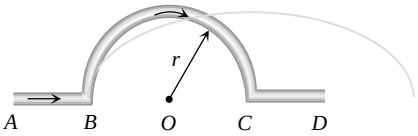
PHYSICS

Single correct questions

1. In the figure shown the magnetic induction at the centre of the arc due to the current in portion AB will be



a) $\frac{\mu_0 i}{r}$ b) $\frac{\mu_0 i}{2r}$ c) $\frac{\mu_0 i}{4r}$ d) Zero

2. A vessel containing 5 $litres$ of a gas at 0.8 m pressure is connected to an evacuated vessel of volume 3 $litres$. The resultant pressure inside will be (assuming whole system to be isolated)

a) $4/3\ m$ b) $0.5\ m$ c) $2.0\ m$ d) $3/4\ m$

3. If pressure at half the depth of a lake is equal to $2/3$ pressure at the bottom of the lake then what is depth of the lake

a) $10\ m$ b) $20\ m$ c) $60\ m$ d) $30\ m$

4. Energy gap between valence band and conduction band of a semiconductor is

a) Zero b) Infinite c) 1 eV d) 10 eV

5. A balloon is rising vertically up with a velocity of 29 ms^{-1}. A stone is dropped from it and it reaches the ground in 10 seconds. The height of the balloon when the stone was dropped from it is ($g = 9.8\ ms^{-2}$)

a) $100\ m$ b) $200\ m$ c) $400\ m$ d) $150\ m$

6. A shell is fired from a cannon with velocity v ms^{-1} at an angle θ with the horizontal direction. At the highest point in its path it explodes into two pieces of equal mass. One of the pieces retraces its path to the cannon and the speed in m/s of the piece immediately after the explosion is

a) $3v\cos\theta$ b) $2v\cos\theta$ c) $\frac{3v}{2}\cos\theta$ d) $\frac{\sqrt{3}v\cos\theta}{2}$

7. On a new scale of temperature (which is linear) and called the W scale, the freezing and boiling points of water are 39° W and 239°W respectively. What will be the temperature on the new scale, corresponding to a temperature of 39°C on the Celsius scale

a) $200^{o}W$ b) $139^{o}W$ c) $78^{o}W$ d) $117^{o}W$

8. A wooden cube (density of wood d) of slide l floats in a liquid of density ρ with its upper and lower surfaces horizontal. If the cube is pushed slightly down and released, its performs simple harmonics motion of period T, then T is equal

a) $2\pi\sqrt{\frac{l\rho}{(\rho-d)g}}$ b) $2\pi\sqrt{\frac{ld}{\rho g}}$ c) $2\pi\sqrt{\frac{l\rho}{dg}}$ d) $2\pi\sqrt{\frac{ld}{(\rho-d)g}}$

9. An electric heater rated 220 V and 550 W is connected to A.C. mains. The current drawn by it is

a) $0.8\ A$ b) $2.5\ A$ c) $0.4\ A$ d) $1.25\ A$

10. Mean life of a radioactive sample is 100 s. Then its half-life(in minutes) is

a) 0.693 b) 1 c) 10^{-4} d) 1.155

11. A capacitor with air as the dielectric is charged to a potential of 100 $volts$. If the space between the plates is now filled with a dielectric of dielectric constant 10, the potential difference between the plates will be

a) 1000 $volts$ b) 100 $volts$ c) 10 $volts$ d) Zero

12. The energy of an electron in an excited hydrogen atom is -3.4 eV. Its angular momentum is

a) 3.72×10^{-34}Jsb) 2.11×10^{-34}Jsc) 1.57×10^{-34}Jsd) 1.11×10^{-34}Js

13. A radar sends the waves towards a distant object and receives the signal reflected by object. These waves are

a) Sound waves b) Light waves c) Radio waves d) Micro waves

14. Given that $2l\sqrt{\frac{m}{T}}$, where l is the length of a string of linear density m, under tension T ha the same dimensional formula as that of

a) Mass b) Time c) Length d) Mole

15. In a Young's double slit experiment the intensity at a point where the path difference is $\frac{\lambda}{6}$ (λ being the wavelength of the light used) is I. If I_0 denotes the maximum intensity, $\frac{I}{I_0}$ is equal to

a) $\frac{1}{\sqrt{2}}$ b) $\frac{\sqrt{3}}{2}$ c) $1/2$ d) $3/4$

16. To break a wire of one metre length, minimum 40 $kg\ wt$, is required. Then the wire of the same material of double radius and 6 m length will require breaking weight

a) 80 kg-wt b) 240 kg-wt c) 200 kg-wt d) 160 kg-wt

17. Magnetic lines of force due to a bar magnet do not intersect because

a) A point always has a single net magnetic field
b) The lines have similar charges and so repel each other
c) The lines always diverge from a single point
d) The lines need magnetic lenses to be made to intersect

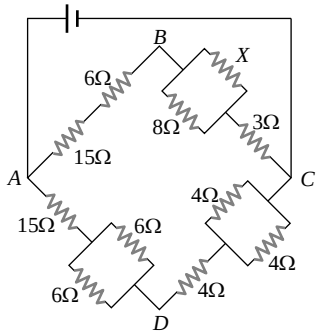
18. A tuning fork vibrates with 2 beats in 0.04 second. The frequency of the fork is

a) 50 Hz b) 100 Hz c) 80 Hz d) None of these

19. At a given temperature the $r.m.s.$ velocity of molecules of the gas is

a) Same
b) Proportional to molecular weight
c) Inversely proportional to molecular weight
d) Inversely proportional to square root of molecular weight

20. In the figure given the value of X resistance will be, when the p.d. between B and D is zero



a) 4 ohm b) 6 ohm c) 8 ohm d) 9 ohm

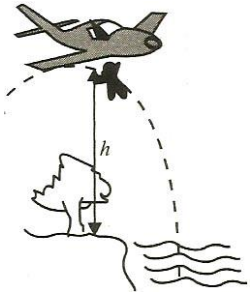
Integer Answer Type

21. A ball is projected from the origin. The x-and y-coordinates of its displacement are given by $x = 3t$ and $y = 4t - 5t^2$. Find the velocity of projection (in m/sec)

22. A capacitor with stored energy 4.0 J is connected with an identical capacitor with no electric field in between. Find the total energy stored (in J) in the two capacitors

23. A current of 2 A is increasing at a rate 4 A/s through a coil of inductance 1 H. Find the energy stored in the inductor per unit time in the units of J/s

24. A man of mass $M = 58$ kg jumps from an aeroplane as shown in Fig. He sees the hard ground below him and a lake at a distance $d = 1$ m from the point directly below him. He immediately puts off his jacket (mass $m = 2$ kg) and throws it in a direction directly away from the lake. If he just fails to strike the ground, find the distance (in 10^1 m) he should walk now to pick his jacket. (Neglect air resistance and take the velocity of man at the time of jump with respect to earth zero)



25. A freshly prepared sample of a radioisotope of half-life 1386s has activity 10^3 disintegrations per second. Given that In $2 = 0.693$, the fraction of the initial number of nuclei (expressed in nearest integer percentage) that will decay in the first 80s after preparation of the sample is

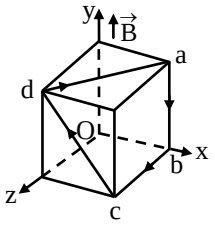
26. A disc is rotating freely about its axis. Percentage change in angular velocity of disc if temperature decreases by 20 °C is (coefficient of linear expansion of material of disc is 5×10^{-4}/°C)

27. A particle starting from rest undergoes acceleration given by $a = |t - 2|$ m/s^2 where t is time in sec. Velocity of particle after 4 sec is –

28. M grams of steam at 100°C is mixed with 200g of ice at its melting point in a thermally insulated container. If it produces liquid water at 40°C [heat of vaporization of water is 540 cal/g and heat of fusion of ice is 80 cal/g], the value of M is_____.

29. A charged particle is accelerated through a potential difference of 12 kV and acquires a speed of 10^6 ms^{-1}. It is projected perpendicularly into the magnetic field of strength 0.2 T. The radius of circle described is…… × 10 cm.

30. In figure, the cube is 40.0 cm on each edge. Four straight segments of wire ab, bc, cd and da form a closed loop that carries a current I = 5.00 A, in the direction shown. A uniform magnetic field of magnitude B = 0.020 T is in the positive y-direction. Determine the magnitude and direction of the magnetic force on each segment.



CHEMISTRY

Single Correct Answer Type

1. A radioactive element is:

a) Sulphur b) Polonium c) Tellurium d) Selenium

2. Nitration of salicylic acid will give:

a) 2,4,6-trinitophenol
b) 2,4,6-trinitrobenzoic acid
c) 2,4,6-trinitrobenzene
d) None of the above

3. Which of the following oxides doesn't react with both of an acid and alkali, is?

a) ZnO b) SnO_2 c) Al_2O_3 d) BeO

4. Silver nitrate produces a black stain on skin due to:

a) Its corrosive action
b) Its reduction to metallic silver
c) Its strong reducing action
d) The formation of a complex compound

5. Sodium metal cannot be stored under:

a) Benzene b) Kerosene c) Alcohol d) Toluene

6. Which of the following statements is correct?

a) Aniline is stronger base than ammonia
b) Methylamine is a stronger base than aniline and ammonia
c) Aniline is stronger than ammonia, but weaker base than methylamine
d) Methylamine is stronger than aniline, but weaker base than ammonia

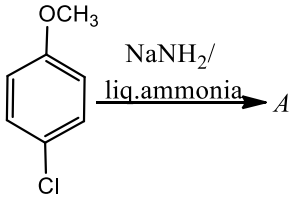
7. A copolymer of vinyl chloride and vinyledene chloride is called:

a) Dynel b) Saran c) Vinylon d) Orlon

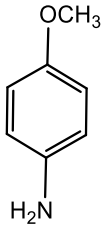
8. In a solution of 7.8 g benzene (C_6H_6) and 46.0 g toluene ($C_6H_5CH_3$), the mole-fraction of benzene is

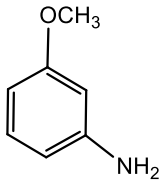
a) $\frac{1}{2}$ b) $\frac{1}{3}$ c) $\frac{1}{5}$ d) $\frac{1}{6}$

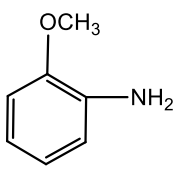
9. In the reaction,

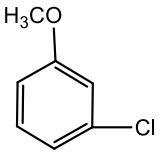


The major product *A* is

a) 

b) 

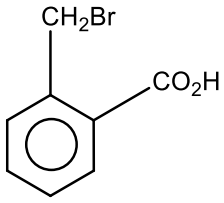
c) 

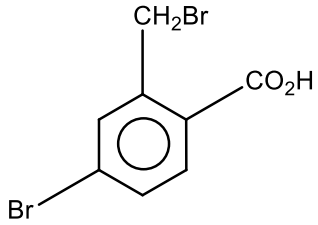
d) 

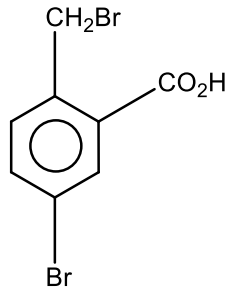
10. Among the following, the compound that contains ionic, covalent and coordinate linkage is

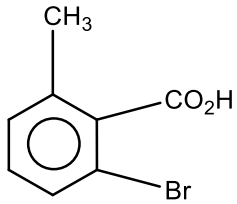
a) NH_3 b) NH_4Cl c) NaCl d) CaO

11. *o*-toluic acid on reaction with $Br_2 + Fe$ gives

a) 

b) 

c) 

d) 

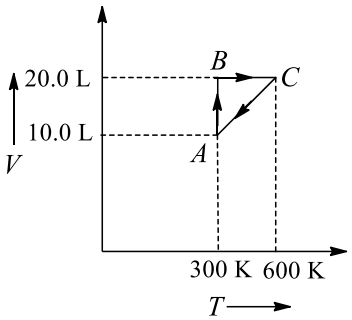
12. Which is not used as pigment in paints?

a) Lead dioxide b) White lead c) Lead chromate d) Pb_3O_4

13. H_2O_2 converts potassium ferrocyanide to ferricyanide. The change observed in the oxidation state of iron is:

a) $Fe^{2+} \longrightarrow Fe^{3+}$ b) $Fe \longrightarrow Fe^{2+}$ c) $Fe^{3+} \longrightarrow Fe^{2+}$ d) $Fe^{2+} \longrightarrow Fe^{+}$

14. This graph expresses the various steps of the system containing 1 mole of gas. Which type of process, system has when it moves from *C* to *A*?



a) Isochoric b) Isobaric c) Isothermal d) Cyclic

15. Protons accelerate the hydrolysis of esters. This is an example of :

a) A heterogeneous catalysis
b) An acid-base catalysis
c) A promoter
d) A negative catalyst

16. If isotopic distribution of C-12 and C-14 is 98% and 2% respectively then the number of C-14 atoms in 12 g of carbon is

a) 1.032×10^{22} b) 3.01×10^{22} c) 5.88×10^{23} d) 6.023×10^{23}

17. State the oxidation number of carbonyl carbon in methanal and methanoic acid respectively

a) 0 and 0 b) 0 and +2 c) +1 and +2 d) +1 and +3

18. A solid having no definite shape is called :

a) Amorphous solid b) Crystalline solid c) Anisotropic d) None of these

19. Which of the following statements is not true?

a) Some disinfectants can be used as antiseptic at low concentration
b) Sulphadiazine is a synthetic antibacterial
c) Ampicillin is natural antibiotic
d) Aspirin is analgesic and antipyretic both

20. 50% neutralization of a solution of formic acid ($K_a = 2 \times 10^{-4}$) with NaOH would result in a solution having a hydrogen ion concentration of:

a) 2×10^{-4} b) 3.7 c) 2.7 d) 1.85

Integer Answer Type

21. Magnetic moment of a complex is 4.9 BM. Thus, unpaired electron(s) may be....

22. What is the total score for the correct statement(s) from the following

Given: $MnO_4^{\ominus} + 8H^{\oplus} + 5e^- \rightarrow Mn^{2+} + 4H_2O; E^{\ominus} = 1.51$ V

$Fe^{3+} + e^- \rightarrow Fe^{2+}$; $E^{\ominus} = 0.77$ V

$Cl_2 + 2e^- \rightarrow 2Cl^{\ominus}; E^{\ominus} = 1.36$ V

	Statement	Score
a	$MnO_4^{\ominus}$ is sufficiently strong oxidant in acidic solution (pH = 0) to oxidize Fe^{2+} ion	1
b	Fe^{2+} ion cannot be titrated against standard $KMnO_4$ solution if the medium is made acidic (pH = 0) by adding HCl	2
c	$MnO_4^{\ominus}$ ion cannot oxidize Ce^{3+} in acidic medium (pH = 0)	3
d	Fe^{2+} cannot be titrated against standard $KMnO_4$ solution in acidic medium (pH = 0) in the presence of Ce^{3+} ion	4

23. In question (1) above, number of α −particles emitted is in question ……..

24. In the case of a first order reaction, the time required for 93.75% of reaction to take place is x times that required for half of the reaction. Find the value of x

25. The enthalpy changes of some processes are given below .

$\propto -D-\text{glucose}_{(s)} + H_2O \rightarrow \propto -D-\text{glucose}_{(aq.)}$; Heat of dissolution = 10.84 kJ

$\beta -D-\text{glucose}_{(s)} + H_2O \rightarrow \beta -D-\text{glucose}_{(aq.)}$; Heat of dissolution = 4.68 kJ

$\propto -D-\text{glucose}_{(aq.)} + H_2O \rightarrow \beta -D-\text{glucose}_{(aq.)}$; Heat of mutarotation = 1.16 kJ

The ΔH° for $\propto -D-\text{glucose} \rightarrow \beta -D-\text{glucose}$ is ....

26. A sample of Pure $KHC_2O_4.H_2C_2O_4.2H_2O$ (three replaceable hydrogen) requires 4.62 mol of NaOH for titration. How many milli moles of $KMnO_4$ will the same sample react with.

27. 1000 gm of 1 (m) sucrose solution in water is cooled to –3.554ºC. What mass of ice would be separated out in nearest possible integers in gm at this temperature ?
For water k_f = 1.86 K mol^{-1} kg

28. The enthalpy of vapourisation of water = $45.953 \frac{kJ}{mol}$

At 1 atm pressure the boiling point of water is 373 K. What is the boiling point of water when pressure equal to $\frac{1}{2}$ atm in Kelvin in nearest possible integers ?
Given : log 2 = 0.3

29. The enthalpy of vapourisation of water = 45.953 kJ/mol. At 1 atm pressure the boiling point of water is 373 K. What is the boiling point of water when pressure equal to ½ atm in Kelvin in nearest possible integers?
Given : log 2 = 0.3

30. The molar volume of liquid benzene (density = 0.8 gm/ml) increases by a factor of 2750 as it vapourises at 20ºC and that of liquid benzene (density = 0.867 gm/ml) increases by a factor of 7720 at 20ºC. A solution of benzene and toluene at 20ºC has a vapour pressure of 46.0 torr. What is the mole percentage of benzene in the solution in nearest possible integers ?

MATHEMATICS

Single Correct Answer Type

1. If $f(x) = |\log|x||$, then

a) $f(x)$ is continuous and differentiable for all x in its domain

b) $f(x)$ is continuous for all x in its domain but not differentiable at $x = \pm 1$

c) $f(x)$ is neither continuous nor differentiable at $x = \pm 1$

d) None of the above

2. The solution of the differential equation $\frac{dy}{dx} = \frac{x-2y+1}{2x-4y}$ is

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

3. If $\tan^{-1}\frac{x-1}{x+2} + \tan^{-1}\frac{x+1}{x+2} = \frac{\pi}{4}$, then x is equal to

a) $\frac{1}{\sqrt{2}}$ b) $-\frac{1}{\sqrt{2}}$ c) $\pm\sqrt{\frac{5}{2}}$ d) $\pm\frac{1}{2}$

4. Consider the inequalities$x_1 + x_2 \leq 3, 2x_1 + 5x_2 \geq 10; x_1, x_2 \geq 0$. Which of the point lies in the feasible region?

a) (2, 2) b) (1, 2) c) (2, 1) d) (4, 2)

5. If the sum of the roots of the quadratic equation $ax^2 + bx + c = 0$ is equal to the sum of the square of their reciprocals, then $\frac{a}{c}, \frac{b}{a}$ and $\frac{c}{b}$ are in

a) Arithmetic progression b) Geometric progression

c) Harmonic progression d) Arithmetico-geometric progression

6. If the primitive of $\sin^{-3/2} x \sin^{-1/2}(x+\theta)$ is $-2\,\text{cosec}\theta\sqrt{f(x)} + c$, then

a) $f(x) = \frac{\sin x}{\sin(x+\theta)}$ b) $f(x) = \tan(x+\theta)$ c) $f(x) = \frac{\sin(x+\theta)}{\sin x}$ d) $f(x) = \frac{\tan(x+\theta)}{\sin x}$

7. The number of common tangents to two circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 8x + 12 = 0$ is

a) 1 b) 2 c) 5 d) 3

8. In order to remove first degree terms from the equation $2x^2 + 7y^2 + 8x - 14y + 4 = 0$, the origin is shifted at the point

a) $(-2, 1)$ b) $(1, 2)$ c) $(2, 1)$ d) $(1, -2)$

9. The point $P(a, b)$ lies on the straight line $3x + 2y = 13$ and the point $Q(b, a)$ lies on the straight line $4x - y = 5$, then equation of the line PQ is

a) $x - 5 = 5$ b) $x + y = 5$ c) $x + y = -5$ d) $x - y = -5$

10. $\sum_{k=0}^{10} {}^{20}C_k$ is equal to

a) $2^{19} + \frac{1}{2}{}^{20}C_{10}$ b) 2^{19} c) ${}^{20}C_{10}$ d) None of these

11. If ${}^{8}C_r - {}^{7}C_3 = {}^{7}C_2$, then r is equal to

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

12. A point on XOZ- plane divides the join of $(5, -3, -2)$ and $(1,2, -2)$ at

a) $\left(\frac{13}{5}, 0, -2\right)$

b) $\left(\frac{13}{5}, 0,2\right)$

c) (5,0,2)

d) $(5,0, -2)$

13. If $f(x) = \frac{1}{x+1} - \log(1+x), x > 0$, then f is

a) an increasing function b) a decreasing function

c) both increasing and decreasing function d) None of the above

14. If $\sin^{-1} x + \sin^{-1} y = \frac{\pi}{2}$, then $\frac{dy}{dx}$ is equal to

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

15. The area of the figure bounded by the parabolas $x = -2y^2$ and $x = 1 - 3y^2$ is

a) 8/3 b) 6/3 c) 4/3 d) 2/3

16. Which of the following propositions is a contradiction?

a) $(\sim p \vee \sim q) \vee (p \vee \sim q)$ b) $(p \to q) \vee (p \wedge \sim q)$ c) $(\sim p \wedge q) \wedge (\sim q)$ d) $(\sim p \wedge q) \vee (\sim q)$

17. In a ΔABC, if $C = 60°$, then $\frac{a}{b+c} + \frac{b}{c+a} =$

a) 2 b) 1 c) 4 d) None of these

18. If $x^2 + 2ax + 10 - 3a > 0$ for all $x \in R$, then

a) $-5 < a < 2$ b) $a < -5$ c) $a > 5$ d) $2 < a < 5$

19. If A and B are two matrices such that both $A+B$ and AB are defined, then

a) A and B are of same order b) A is of order $m \times m$ and B is of order $n \times n$

c) Both A and B are of same order $n \times n$ d) A is of order $m \times n$ and B is of order $n \times m$

20. If A and B are two mutually exclusive events, then

a) $P(A) < P(\bar{B})$ b) $P(A) > P(\bar{B})$ c) $P(A) < P(B)$ d) None of these

Integer Answer Type

21. Three distinct points $P(3u^2, 2u^3)$; $Q(3v^2, 2v^2)$ and $R(3w^2, 2w^2)$ are collinear then $uv + vw + wu$ is equal to

22. Let $f : R \to R$ be a continuous odd function, which vanishes exactly at one point and $f(1) = \frac{1}{2}$. Suppose that $F(x) = \int_{-1}^{x} f(t)\,dt$ for all $x \in [-1, 2]$ and $G(x) = \int_{-1}^{x} t \mid f\{f(t)\}\mid dt$ for all $x \in [-1, 2]$. If $\lim_{x \to 1} \frac{F(x)}{G(x)} = \frac{1}{14}$, then the value of $f\left(\frac{1}{2}\right)$ is

23. The coefficient of the quadratic equation $ax^2 + (a+d)x + (a+2d) = 0$ are consecutive terms of a positively valued, increasing arithmetic sequence. Then the least integral value of $\frac{d}{a}$ such that the equation has real solutions is

24. If $f(x) = \sqrt{4 - x^2} + \sqrt{x^2 - 1}$, then the maximum value of $\left(f(x)\right)^2$ is

25. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} \cdot \vec{b} = 0 = \vec{a} \cdot \vec{c}$ and the between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$, then find the value of $|\vec{a} \times \vec{b} - \vec{a} \times \vec{c}|$

26. The number of integral values of m, for which the $x-$co-ordinate of the point of intersection of the lines $3x + 4y = 9$ and $y = mx + 1$ is also an integer is

27. If y = 1/x, then the value of $\frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} + 1$ is equal to-

28. The minimum value of $\frac{12}{\pi}\left(\operatorname{cosec}^{-1}\left[3x^2+\frac{5}{4}\right]+\sec^{-1}\left[3x^2+\frac{1}{4}\right]\right)$ is equal to (where [·] denotes the greatest integer function)

29. If equation $\cot^4 x - 2\operatorname{cosec}^2 x + a^2 = 0$ has at least one solution then, sum of all possible integral values of a is

30. The numerical value of coefficient of x^5 in the expansion of $(2 - x + 3x^2)^6$ is.....