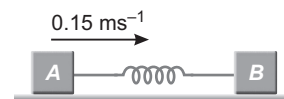


MET 2009 Memory Based Question Paper PDF

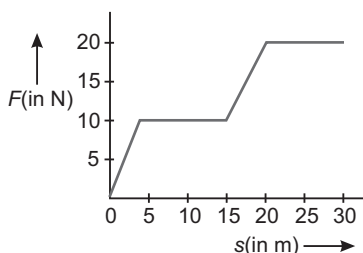
» PHYSICS

- In ruby laser, the stimulated emission is due to transition from
 - metastable state to any lower state
 - any higher state to lower state
 - metastable state to ground state
 - any higher state to ground state
- A direct current I flows along the length of an infinitely long straight thin walled pipe, then the magnetic field is
 - uniform throughout the pipe but not zero
 - zero only along the axis of the pipe
 - zero at any point inside the pipe
 - maximum at the centre and minimum at the edge
- A convex lens made of glass has focal length 0.15 m in air. If the refractive index of glass is $\frac{3}{2}$ and that of water is $\frac{4}{3}$, the focal length of lens when immersed in water is
 - 0.45 m
 - 0.15 m
 - 0.30 m
 - 0.6 m
- Two sources are said to be coherent if they produce waves
 - having a constant phase difference
 - of equal wavelength
 - of equal speed
 - having same shape of wavefront
- Three resistors $1\ \Omega$, $2\ \Omega$ and $3\ \Omega$ are connected to form a triangle. Across $3\ \Omega$ resistor a 3 V battery is connected. The current through $3\ \Omega$ resistor is
 - 0.75 A
 - 1 A
 - 2 A
 - 1.5 A
- In a common emitter amplifier the input signal is applied across
 - anywhere
 - emitter-collector
 - collector-base
 - base-emitter
- In a radioactive disintegration, the ratio of initial number of atoms to the number of atoms present at an instant of time equal to its mean life is
 - $\frac{1}{e^2}$
 - $\frac{1}{e}$
 - e
 - e^2
- A ray of light is incident on a surface of glass slab at an angle 45° . If the lateral shift produced per unit thickness is $\frac{1}{\sqrt{3}}\text{ m}$, the angle of refraction produced is
 - $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$
 - $\tan^{-1}\left(1 - \sqrt{\frac{2}{3}}\right)$
 - $\sin^{-1}\left(1 - \sqrt{\frac{2}{3}}\right)$
 - $\tan^{-1}\left(\sqrt{\frac{2}{\sqrt{3}-1}}\right)$
- Ferromagnetic materials used in a transformer must have
 - low permeability and high hysteresis loss
 - high permeability and low hysteresis loss
 - high permeability and high hysteresis loss
 - low permeability and low hysteresis loss
- According to Newton's corpuscular theory, the speed of light is
 - same in all the media
 - lesser in rarer medium
 - lesser in denser medium
 - independent of the medium
- For the constructive interference the path difference between the two interfering waves must be equal to
 - $(2n+1)\lambda$
 - $2n\pi$
 - $n\lambda$
 - $(2n+1)\frac{\lambda}{2}$
- The accurate measurement of emf can be obtained using
 - multimeter
 - voltmeter
 - voltmeter
 - potentiometer

13. The kinetic energy of an electron gets tripled, then the de-Broglie wavelength associated with it changes by a factor
 (a) $\frac{1}{3}$ (b) $\sqrt{3}$
 (c) $\frac{1}{\sqrt{3}}$ (d) 3
14. Which of the following is not a thermodynamic coordinate?
 (a) Gas constant (R) (b) Pressure (p)
 (c) Volume (V) (d) Temperature (T)
15. Two solid pieces, one of steel and the other of aluminium when immersed completely in water have equal weights. When the solid pieces are weighed in air
 (a) the weight of aluminium is half the weight of steel
 (b) steel piece will weigh more
 (c) they have the same weight
 (d) aluminium piece will weigh more
16. The amount of energy released when one microgram of matter is annihilated is
 (a) 25 kWh (b) 9×10^{10} kWh
 (c) 3×10^{10} kWh (d) 0.5×10^5 kWh
17. The number of significant figures in the numbers 4.8000×10^4 and 48000.50 are respectively
 (a) 5 and 6 (b) 5 and 7
 (c) 2 and 7 (d) 2 and 6
18. β -decay means emission of electron from
 (a) innermost electron orbit
 (b) a stable nucleus
 (c) outermost electron orbit
 (d) radioactive nucleus
19. An electric heater rated 220 V and 550 W is connected to AC mains. The current drawn by it is
 (a) 0.8 A (b) 2.5 A
 (c) 0.4 A (d) 1.25 A
20. A body of mass m moving along a straight line covers half the distance with a speed of 2 ms^{-1} . The remaining half of the distance is covered in two equal time intervals with a speed of 3 ms^{-1} and 5 ms^{-1} respectively. The average speed of the particle for the entire journey is
 (a) $\frac{3}{8} \text{ ms}^{-1}$ (b) $\frac{8}{3} \text{ ms}^{-1}$
 (c) $\frac{4}{3} \text{ ms}^{-1}$ (d) $\frac{16}{3} \text{ ms}^{-1}$
21. The moment of inertia of a circular ring of radius r and mass M about diameter is
 (a) $\frac{2}{5} Mr^2$ (b) $\frac{Mr^2}{4}$
 (c) $\frac{Mr^2}{2}$ (d) $\frac{Mr^2}{12}$
22. A body of mass 0.05 kg is observed to fall with an acceleration of 9.5 ms^{-2} . The opposing force of air on the body is ($g = 9.8 \text{ ms}^{-2}$)
 (a) 0.015 N (b) 0.15 N
 (c) 0.030 N (d) zero
23. The colloidal solution in which both the dispersed phase and dispersion medium are liquids are called
 (a) emulsions (b) gels
 (c) foams (d) liquid crystals
24. In fog, photographs of the objects taken with infrared radiations are more clear than those obtained during visible light because
 (a) I-R radiation has lesser wavelength than visible radiation
 (b) scattering of I-R light is more than visible light
 (c) the intensity of I-R light from the object is less
 (d) scattering of I-R light is less than visible light
25. Three concurrent co-planar forces 1 N, 2 N and 3 N acting along different directions on a body
 (a) can keep the body in equilibrium if 2 N and 3 N act at right angle
 (b) can keep the body in equilibrium if 1 N and 2 N act at right angle
 (c) cannot keep the body in equilibrium
 (d) can keep the body in equilibrium in 1 N and 3 N act at an acute angle
26. Sound waves transfer
 (a) only energy not momentum
 (b) energy
 (c) momentum
 (d) Both (a) and (b)
27. Two rectangular blocks A and B of masses 2 kg and 3 kg respectively are connected by a spring of spring constant 10.8 Nm^{-1} and are placed on a frictionless horizontal surface. The block A was given an initial velocity of 0.15 ms^{-1} in the direction shown in the figure. The maximum compression of the spring during the motion is
 (a) 0.01 m (b) 0.02 m
 (c) 0.05 m (d) 0.03 m

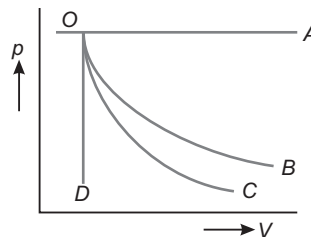


28. G P Thomson experimentally confirmed the existence of matter waves by the phenomena
 (a) diffraction (b) refraction
 (c) polarisation (d) scattering
29. The resistance of a wire at 300 K is found to be 0.3Ω . If the temperature coefficient of resistance of wire is $1.5 \times 10^{-3} \text{ K}^{-1}$, the temperature at which the resistance becomes 0.6Ω is
 (a) 720 K (b) 345 K
 (c) 993 K (d) 690 K
30. The work done by a force acting on a body is as shown in the graph. The total work done in covering an initial distance of 20 m is

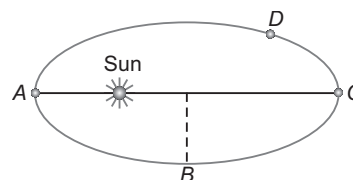


- (a) 225 J (b) 200 J
 (c) 400 J (d) 175 J
31. Two luminous point sources separated by a certain distance are at 10 km from an observer. If the aperture of his eye is $2.5 \times 10^{-3} \text{ m}$ and the wavelength of light used is 500 nm, the distance of separation between the point sources just seen to be resolved is
 (a) 12.2 m (b) 24.2 m
 (c) 2.44 m (d) 1.22 m
32. A door 1.6 m wide requires a force of 1 N to be applied at the free end to open or close it. The force that is required at a point 0.4 m distance from the hinges for opening or closing the door is
 (a) 1.2 N (b) 3.6 N
 (c) 2.4 N (d) 4 N
33. 0.1 m^3 of water at 80°C is mixed with 0.3 m^3 of water at 60°C . The final temperature of the mixture is
 (a) 65°C (b) 70°C
 (c) 60°C (d) 75°C
34. The spectral series of the hydrogen atom that lies in the visible region of the electromagnetic spectrum
 (a) Paschen (b) Balmer
 (c) Lyman (d) Brackett

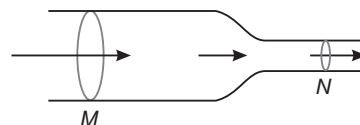
35. A graph of pressure *versus* volume for an ideal gas for different processes is as shown. In the graph curve OC represents



- (a) isochoric process
 (b) isothermal process
 (c) isobaric process
 (d) adiabatic process
36. Which of the following statement does not hold good for thermal radiation?
 (a) The wavelength changes when it travels from one medium to another
 (b) The frequency changes when it travels from one medium to another
 (c) The speed changes when it travels from one medium to another
 (d) They travel in straight line in a given medium
37. A planet revolves around the sun in an elliptical orbit. The linear speed of the planet will be maximum at



- (a) D (b) B
 (c) A (d) C
38. Horizontal tube of non-uniform cross-section has radii of 0.1 m and 0.05 m respectively at M and N. For a streamline flow of liquid the rate of liquid flow is



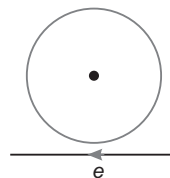
- (a) changing continuously with time
 (b) greater at M than at N
 (c) greater at N than at M
 (d) same at M and N

39. A resistor and a capacitor are connected in series with an AC source. If the potential drop across the capacitor is 5 V and that across resistor is 12 V, then applied voltage is
(a) 13 V (b) 17 V
(c) 5 V (d) 12 V
40. The amount of heat energy radiated by a metal at temperature T is E. When the temperature is increased to 3T, energy radiated is
(a) 81E (b) 9E
(c) 3E (d) 27E
41. The angle of minimum deviation for an incident light ray on an equilateral prism is equal to its refracting angle. The refractive index of its material is
(a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{3}$
(c) $\frac{\sqrt{3}}{2}$ (d) $\frac{3}{2}$
42. In the following combinations of logic gates, the outputs of A, B and C are respectively
- (A)
- (B)
- (C)
- (a) 0, 1, 1 (b) 0, 1, 0
(c) 1, 1, 0 (d) 1, 0, 1
43. A stationary point source of sound emits sound uniformly in all directions in a non-absorbing medium. Two points P and Q are at a distance of 4 m and 9 m respectively from the source. The ratio of amplitudes of the waves at P and Q is
(a) $\frac{3}{2}$ (b) $\frac{4}{9}$
(c) $\frac{2}{3}$ (d) $\frac{9}{4}$
44. A galvanometer of resistance 240 Ω allows only 4% of the main current after connecting a shunt resistance. The value of the shunt resistance is
(a) 10 Ω (b) 20 Ω
(c) 8 Ω (d) 5 Ω
45. The phenomena in which proton flips is
(a) nuclear magnetic resonance
(b) lasers
(c) radioactivity
(d) nuclear fusion
46. $y = 3 \sin \pi \left(\frac{t}{2} - \frac{x}{4} \right)$ represents an equation of a progressive wave, where t is in second and x is in metre. The distance travelled by the wave in 5 s is
(a) 8 m (b) 10 m
(c) 5 m (d) 32 m
47. According to the quark model, it is possible to build all the hadrons using
(a) 2 quarks and 3 antiquarks
(b) 3 quarks and 2 antiquarks
(c) 3 quarks and 3 antiquarks
(d) 2 quarks and 2 antiquarks
48. An α -particle of mass 6.4×10^{-27} kg and charge 3.2×10^{-19} C is situated in a uniform electric field of 1.6×10^5 Vm $^{-1}$. The velocity of the particle at the end of 2×10^{-2} m path when it starts from rest is
(a) $2\sqrt{3} \times 10^5$ ms $^{-1}$ (b) 8×10^5 ms $^{-1}$
(c) 16×10^5 ms $^{-1}$ (d) $4\sqrt{2} \times 10^5$ ms $^{-1}$
49. A cylindrical tube open at both the ends has a fundamental frequency of 390 Hz in air. If $\frac{1}{4}$ th of the tube is immersed vertically in water the fundamental frequency of air column is
(a) 260 Hz (b) 130 Hz
(c) 390 Hz (d) 520 Hz
50. The surface temperature of the stars is determined using
(a) Planck's law
(b) Wien's displacement law
(c) Rayleigh-Jeans law
(d) Kirchhoff's law
51. The charge deposited on 4 μ F capacitor in the circuit is
-
- (a) 6×10^{-6} C (b) 12×10^{-6} C
(c) 24×10^{-6} C (d) 36×10^{-6} C
52. A parallel beam of light is incident on a converging lens parallel to its principal axis. As one moves away from the lens on the other side of the principal axis, the intensity of light

- (a) first decreases and then increases
(b) continuously increases
(c) continuously decreases
(d) first increases and then decreases
53. Continuous emission spectrum is produced by
(a) incandescent electric lamp
(b) mercury vapour lamp
(c) sodium vapour lamp
(d) polyatomic substances
54. A coil of n number of turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current of strength I is passed through the coil, the magnetic field at its centre is
(a) $\frac{\mu_0 n I}{(b-a)} \log_e \frac{a}{b}$ (b) $\frac{\mu_0 n I}{2(b-a)}$
(c) $\frac{2\mu_0 n I}{b}$ (d) $\frac{\mu_0 n I}{2(b-a)} \log_e \frac{b}{a}$
55. A ray of light is incident on a plane mirror at an angle of 60° . The angle of deviation produced by the mirror is
(a) 120° (b) 30°
(c) 60° (d) 90°
56. The electric potential at any point x, y, z in metres is given by $V = 3x^2$. The electric field at a point $(2, 0, 1)$ is
(a) 12 Vm^{-1} (b) -6 Vm^{-1}
(c) 6 Vm^{-1} (d) -12 Vm^{-1}
57. Young's double slit experiment gives interference fringes of width 0.3 mm . A thin glass plate made of material of refractive index 1.5 is kept in the path of light from one of the slits, then the fringe width becomes

- (a) zero (b) 0.3 mm
(c) 0.45 mm (d) 0.15 mm

58. Near a circular loop of conducting wire as shown in the figure an electron moves along a straight line. The direction of the induced current if any in the loop is



- (a) variable (b) clockwise
(c) anticlockwise (d) zero
59. Hydrogen atom from excited state comes to the ground stage by emitting a photon of wavelength λ . If R is the Rydberg constant, the principal quantum number n of the excited state is
(a) $\sqrt{\frac{\lambda R}{\lambda R - 1}}$ (b) $\sqrt{\frac{\lambda}{\lambda R - 1}}$
(c) $\sqrt{\frac{\lambda R^2}{\lambda R - 1}}$ (d) $\sqrt{\frac{\lambda R}{\lambda - 1}}$
60. The magnetic dipole moment of a current loop is independent of
(a) magnetic field in which it is lying
(b) number of turns
(c) area of the loop
(d) current in the loop

» CHEMISTRY

1. The correct statement with regard to H_2^+ and H_2^- is
(a) both H_2^+ and H_2^- are equally stable
(b) both H_2^+ and H_2^- do not exist
(c) H_2^- is more stable than H_2^+
(d) H_2^+ is more stable than H_2^-
2. Arrange the following in the increasing order of their bond order
 $\text{O}_2, \text{O}_2^+, \text{O}_2^-$ and O_2^{2-}
(a) $\text{O}_2^{2-}, \text{O}_2^-, \text{O}_2, \text{O}_2^+$ (b) $\text{O}_2^{2-}, \text{O}_2^-, \text{O}_2^+, \text{O}_2$
(c) $\text{O}_2^+, \text{O}_2, \text{O}_2^-, \text{O}_2^{2-}$ (d) $\text{O}_2, \text{O}_2^+, \text{O}_2^-, \text{O}_2^{2-}$
3. 2 g of a radioactive sample having half-life of 15 days was synthesised on 1st Jan 2009. The amount of the sample left behind on 1st March, 2009 (including both the days) is
(a) 0 g (b) 0.125 g
(c) 1 g (d) 0.5 g
4. For a chemical reaction $\text{A} \rightarrow \text{B}$, the rate of the reaction is $2 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$, when the initial concentration is 0.05 mol dm^{-3} . The rate of the same reaction is $1.6 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$ when the initial concentration is 0.1 mol dm^{-3} . The order of the reaction is
(a) 2 (b) 0
(c) 3 (d) 1

5. For the decomposition of a compound AB at 600 K, the following data were obtained

[AB] mol dm ⁻³	Rate of decomposition of AB in mol dm ⁻³ s ⁻¹
0.20	2.75×10^{-8}
0.40	11.0×10^{-8}
0.60	24.75×10^{-8}

The order for the decomposition of AB is

- (a) 1.5 (b) 0
(c) 1 (d) 2
6. The rate equation for a reaction $A \rightarrow B$ is $r = k[A]^0$. If the initial concentration of the reactant is a mol dm⁻³, the half-life period of the reaction is
- (a) $\frac{a}{2k}$ (b) $\frac{k}{a}$
(c) $\frac{a}{k}$ (d) $\frac{2a}{k}$
7. 30 cc of $\frac{M}{3}$ HCl, 20 cc of $\frac{M}{2}$ HNO₃ and 40 cc of $\frac{M}{4}$ NaOH solutions are mixed and the volume was made up to 1 dm³. The pH of the resulting solution is
- (a) 8 (b) 2
(c) 1 (d) 3
8. An aqueous solution containing 6.5 g of NaCl of 90% purity was subjected to electrolysis. After the complete electrolysis, the solution was evaporated to get solid NaOH. The volume of 1 M acetic acid required to neutralise NaOH obtained above is
- (a) 1000 cm³ (b) 2000 cm³
(c) 100 cm³ (d) 200 cm³
9. The standard electrode potential for the half-cell reactions are
- $$\text{Zn}^{2+} + 2e^- \longrightarrow \text{Zn}; E^\circ = -0.76 \text{ V}$$
- $$\text{Fe}^{2+} + 2e^- \longrightarrow \text{Fe}; E^\circ = -0.44 \text{ V}$$
- The emf of the cell reaction,
- $$\text{Fe}^{2+} + \text{Zn} \longrightarrow \text{Zn}^{2+} + \text{Fe}$$
- (a) -0.32 V (b) -1.20 V
(c) +1.20 V (d) +0.32 V
10. 10⁻⁶ M NaOH is diluted 100 times. The pH of the diluted base is
- (a) between 7 and 8
(b) between 5 and 6
(c) between 6 and 7
(d) between 10 and 11
11. In the electrolysis of acidulated water, it is desired to obtain 1.12 cc of hydrogen per second under STP condition. The current to be passed is
- (a) 1.93 A (b) 9.65 A
(c) 19.3 A (d) 0.965 A
12. The one which decreases with dilution is
- (a) molar conductance
(b) conductance
(c) specific conductance
(d) equivalent conductance
13. Vapour pressure of pure 'A' is 70 mm of Hg at 25°C. It forms an ideal solution with 'B' in which mole fraction of A is 0.8. If the vapour pressure of the solution is 84 mm of Hg at 25°C, the vapour pressure of pure 'B' at 25°C is
- (a) 28 mm (b) 56 mm
(c) 70 mm (d) 140 mm
14. A 6% solution of urea is isotonic with
- (a) 1 M solution of glucose
(b) 0.05 M solution of glucose
(c) 6% solution of glucose
(d) 25% solution of glucose
15. In countries nearer to polar region, the roads are sprinkled with CaCl₂. This is
- (a) to minimise the wear and tear of the roads
(b) to minimise the snow fall
(c) to minimise pollution
(d) to minimise the accumulation of dust on the road
16. For the reaction $\text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{O}(\text{g})$ at 373 K and 1 atm pressure
- (a) $\Delta H = 0$ (b) $\Delta E = 0$
(c) $\Delta H = T\Delta S$ (d) $\Delta H = \Delta E$
17. A compound of 'A' and 'B' crystallises in a cubic lattice in which 'A' atoms occupy the lattice points at the corners of the cube. The 'B' atoms occupy the centre of each face of the cube. The probable empirical formula of the compound is
- (a) AB₂ (b) A₃B
(c) AB (d) AB₃
18. In electrophilic aromatic substitution reaction, the nitro group is *meta* directing because it
- (a) decreases electron density at *ortho* and *para* positions
(b) decreases electron density at *meta* position
(c) increases electron density at *meta* position
(d) increases electron density at *ortho* and *para* positions
19. $\text{CH}_3\text{COOH} \xrightarrow{\text{LiAlH}_4} \text{X} \xrightarrow[300^\circ\text{C}]{\text{Cu}} \text{Y} \xrightarrow[\text{NaOH}]{\text{Dilute}} \text{Z}$
In the above reaction Z is

- (a) butanol (b) aldol
(c) ketol (d) acetal
20. The best method for the conversion of an alcohol into an alkyl chloride is by treating the alcohol with
(a) PCl_3
(b) PCl_5
(c) SOCl_2 in presence of pyridine
(d) dry HCl in the presence of anhydrous ZnCl_2
21. The electrophile involved in the sulphonation of benzene is
(a) SO_3^+ (b) SO_3^{2-}
(c) H_3O^+ (d) SO_3
22. The carbon-carbon bond length in benzene is
(a) in between C_2H_6 and C_2H_4
(b) same as in C_2H_4
(c) in between C_2H_6 and C_2H_2
(d) in between C_2H_4 and C_2H_2
23. The compound which is not formed during the dry distillation of a mixture of calcium formate and calcium acetate is
(a) methanal (b) propanal
(c) propanone (d) ethanal
24. An organic compound X is oxidised by using acidified $\text{K}_2\text{Cr}_2\text{O}_7$. The product obtained reacts with phenyl hydrazine but does not answer silver mirror test. The possible structure of X is
(a) $\text{CH}_3\text{CH}_2\text{OH}$ (b) $\text{CH}_3-\text{C}(=\text{O})-\text{CH}_3$
(c) $(\text{CH}_3)_2\text{CHOH}$ (d) CH_3CHO
25. The reaction involved in the oil of winter green test is salicylic acid $\xrightarrow[\text{Conc. H}_2\text{SO}_4]{\Delta}$ product. The product is treated with Na_2CO_3 solution. The missing reagent in the above reaction is
(a) phenol (b) NaOH
(c) ethanol (d) methanol
26. The compound which forms acetaldehyde when heated with dilute NaOH , is
(a) 1, 1-dichloroethane
(b) 1, 1, 1-trichloroethane
(c) 1-chloroethane
(d) 1, 2-dichloroethane
27. Arrange the following in the increasing order of their basic strengths CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$, NH_3
(a) $\text{NH}_3 < (\text{CH}_3)_3\text{N} < (\text{CH}_3)_2\text{NH} < \text{CH}_3\text{NH}_2$
(b) $\text{NH}_3 < (\text{CH}_3)_3\text{N} < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH}$
(c) $(\text{CH}_3)_3\text{N} < \text{NH}_3 < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH}$
(d) $\text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH} < (\text{CH}_3)_3\text{N} < \text{NH}_3$
28. The one which has least iodine value is
(a) sunflower oil (b) ginger oil
(c) ghee (d) groundnut oil
29. A diabetic person carries a packet of glucose with him always, because
(a) glucose reduces the blood sugar level slowly
(b) glucose increases the blood sugar level slowly
(c) glucose reduces the blood sugar level
(d) glucose increases the blood sugar level almost instantaneously
30. There are 20 naturally occurring amino acids. The maximum number of tripeptides that can be obtained is
(a) 8000 (b) 6470
(c) 7465 (d) 5360
31. Cooking is fast in a pressure cooker, because
(a) food particles are effectively smashed
(b) water boils at higher temperature inside the pressure cooker
(c) food is cooked at constant volume
(d) loss of heat due to radiation is minimum
32. The ore that is concentrated by froth floatation process is
(a) zincite (b) cinnabar
(c) bauxite (d) malachite
33. The correct set of four quantum numbers for outermost electron of potassium ($Z = 19$) is
(a) 4, 1, 0, $\frac{1}{2}$ (b) 3, 1, 0, $\frac{1}{2}$
(c) 4, 0, 0, $\frac{1}{2}$ (d) 3, 0, 0, $\frac{1}{2}$
34. A body of mass x kg is moving with a velocity of 100 ms^{-1} . Its de-Broglie wavelength is $6.62 \times 10^{-35} \text{ m}$. Hence, x is ($h = 6.62 \times 10^{-34} \text{ Js}$)
(a) 0.1 kg (b) 0.25 kg
(c) 0.15 kg (d) 0.2 kg
35. The correct order of ionisation energy of C, N, O, F is
(a) $\text{F} < \text{O} < \text{N} < \text{C}$ (b) $\text{F} < \text{N} < \text{C} < \text{O}$
(c) $\text{C} < \text{N} < \text{O} < \text{F}$ (d) $\text{C} < \text{O} < \text{N} < \text{F}$
36. The oxide of an element whose electronic configuration is $1s^2, 2s^2, 2p^6, 3s^1$ is
(a) neutral (b) amphoteric
(c) basic (d) acidic
37. The characteristic not related to alkali metal is
(a) high ionisation energy
(b) their ions are isoelectronic with noble gases
(c) low melting point
(d) low electronegativity

38. Among the following, the compound that contains ionic, covalent and coordinate linkage is
 (a) NH_3 (b) NH_4Cl
 (c) NaCl (d) CaO
39. A covalent molecule AB_3 has pyramidal structure. The number of lone pair and bond pair of electrons in the molecule are respectively
 (a) 2 and 2 (b) 0 and 4
 (c) 3 and 1 (d) 1 and 3
40. Excess of carbon dioxide is passed through 50 mL of 0.5 M calcium hydroxide solution. After the completion of the reaction, the solution was evaporated to dryness. The solid calcium carbonate was completely neutralised with 0.1 N hydrochloric acid. The volume of hydrochloric acid required is (Atomic mass of calcium = 40)
 (a) 300 cm^3 (b) 200 cm^3
 (c) 500 cm^3 (d) 400 cm^3
41. A bivalent metal has an equivalent mass of 32. The molecular mass of the metal nitrate is
 (a) 182 (b) 168
 (c) 192 (d) 188
42. The rms velocity of molecules of a gas of density 4 kg m^{-3} and pressure $1.2 \times 10^5 \text{ Nm}^{-2}$ is
 (a) 300 ms^{-1} (b) 900 ms^{-1}
 (c) 120 ms^{-1} (d) 600 ms^{-1}
43. 0.5 mole of each of H_2 , SO_2 and CH_4 are kept in a container. A hole was made in the container. After 3 h, the order of partial pressures in the container will be
 (a) $p\text{SO}_2 > p\text{H}_2 > p\text{CH}_4$
 (b) $p\text{SO}_2 > p\text{CH}_4 > p\text{H}_2$
 (c) $p\text{H}_2 > p\text{SO}_2 > p\text{CH}_4$
 (d) $p\text{H}_2 > p\text{CH}_4 > p\text{SO}_2$
44. The enthalpy of formation of NH_3 is -46 kJ mol^{-1} . The enthalpy change for the reaction

$$2\text{NH}_3(\text{g}) \longrightarrow \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$$
 is
 (a) $+184 \text{ kJ}$ (b) $+23 \text{ kJ}$
 (c) $+92 \text{ kJ}$ (d) $+46 \text{ kJ}$
45. 5 moles of SO_2 and 5 moles of O_2 are allowed to react. At equilibrium, it was found that 60% of SO_2 is used up. If the partial pressure of the equilibrium mixture is one atmosphere, the partial pressure of O_2 is
 (a) 0.82 atm (b) 0.52 atm
 (c) 0.21 atm (d) 0.41 atm
46. $2\text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$
 The equilibrium constant of the above reaction is 6.4 at 300 K. If 0.25 mole each of H_2 and I_2 are added to the system, the equilibrium constant will be
 (a) 6.4 (b) 0.8
 (c) 3.2 (d) 1.6
47. Rate of physical adsorption increases with
 (a) decrease in surface area
 (b) decrease in temperature
 (c) decrease in pressure
 (d) increase in temperature
48. IUPAC name of $(\text{CH}_3)_3\text{CCl}$ is
 (a) *n*-butyl chloride
 (b) 3-chloro butane
 (c) 2-chloro 2-methyl propane
 (d) *t*-butyl chloride
49. Lucas test is associated with
 (a) aldehydes (b) phenols
 (c) carboxylic acids (d) alcohols
50. An organic compound on heating with CuO produces CO_2 but no water. The organic compound may be
 (a) carbon tetrachloride
 (b) chloroform
 (c) methane
 (d) ethyl iodide
51. The condensation polymer among the following is
 (a) rubber (b) protein
 (c) PVC (d) polyethene
52. The order of stability of metal oxides is
 (a) $\text{Al}_2\text{O}_3 < \text{MgO} < \text{Fe}_2\text{O}_3 < \text{Cr}_2\text{O}_3$
 (b) $\text{Cr}_2\text{O}_3 < \text{MgO} < \text{Al}_2\text{O}_3 < \text{Fe}_2\text{O}_3$
 (c) $\text{Fe}_2\text{O}_3 < \text{Cr}_2\text{O}_3 < \text{Al}_2\text{O}_3 < \text{MgO}$
 (d) $\text{Fe}_2\text{O}_3 < \text{Al}_2\text{O}_3 < \text{Cr}_2\text{O}_3 < \text{MgO}$
53. The temperature of the slag zone in the metallurgy of iron using blast furnace is
 (a) $1200\text{--}1500^\circ\text{C}$ (b) $1500\text{--}1600^\circ\text{C}$
 (c) $400\text{--}700^\circ\text{C}$ (d) $800\text{--}1000^\circ\text{C}$
54. The function of $\text{Fe}(\text{OH})_3$ in the contact process is
 (a) to remove arsenic impurity
 (b) to detect colloidal impurity
 (c) to remove moisture
 (d) to remove dust particles
55. In which of the following, NH_3 is not used?
 (a) Tollen's reagent
 (b) Nessler's reagent
 (c) Group reagent for the analysis of IV group basic radicals
 (d) Group reagent for the analysis of III group basic radicals

56. Argon is used
 (a) in filling airships
 (b) to obtain low temperature
 (c) in high temperature welding
 (d) in radiotherapy for treatment of cancer
57. The incorrect statement in respect of chromyl chloride test is
 (a) formation of red vapours
 (b) formation of lead chromate
 (c) formation of chromyl chloride
 (d) liberation of chlorine
58. The magnetic moment of a transition metal ion is $\sqrt{15}$ BM. Therefore, the number of unpaired electrons present in it, is
 (a) 3 (b) 4
 (c) 1 (d) 2
59. The IUPAC name of $[\text{Co}(\text{NH}_3)_5\text{ONO}]^{2+}$ ion is
 (a) penta ammine nitrito cobalt (IV) ion
 (b) penta ammine nitrito cobalt (III) ion
 (c) penta ammine nitro cobalt (III) ion
 (d) penta ammine nitro cobalt (IV) ion
60. The oxidation state of Fe in the brown ring complex: $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$ is
 (a) +3 (b) 0
 (c) +2 (d) +1

» MATHEMATICS

1. If $f: [2, 3] \rightarrow \mathbb{R}$ is defined by $f(x) = x^3 + 3x - 2$, then the range $f(x)$ is contained in the interval
 (a) $[1, 12]$ (b) $[12, 34]$
 (c) $[35, 50]$ (d) $[-12, 12]$
2. $\left\{ x \in \mathbb{R} : \frac{2x-1}{x^3+4x^2+3x} \in \mathbb{R} \right\}$ equals
 (a) $\mathbb{R} - \{0\}$
 (b) $\mathbb{R} - \{0, 1, 3\}$
 (c) $\mathbb{R} - \{0, -1, -3\}$
 (d) $\mathbb{R} - \left\{ 0, -1, -3, +\frac{1}{2} \right\}$
3. Using mathematical induction, the numbers a_n 's are defined by,
 $a_0 = 1, a_{n+1} = 3n^2 + n + a_n, (n \geq 0)$.
 Then, a_n is equal to
 (a) $n^3 + n^2 + 1$ (b) $n^3 - n^2 + 1$
 (c) $n^3 - n^2$ (d) $n^3 + n^2$
4. The number of subsets of $\{1, 2, 3, \dots, 9\}$ containing at least one odd number is
 (a) 324 (b) 396
 (c) 496 (d) 512
5. p points are chosen on each of the three coplanar lines. The maximum number of triangles formed with vertices at these points is
 (a) $p^3 + 3p^2$ (b) $\frac{1}{2}(p^3 + p)$
 (c) $\frac{p^2}{2}(5p - 3)$ (d) $p^2(4p - 3)$
6. A binary sequence is an array of 0's and 1's. The number of n -digit binary sequences which contain even number of 0's is
 (a) 2^{n-1} (b) $2^n - 1$
 (c) $2^{n-1} - 1$ (d) 2^n
7. The coefficient of x^{24} in the expansion of $(1+x^2)^{12}(1+x^{12})(1+x^{24})$ is
 (a) ${}^{12}C_6$ (b) ${}^{12}C_6 + 2$
 (c) ${}^{12}C_6 + 4$ (d) ${}^{12}C_6 + 6$
8. If x is numerically so small so that x^2 and higher powers of x can be neglected, then
 $\left(1 + \frac{2x}{3}\right)^{3/2} \cdot (32 + 5x)^{-1/5}$ is approximately equal to
 (a) $\frac{32+31x}{64}$ (b) $\frac{31+32x}{64}$
 (c) $\frac{31-32x}{64}$ (d) $\frac{1-2x}{64}$
9. For $|x| < 1$, the constant term in the expansion of $\frac{1}{(x-1)^2(x-2)}$ is
 (a) 2 (b) 1
 (c) 0 (d) $-\frac{1}{2}$
10. $\frac{1}{e^{3x}}(e^x + e^{5x}) = a_0 + a_1x + a_2x^2 + \dots$
 $\Rightarrow 2a_1 + 2^3a_3 + 2^5a_5 + \dots$ is equal to
 (a) e (b) e^{-1}
 (c) 1 (d) 0

11. The roots of $(x - a)(x - a - 1) + (x - a - 1)(x - a - 2) + (x - a)(x - a - 2) = 0$, $a \in \mathbb{R}$ are always
 (a) equal (b) imaginary
 (c) real and distinct (d) rational and equal
12. Let $f(x) = x^2 + ax + b$, where $a, b \in \mathbb{R}$. If $f(x) = 0$ has all its roots imaginary, then the roots of $f(x) + f'(x) + f''(x) = 0$ are
 (a) real and distinct (b) imaginary
 (c) equal (d) rational and equal
13. If α, β, γ are the roots of $x^3 + 4x + 1 = 0$, then the equation whose roots are $\frac{\alpha^2}{\beta + \gamma}, \frac{\beta^2}{\gamma + \alpha}, \frac{\gamma^2}{\alpha + \beta}$ is
 (a) $x^3 - 4x - 1 = 0$ (b) $x^3 - 4x + 1 = 0$
 (c) $x^3 + 4x - 1 = 0$ (d) $x^3 + 4x + 1 = 0$
14. If $f(x) = 2x^4 - 13x^2 + ax + b$ is divisible by $x^2 - 3x + 2$, then (a, b) is equal to
 (a) $(-9, -2)$ (b) $(6, 4)$
 (c) $(9, 2)$ (d) $(2, 9)$
15. Let A and B be two symmetric matrices of same order. Then, the matrix $AB - BA$ is
 (a) a symmetric matrix
 (b) a skew-symmetric matrix
 (c) a null matrix
 (d) the identity matrix
16. If one of the roots of $\begin{vmatrix} 3 & 5 & x \\ 7 & x & 7 \\ x & 5 & 3 \end{vmatrix} = 0$ is -10 , then the other roots are
 (a) 3, 7 (b) 4, 7
 (c) 3, 9 (d) 3, 4
17. If x, y, z are all positive and are the p th, q th and r th terms of a geometric progression respectively, then the value of the determinant $\begin{vmatrix} \log x & p & 1 \\ \log y & q & 1 \\ \log z & r & 1 \end{vmatrix}$ equals
 (a) $\log xyz$
 (b) $(p - 1)(q - 1)(r - 1)$
 (c) pqr
 (d) 0
18. If $\begin{bmatrix} 1 & -1 & x \\ 1 & x & 1 \\ x & -1 & 1 \end{bmatrix}$ has no inverse, then the real value of x is
 (a) 2 (b) 3
 (c) 0 (d) 1
19. If α and β are the roots of $x^2 - 2x + 4 = 0$, then the value of $\alpha^6 + \beta^6$ is
 (a) 32 (b) 64
 (c) 128 (d) 256
20. The locus of z satisfying the inequality $\left| \frac{z + 2i}{2z + i} \right| < 1$, where $z = x + iy$, is
 (a) $x^2 + y^2 < 1$ (b) $x^2 - y^2 < 1$
 (c) $x^2 + y^2 > 1$ (d) $2x^2 + 3y^2 < 1$
21. If n is an integer which leaves remainder one when divided by three, then $(1 + \sqrt{3}i)^n + (1 - \sqrt{3}i)^n$ equals
 (a) -2^{n+1} (b) 2^{n+1}
 (c) $-(-2)^n$ (d) -2^n
22. The period of $\sin^4 x + \cos^4 x$ is
 (a) $\frac{\pi^4}{2}$ (b) $\frac{\pi^2}{2}$
 (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$
23. $\frac{\cos x}{\cos(x - 2y)} = \lambda \Rightarrow \tan(x - y) \tan y$ is equal to
 (a) $\frac{1 + \lambda}{1 - \lambda}$ (b) $\frac{1 - \lambda}{1 + \lambda}$
 (c) $\frac{\lambda}{1 + \lambda}$ (d) $\frac{\lambda}{1 - \lambda}$
24. $\cos A \cos 2A \cos 4A \dots \cos 2^{n-1} A$ equals
 (a) $\frac{\sin 2^n A}{2^n \sin A}$ (b) $\frac{2^n \sin 2^n A}{\sin A}$
 (c) $\frac{2^n \sin A}{\sin 2^n A}$ (d) $\frac{\sin A}{2^n \sin 2^n A}$
25. If $3 \cos x \neq 2 \sin x$, then the general solution of $\sin^2 x - \cos 2x = 2 - \sin 2x$ is
 (a) $n\pi + (-1)^n \frac{\pi}{2}, n \in \mathbb{Z}$
 (b) $\frac{n\pi}{2}, n \in \mathbb{Z}$

- (c) $(4n + 1)\frac{\pi}{2}$, $n \in \mathbb{Z}$
 (d) $(2n - 1)\pi$, $n \in \mathbb{Z}$
26. $\cos^{-1}\left(\frac{-1}{2}\right) - 2\sin^{-1}\left(\frac{1}{2}\right) + 3\cos^{-1}\left(\frac{-1}{\sqrt{2}}\right) - 4\tan^{-1}(-1)$ equals
- (a) $\frac{19\pi}{12}$ (b) $\frac{35\pi}{12}$
 (c) $\frac{47\pi}{12}$ (d) $\frac{43\pi}{12}$
27. $\sinh^{-1} 2 + \sinh^{-1} 3 = x \Rightarrow \cosh x$ is equal to
- (a) $\frac{1}{2}(3\sqrt{5} + 2\sqrt{10})$ (b) $\frac{1}{2}(3\sqrt{5} - 2\sqrt{10})$
 (c) $\frac{1}{2}(12 + 2\sqrt{50})$ (d) $\frac{1}{2}(12 - 2\sqrt{50})$
28. In any ΔABC , $a(b \cos C - c \cos B)$ equals
- (a) $b^2 + c^2$ (b) $b^2 - c^2$
 (c) $\frac{1}{b} + \frac{1}{c}$ (d) $\frac{1}{b^2} - \frac{1}{c^2}$
29. In a ΔABC

$$\frac{(a + b + c)(b + c - a)(c + a - b)(a + b - c)}{4b^2c^2}$$
 equals
- (a) $\cos^2 A$ (b) $\cos^2 B$
 (c) $\sin^2 A$ (d) $\sin^2 B$
30. P is a point on the segment joining the feet of two vertical poles of heights a and b . The angles of elevation of the tops of the poles from P are 45° each. Then, the square of the distance between the tops of the poles is
- (a) $\frac{a^2 + b^2}{2}$ (b) $a^2 + b^2$
 (c) $2(a^2 + b^2)$ (d) $4(a^2 + b^2)$
31. In a quadrilateral $ABCD$, the point P divides DC in the ratio $1 : 2$ and Q is the mid point of AC . If $\vec{AB} + 2\vec{AD} + \vec{BC} - 2\vec{DC} = k\vec{PQ}$, then k is equal to
- (a) -6 (b) -4
 (c) 6 (d) 4
32. The angle between the lines whose direction cosines satisfy the equations $l + m + n = 0$, $l^2 + m^2 - n^2 = 0$ is
- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
 (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$
33. If $\vec{a} = -\hat{i} + \hat{j} + 2\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} - \hat{k}$ and $\vec{c} = -2\hat{i} + \hat{j} + 3\hat{k}$, then the angle between $2\vec{a} - \vec{c}$ and $\vec{a} + \vec{b}$ is
- (a) $\frac{\pi}{4}$ (b) $\frac{\pi}{3}$
 (c) $\frac{\pi}{2}$ (d) $\frac{3\pi}{2}$
34. If m_1, m_2, m_3 and m_4 are respectively the magnitudes of the vectors
 $\vec{a}_1 = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{a}_2 = 3\hat{i} - 4\hat{j} - 4\hat{k}$,
 $\vec{a}_3 = \hat{i} + \hat{j} - \hat{k}$ and $\vec{a}_4 = -\hat{i} + 3\hat{j} + \hat{k}$,
 then the correct order of m_1, m_2, m_3 and m_4 is
- (a) $m_3 < m_1 < m_4 < m_2$
 (b) $m_3 < m_1 < m_2 < m_4$
 (c) $m_3 < m_4 < m_1 < m_2$
 (d) $m_3 < m_4 < m_2 < m_1$
35. Suppose $\vec{a} = \lambda\hat{i} - 7\hat{j} + 3\hat{k}$, $\vec{b} = \lambda\hat{i} + \hat{j} + 2\lambda\hat{k}$. If the angle between $\vec{a}$ and $\vec{b}$ is greater than 90° , then λ satisfies the inequality
- (a) $-7 < \lambda < 1$ (b) $\lambda > 1$
 (c) $1 < \lambda < 7$ (d) $-5 < \lambda < 1$
36. The volume of the tetrahedron having the edges $\hat{i} + 2\hat{j} - \hat{k}$, $\hat{i} + \hat{j} + \hat{k}$, $\hat{i} - \hat{j} + \lambda\hat{k}$ as coterminal, is $\frac{2}{3}$ cubic unit. Then λ equals
- (a) 1 (b) 2
 (c) 3 (d) 4
37. If A and B are events of a random experiment such that $P(A \cup B) = \frac{4}{5}$, $P(\bar{A} \cup \bar{B}) = \frac{7}{10}$ and $P(B) = \frac{2}{5}$, then $P(A)$ equals
- (a) $\frac{9}{10}$ (b) $\frac{8}{10}$
 (c) $\frac{7}{10}$ (d) $\frac{3}{5}$
38. The probability of choosing randomly a number c from the set $\{1, 2, 3, \dots, 9\}$ such that the quadratic equation $x^2 + 4x + c = 0$ has real roots is
- (a) $\frac{1}{9}$ (b) $\frac{2}{9}$
 (c) $\frac{3}{9}$ (d) $\frac{4}{9}$

39. Suppose that E_1 and E_2 are two events of a random experiment such that $P(E_1) = \frac{1}{4}$,

$P(E_2/E_1) = \frac{1}{2}$ and $P(E_1/E_2) = \frac{1}{4}$, observe the lists given below

List I	List II
(A) $P(E_2)$	(i) $1/4$
(B) $P(E_1 \cup E_2)$	(ii) $5/8$
(C) $P(\bar{E}_1/\bar{E}_2)$	(iii) $1/8$
(D) $P(E_1/\bar{E}_2)$	(iv) $1/2$
	(v) $3/8$
	(vi) $3/4$

The correct matching of the List I from the List II is

(A)	(B)	(C)	(D)
(a) (ii)	(iii)	(vi)	(i)
(b) (iv)	(v)	(vi)	(i)
(c) (iv)	(ii)	(vi)	(i)
(d) (i)	(ii)	(iii)	(iv)

40. If m and σ^2 are the mean and variance of the random variable X , whose distribution is given by

$X = x$	0	1	2	3
$P(X = x)$	$\frac{1}{3}$	$\frac{1}{2}$	0	$\frac{1}{6}$

Then

- (a) $m = \sigma^2 = 2$ (b) $m = 1, \sigma^2 = 2$
 (c) $m = \sigma^2 = 1$ (d) $m = 2, \sigma^2 = 1$

41. If X is a binomial variate with the range $\{0, 1, 2, 3, 4, 5, 6\}$ and $P(X = 2) = 4P(X = 4)$, then the parameter p of X is

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

42. The transformed equation of $x^2 + y^2 = r^2$ when the axes are rotated through an angle 36° is

- (a) $\sqrt{5}X^2 - 4XY + Y^2 = r^2$
 (b) $X^2 + 2XY - \sqrt{5}Y^2 = r^2$
 (c) $X^2 - Y^2 = r^2$
 (d) $X^2 + Y^2 = r^2$

43. The area (in square unit) of the circle which touches the lines $4x + 3y = 15$ and $4x + 3y = 5$ is

- (a) 4π (b) 3π
 (c) 2π (d) π

44. The point on the line $3x + 4y = 5$ which is equidistant from $(1, 2)$ and $(3, 4)$ is

- (a) $(7, -4)$ (b) $(15, -10)$
 (c) $(1/7, 8/7)$ (d) $(0, 5/4)$

45. The equation of the straight line perpendicular to the straight line $3x + 2y = 0$ and passing through the point of intersection of the lines $x + 3y - 1 = 0$ and $x - 2y + 4 = 0$ is

- (a) $2x - 3y + 1 = 0$ (b) $2x - 3y + 3 = 0$
 (c) $2x - 3y + 5 = 0$ (d) $2x - 3y + 7 = 0$

46. The value of λ with $|\lambda| < 16$ such that $2x^2 - 10xy + 12y^2 + 5x + \lambda y - 3 = 0$ represents a pair of straight lines, is

- (a) -10 (b) -9
 (c) 10 (d) 9

47. The area (in square unit) of the triangle formed by $x + y + 1 = 0$ and the pair of straight lines $x^2 - 3xy + 2y^2 = 0$ is

- (a) $\frac{7}{12}$ (b) $\frac{5}{12}$
 (c) $\frac{1}{12}$ (d) $\frac{1}{6}$

48. The pairs of straight lines $x^2 - 3xy + 2y^2 = 0$ and $x^2 - 3xy + 2y^2 + x - 2 = 0$ form a

- (a) square but not rhombus
 (b) rhombus
 (c) parallelogram
 (d) rectangle but not a square

49. The equations of the circle which pass through the origin and makes intercepts of lengths 4 and 8 on the x and y -axes respectively are

- (a) $x^2 + y^2 \pm 4x \pm 8y = 0$
 (b) $x^2 + y^2 \pm 2x \pm 4y = 0$
 (c) $x^2 + y^2 \pm 8x \pm 16y = 0$
 (d) $x^2 + y^2 \pm x \pm y = 0$

50. The locus of centre of a circle which passes through the origin and cuts off a length of 4 unit from the line $x = 3$ is

- (a) $y^2 + 6x = 0$
 (b) $y^2 + 6x = 13$
 (c) $y^2 + 6x = 10$
 (d) $x^2 + 6y = 13$

51. The diameters of a circle are along $2x + y - 7 = 0$ and $x + 3y - 11 = 0$. Then, the equation of this circle, which also passes through $(5, 7)$, is

- (a) $x^2 + y^2 - 4x - 6y - 16 = 0$
 (b) $x^2 + y^2 - 4x - 6y - 20 = 0$
 (c) $x^2 + y^2 - 4x - 6y - 12 = 0$
 (d) $x^2 + y^2 + 4x + 6y - 12 = 0$
52. The point $(3, -4)$ lies on both the circles $x^2 + y^2 - 2x + 8y + 13 = 0$ and $x^2 + y^2 - 4x + 6y + 11 = 0$. Then, the angle between the circles is
 (a) 60° (b) $\tan^{-1}\left(\frac{1}{2}\right)$
 (c) $\tan^{-1}\left(\frac{3}{5}\right)$ (d) 135°
53. The equation of the circle which passes through the origin and cuts orthogonally each of the circles $x^2 + y^2 - 6x + 8 = 0$ and $x^2 + y^2 - 2x - 2y = 7$ is
 (a) $3x^2 + 3y^2 - 8x - 13y = 0$
 (b) $3x^2 + 3y^2 - 8x + 29y = 0$
 (c) $3x^2 + 3y^2 + 8x + 29y = 0$
 (d) $3x^2 + 3y^2 - 8x - 29y = 0$
54. The number of normals drawn to the parabola $y^2 = 4x$ from the point $(1, 0)$ is
 (a) 0 (b) 1
 (c) 2 (d) 3
55. If the distance between the foci of an ellipse is 6 and the length of the minor axis is 8, then the eccentricity is
 (a) $\frac{1}{\sqrt{5}}$ (b) $\frac{1}{2}$
 (c) $\frac{3}{5}$ (d) $\frac{4}{5}$
56. If the circle $x^2 + y^2 = a^2$ intersects the hyperbola $xy = c^2$ in four points (x_i, y_i) , for $i = 1, 2, 3$ and 4 , then $y_1 + y_2 + y_3 + y_4$ equals
 (a) 0 (b) c
 (c) a (d) c^4
57. The mid point of the chord $4x - 3y = 5$ of the hyperbola $2x^2 - 3y^2 = 12$ is
 (a) $\left(0, -\frac{5}{3}\right)$ (b) $(2, 1)$
 (c) $\left(\frac{5}{4}, 0\right)$ (d) $\left(\frac{11}{4}, 2\right)$
58. The eccentricity of the conic $\frac{5}{r} = 2 + 3 \cos \theta + 4 \sin \theta$ is
 (a) $\frac{1}{2}$ (b) 1
 (c) $\frac{3}{2}$ (d) $\frac{5}{2}$
59. The perimeter of the triangle with vertices at $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$ is
 (a) 3 (b) 2
 (c) $2\sqrt{2}$ (d) $3\sqrt{2}$
60. If a line in the space makes angle α, β and γ with the coordinate axes, then $\cos 2\alpha + \cos 2\beta + \cos 2\gamma + \sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$ equals
 (a) -1 (b) 0
 (c) 1 (d) 2
61. The image of the point $(3, 2, 1)$ in the plane $2x - y + 3z = 7$ is
 (a) $(1, 2, 3)$ (b) $(2, 3, 1)$
 (c) $(3, 2, 1)$ (d) $(2, 1, 3)$
62. The radius of the sphere $x^2 + y^2 + z^2 = 12x + 4y + 3z$ is
 (a) $\frac{13}{2}$ (b) 13
 (c) 26 (d) 52
63. $\lim_{x \rightarrow \infty} \left(\frac{x+5}{x+2} \right)^{x+3}$ equals
 (a) e (b) e^2
 (c) e^3 (d) e^5
64. If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined by
$$f(x) = \begin{cases} \frac{2 \sin x - \sin 2x}{2x \cos x}, & \text{if } x \neq 0 \\ a, & \text{if } x = 0 \end{cases}$$
 then the value of a so that f is continuous at 0 is
 (a) 2 (b) 1
 (c) -1 (d) 0
65. $x = \frac{1 - \sqrt{y}}{1 + \sqrt{y}} \Rightarrow \frac{dy}{dx}$ is equal to
 (a) $\frac{4}{(x+1)^2}$ (b) $\frac{4(x-1)}{(1+x)^3}$
 (c) $\frac{x-1}{(1+x)^3}$ (d) $\frac{4}{(x+1)^3}$
66. $x = \cos^{-1} \left(\frac{1}{\sqrt{1+t^2}} \right), y = \sin^{-1} \left(\frac{t}{\sqrt{1+t^2}} \right) \Rightarrow \frac{dy}{dx}$ is equal to

- (a) 0 (b) $\tan t$
 (c) 1 (d) $\sin t \cos t$
67. $\frac{d}{dx} \left[a \tan^{-1} x + b \log \left(\frac{x-1}{x+1} \right) \right] = \frac{1}{x^4 - 1}$
 $\Rightarrow a - 2b$ is equal to
 (a) 1 (b) -1
 (c) 0 (d) 2
68. $y = e^{a \sin^{-1} x} \Rightarrow (1 - x^2) y_{n+2} - (2n+1) x y_{n+1}$ is equal to
 (a) $-(n^2 + a^2) y_n$
 (b) $(n^2 - a^2) y_n$
 (c) $(n^2 + a^2) y_n$
 (d) $-(n^2 - a^2) y_n$
69. There is an error of ± 0.04 cm in the measurement of the diameter of a sphere. When the radius is 10 cm, the percentage error in the volume of the sphere is
 (a) ± 1.2 (b) ± 1.0
 (c) ± 0.8 (d) ± 0.6
70. The function $f(x) = x^3 + ax^2 + bx + c$, $a^2 \leq 3b$ has
 (a) one maximum value
 (b) one minimum value
 (c) no extreme value
 (d) one maximum and one minimum value
71. The maximum value of $\frac{\log x}{x}$, $0 < x < \infty$ is
 (a) ∞ (b) e
 (c) 1 (d) e^{-1}
72. $z = \tan(y + ax) + \sqrt{y - ax} \Rightarrow z_{xx} - a^2 z_{yy}$ is equal to
 (a) 0 (b) 2
 (c) $z_x + z_y$ (d) $z_x z_y$
73. $\int \frac{dx}{(x+1)\sqrt{4x+3}}$ is equal to
 (a) $\tan^{-1} \sqrt{4x+3} + c$
 (b) $3 \tan^{-1} \sqrt{4x+3} + c$
 (c) $2 \tan^{-1} \sqrt{4x+3} + c$
 (d) $4 \tan^{-1} \sqrt{4x+3} + c$
74. $\int \left(\frac{2 - \sin 2x}{1 - \cos 2x} \right) e^x dx$ is equal to
 (a) $-e^x \cot x + c$ (b) $e^x \cot x + c$
 (c) $2e^x \cot x + c$ (d) $-2e^x \cot x + c$
75. If $I_n = \int \sin^n x dx$, then $nI_n - (n-1)I_{n-2}$ equals
 (a) $\sin^{n-1} x \cos x$ (b) $\cos^{n-1} x \sin x$
 (c) $-\sin^{n-1} x \cos x$ (d) $-\cos^{n-1} x \sin x$
76. $\int_0^\pi \frac{1}{1 + \sin x} dx$ is equal to
 (a) 1 (b) 2
 (c) -1 (d) -2
77. The line $x = \frac{\pi}{4}$ divides the area of the region bounded by $y = \sin x$, $y = \cos x$ and x -axis $\left(0 \leq x \leq \frac{\pi}{2} \right)$ into two regions of areas A_1 and A_2 . Then A_1, A_2 equals
 (a) 4 : 1 (b) 3 : 1
 (c) 2 : 1 (d) 1 : 1
78. The velocity of a particle which starts from rest is given by the following table.
- | t (in second) | 0 | 2 | 4 | 6 | 8 | 10 |
|-----------------|---|----|----|----|----|----|
| v (in m/s) | 0 | 12 | 16 | 20 | 35 | 60 |
- The total distance travelled (in metre) by the particles in 10 s, using Trapezoidal rule is given by
 (a) 113 (b) 226
 (c) 143 (d) 246
79. The solution of the differential equation $\frac{dy}{dx} = \sin(x+y) \tan(x+y) - 1$ is
 (a) $\operatorname{cosec}(x+y) + \tan(x+y) = x + c$
 (b) $x + \operatorname{cosec}(x+y) = c$
 (c) $x + \tan(x+y) = c$
 (d) $x + \sec(x+y) = c$
80. The differential equation of the family $y = ae^x + bx e^x + cx^2 e^x$ of curves, where a, b, c are arbitrary constants, is
 (a) $y''' + 3y'' + 3y' + y = 0$
 (b) $y''' + 3y'' - 3y' - y = 0$
 (c) $y''' - 3y'' - 3y' + y = 0$
 (d) $y''' - 3y'' + 3y' - y = 0$

GENERAL ENGLISH AND APTITUDE

◆ **Directions (Q. 1-4) :** In each of the following questions, choose the alternative which best expresses the meaning of the word given in capital letters.

1. INTREPID
(a) Coward (b) Fearless
(c) Selfish (d) Ugly
2. LAMENTABLE
(a) Deplorable (b) Contemptible
(c) Remorseful (d) Scornful
3. DEFT
(a) Skilful (b) Vigorous
(c) Swift (d) Deceitful
4. HOARD
(a) Destroy (b) Hide
(c) Store (d) Divide

◆ **Directions (Q. 5-8) :** In each of the following questions, choose the most suitable alternative to fill in the blank.

5. He is too dull the problem.
(a) solves (b) to solve
(c) solving (d) to solving
6. The speaker drew the attention of the audience the burning issue.
(a) to (b) towards
(c) on (d) into
7. It's nine o'clock and I'm still at breakfast.
(a) till (b) yet
(c) so (d) already
8. Although he is blind, he is very fast calculations.
(a) in (b) with
(c) at (d) about

◆ **Directions (Q. 9-12) :** In each of the following questions, choose the alternative which is opposite in meaning to the word given in capital letters.

9. VIRTUE
(a) Vice (b) Fraud
(c) Wickedness (d) Crime
10. ZEAL
(a) Hostility (b) Diffidence
(c) Apathy (d) Contempt
11. AGONY
(a) Enmity (b) Cruelty
(c) Abhorrence (d) Ecstasy

12. ERUDITE
(a) Professional (b) Immature
(c) Unimaginative (d) Ignorant

◆ **Directions (Q. 13-16) :** In each of the following questions, choose the alternative which can be substituted for the given words/sentence.

13. A person who speaks for or supports an idea
(a) Pioneer (b) Adviser
(c) Advocate (d) Ideologist
14. A man of odd habits
(a) Eccentric (b) Cynical
(c) Introvert (d) Moody
15. A thing or person behind time
(a) Lazy (b) Sluggish
(c) Indolent (d) Antiquated
16. One whose attitude is : 'eat, drink and be merry'
(a) Epicurean (b) Cynic
(c) Materialistic (d) Stoic

◆ **Directions (Q. 17-20) :** In each of the following questions, choose the alternative which can best improve the given sentence by substituting the italicised portion. If the sentence is correct as it is, your answer is (d).

17. Older people *often* stay at home and watch TV because it is cold and dark in winter.
(a) seldom (b) frequently
(c) sometimes (d) No improvement
18. You must find *someone* to accompany you to Mumbai
(a) no one (b) everyone
(c) anyone (d) No improvement
19. No sooner *he reached* home than all the villagers gathered at his home to listen to his story.
(a) would he reach (b) did he reach
(c) have he reached (d) No improvement
20. I wish I *was* with him.
(a) have been (b) were
(c) am (d) No improvement

◆ **Directions (Q. 21-25) :** In the following questions, choose the option which shows common feature in the relationship given in each question.

21. Sandstone : Limestone : Coal
(a) They are formed by metamorphic rocks.
(b) They are chemical minerals.
(c) They are found in river beds.
(d) They are formed in sedimentary rocks.

22. Sweep : Scrub : Wipe
 (a) These are terms connected with rubbing.
 (b) These are games of cards.
 (c) These are terms used by motor mechanics.
 (d) These are terms connected with cleaning.
23. Delhi : Agra : Mathura
 (a) They have been capitals of the country
 (b) They have exquisite temples.
 (c) They have religious background
 (d) They are situated on the bank of river Yamuna.
24. Press : Television : Cinema
 (a) They are means of entertainment.
 (b) They are means of mass media.
 (c) They give world wide news.
 (d) All are public undertakings.
25. Comets : Stars : Satellites
 (a) They are shining masses.
 (b) They give out light.
 (c) They are rotating from left to right
 (d) They are heavenly bodies.
- ◆ **Directions (Q. 26-30) :** In the questions, choose the group of words that shows the same relationship as given at the top of every question.
26. Magazine : Story : Article
 (a) Tea : Milk : Sugar
 (b) Television : Newspaper : Entertainment
 (c) Bed : Quilt : Pillow
 (d) Novel : Drama : Literature
27. Juice : Orange : Banana
 (a) Table : Chair : Wood
 (b) Fish : Shork : Water
 (c) Cow : Milk : Curd
 (d) Ink : Pen : Pencil
28. Carnivorous : Tiger : Wolf
 (a) Mango : Banana : Fruit
 (b) Worker : Master : Manager
 (c) Cat : Cow : Milk
 (d) Student : Boy : Girl
29. Rain : Cloud : Evaporation
 (a) Pain : Injury : Accident
 (b) Cold : Cough : Sneezing
 (c) Purse : Leather : Tanning
 (d) Fragrance : Flower : Bud
30. Dog : Squirrel : Tail
 (a) Cottage : Hut : Palace
 (b) Fish : Crocodile : Water
 (c) Horse : OX : Horn
 (d) Truck : Scooter : Gear
31. The five intertwined rings or circles on the olympic flag made of white [From left to right] are
 (a) Blue, yellow, black, green and red.
 (b) Yellow, red, green, black and blue.
 (c) Red, green, black, yellow and blue.
 (d) Yellow, green black, blue and red.
32. The national remote sensing agency is located at
 (a) Delhi (b) Hyderabad
 (c) Bangalore (d) Lucknow
33. The Nobel Prize are given to Dec, 10 on the death anniversary of
 (a) Linus Pauling (b) Frederic Sanger
 (c) Alfred Bernard (d) John Bardeen
34. The term Gambit is used in
 (a) Chess (b) Boning
 (c) Baseball (d) Polo
35. Word's fastest missileship 'INS Prahar' was commissioned in
 (a) 1996 (b) 1997
 (c) 1998 (d) 1999
36. Nati is the classical dances of
 (a) Tamil Nadu (b) Assam
 (c) Himachal Pradesh (d) Andhra Pradesh
37. The headquarter of International Labour Organisation is located at
 (a) Geneva (b) Paris
 (c) New York (d) Rome
38. The first Indian woman to receive Bharat Ratna was
 (a) Mother Teresa (b) Mrs. Indira Gandhi
 (c) Ashapurana devi (d) Aarti Saha
39. 'Kip' is the currency of
 (a) Kuwait (b) Lebanon
 (c) Laos (d) Malaysia
40. The charter of the United Nations was signed on June 26, 1945 in
 (a) San Francisco (b) Washington D.C.
 (c) Landon (d) Trygue Le