
 (c) -3, -12 and 0 (d) 12, -3 and 0

172. A circular sector of perimeter 60 m with maximum area is to be constructed, The radius of the circular are in metre must be

- (a) 10 (b) 15
 (c) 5 (d) 20

173. The tangent and the normal drawn to the curve $y = x^2 - x + 4$ at $P(1, 4)$ cut the X-axis at A and B respectively. If the length of the subtangent drawn to the curve at P is equal to the length of the subnormal, then the area of the $\triangle PAB$ in square units is,

- (a) 16 (b) 8
 (c) 32 (d) 4

174. $\int \frac{(x^3 + 3x^2 + 3x + 1)}{(x+1)^5} dx =$

- (a) $\tan^{-1} x + c$ (b) $\log(x+1) + c$
 (c) $\frac{1}{5} \log(x+1) + c$ (d) $-\frac{1}{(x+1)} + c$

175. $\int \frac{\operatorname{cosec} x}{\cos^2(1 + \log \tan \frac{x}{2})} dx =$

- (a) $-\tan[1 + \log \tan x/2] + c$
 (b) $\sec^2[1 + \log \tan x/2] + c$
 (c) $\tan[1 + \log \tan x/2] + c$
 (d) $\sin^2[1 + \log \tan x/2] + c$

176. $\int \frac{dx}{x\sqrt{x^6-16}}$
- (a) $\sec^{-1}\left(\frac{x^3}{4}\right) + c$ (b) $\frac{1}{12}\sec^{-1}\left(\frac{x^3}{4}\right) + c$
 (c) $\cosh^{-1}\left(\frac{x^3}{4}\right) + c$ (d) $\frac{1}{3}\sec^{-1}\left(\frac{x^3}{4}\right) + c$
177. If $I_1 = \int_0^{\pi/2} x \sin x dx$ and $I_2 = \int_0^{\pi/2} x \cos x dx$, then which one of the following is true?
- (a) $I_1 = I_2$ (b) $I_1 + I_2 = 0$
 (c) $I_1 = \frac{\pi}{2} I_2$ (d) $I_1 + I_2 = \frac{\pi}{2}$
178. If $f(x)$ is defined in $[-2, 2]$ by $f(x) = 4x^2 - 3x + 1$ and $g(x) = \frac{f(-x)-f(x)}{(x^2+3)}$, then $\int_{-2}^2 g(x) dx =$
- (a) 24 (b) 0
 (c) -48 (d) 64
179. The area enclosed between the parabola $y = x^2 - x + 2$ and the line $y = x + 2$ in sq units =
- (a) $\frac{4}{3}$ (b) $\frac{2}{3}$
 (c) $\frac{1}{3}$ (d) $\frac{8}{3}$
180. The solution of the differential equation $e^{-x}(y+1)dy + (\cos^2 x - \sin 2x)y(dx) = 0$ subjected to the condition that $y = 1$, when $x = 0$ is
- (a) $(y+1) + e^x \cos^2 x = 2$
 (b) $y + \log y = e^x \cos^2 x$
 (c) $\log(y+1) + e^x \cos^2 x = 1$
 (d) $y + \log y + e^x \cos^2 x = 2$