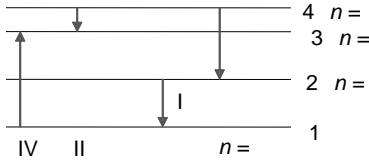


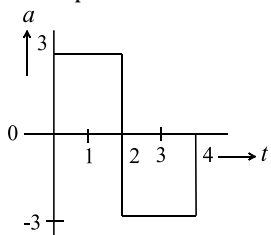
# PHYSICS

## Single Correct Answer Type

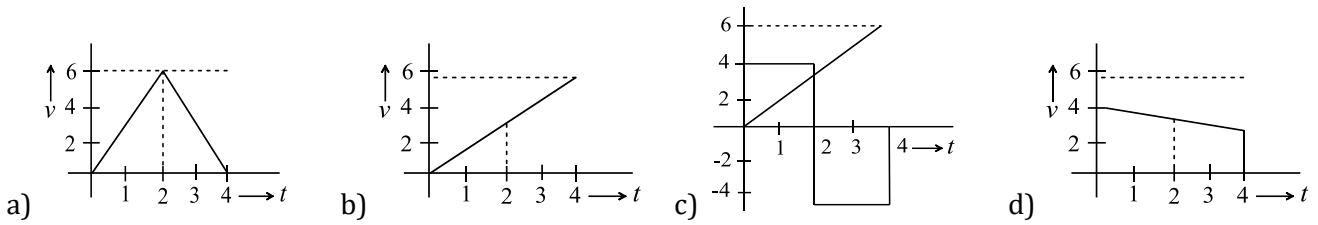
1. In a fission reaction  ${}_{92}^{236}\text{U} = X^{117} + Y^{117} + n + n$ , the binding energy per nucleon of  $X$  and  $Y$  is 8.5 MeV, whereas of  ${}_{92}^{236}\text{U}$  is 7.6 MeV. The total energy liberated will be about
- a) 200 keV                      b) 2 MeV                      c) 200 MeV                      d) 2000 MeV
2. Reactance of a capacitor of capacitance  $C\mu\text{F}$  for ac frequency  $\frac{400}{\pi}\text{Hz}$  is  $25\Omega$ . The value  $C$  is
- a)  $50\mu\text{F}$    b)  $25\mu\text{F}$    c)  $100\mu\text{F}$    d)  $75\mu\text{F}$
3. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?



- a) III                      b) IV                      c) I                      d) II
4. Which one of the following units is not that of mutual inductance?
- a) Henry                      b)  $(\text{Weber})^{-1}$   
c) Ohm second   d) Volt second (ampere) $^{-1}$
5. A transverse wave propagating on a stretched string of linear density  $3 \times 10^{-4}\text{ kg m}^{-1}$  is represented by the equation  $y = 0.2 \sin(1.5x + 60t)$  where  $x$  is in meter and  $t$  is in second. The tension in the string (in newton) is
- a) 0.24  
b) 0.48  
c) 1.20  
d) 1.80
6. A gas undergoes a process in which its pressure  $p$  and volume  $V$  are related as  $Vp^n = \text{constant}$ . The bulk modulus for the gas in this process is
- a)  $np$                       b)  $p^{1/n}$                       c)  $\frac{p}{n}$                       d)  $p^n$
7. An expression for the magnetic field strength  $B$  at the point between the capacitor plates indicates in figure express  $B$  in terms of the rate of change of the electric field strength  $i.e., dE/dt$  between the plates
- a)  $\frac{\mu_0 i}{2\pi r}$                       b)  $\frac{\epsilon_0 \mu_0 r}{2} dE/dt$                       c) Zero                      d)  $\frac{\mu_0 i}{2r}$
8. An electron, moving in a uniform magnetic field of induction of intensity  $\vec{B}$ , has its radius directly proportional to
- a) Its charge                      b) Magnetic field                      c) Speed                      d) None of these
9. A particle starts from rest at  $t = 0$  and undergoes an acceleration  $a$  in  $\text{ms}^{-2}$  with time  $t$  in seconds which is as shown



Which one of the following plot represents velocity  $V$  in  $\text{ms}^{-1}$  versus time  $t$  in seconds



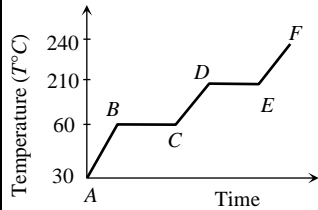
10. Which of the following statements is not true

- a) While taking reading of tangent galvanometer, the plane of the coil must be set at right angles to the earth's magnetic meridian
- b) A short magnet is used in a tangent galvanometer since a long magnet would be heavy and may not easily move
- c) Measurement with the tangent galvanometer will be more accurate when the deflection is around  $45^\circ$
- d) A tangent galvanometer can not be used in the polar region

11. Molecular motion shows itself as

- a) Temperature
- b) Internal Energy
- c) Friction
- d) Viscosity

12. A solid substance is at  $30^\circ\text{C}$ . To this substance heat energy is supplied at a constant rate. Then temperature versus time graph is as shown in the figure. The substance is in liquid state for the portion (of the graph)



- a) BC
- b) CD
- c) ED
- d) EF

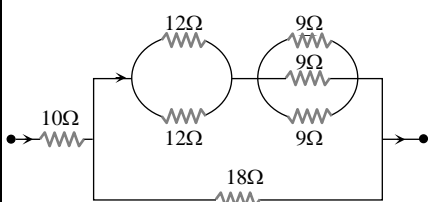
13. A second's pendulum is mounted in a rocket. Its period of oscillation decreases when the rocket

- a) Comes down with uniform acceleration
- b) Moves round the earth in a geostationary orbit
- c) Moves up with a uniform velocity
- d) Moves up with uniform acceleration

14. A star is going away from the earth. An observer on the earth will see the wavelength of light coming from the star

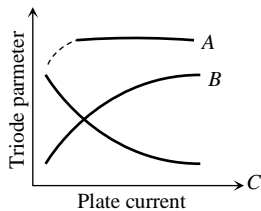
- a) Decreased
- b) Increased
- c) Neither decreased nor increased
- d) Decreased or increased depending upon the velocity of the star

15. In the following circuit,  $18\Omega$  resistor develops  $2\text{J}/\text{sec}$  due to current flowing through it. The power developed across  $10\Omega$  resistance is



- a)  $125\text{ W}$
- b)  $10\text{ W}$
- c)  $\frac{4}{5}\text{ W}$
- d)  $25\text{ W}$

16. The figure represents variation of triode parameter ( $\mu$  or  $r_p$  or  $g_m$ ) with the plate current. The correct variation of  $\mu$  and  $r_p$  are given, respectively by the curves

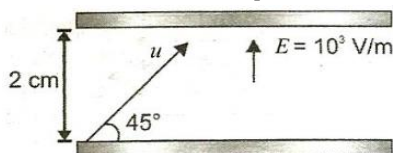


- a) A and B                      b) B and C                      c) A and C                      d) None of the above

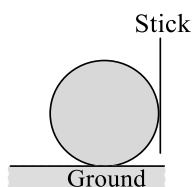
17. A particle executing simple harmonic motion with amplitude of  $0.1\text{ m}$ . At a certain instant when its displacement is  $0.02\text{ m}$ , its acceleration is  $0.5\text{ m/s}^2$ . The maximum velocity of the particle is (in  $\text{m/s}$ )  
 a) 0.01                      b) 0.05                      c) 0.5                      d) 0.25
18. A steel wire of cross-sectional area  $3 \times 10^{-6}\text{ m}^2$  can withstand a maximum strain of  $10^{-3}$ . Young's modulus of steel is  $2 \times 10^{11}\text{ Nm}^{-2}$ . The maximum mass the wire can hold is (take  $g = 10\text{ ms}^{-2}$ )  
 a) 40 kg                      b) 60 kg                      c) 80 kg                      d) 100 kg
19. Positive and negative point charges of equal magnitude are kept at  $(0,0,\frac{a}{2})$  and  $(0,0,-\frac{a}{2})$ , respectively. The work done by the electric field when another positive point charge is moved from  $(-a,0,0)$  to  $(0,a,0)$  is  
 a) Positive  
 b) Negative  
 c) Zero  
 d) Depends on the path connecting the initial and final positions
20. The working of venturimeter is based on  
 a) Torricelli's law                      b) Pascal's law  
 c) Bernoulli's theorem                      d) Archimede's principle

### Integer Answer Type

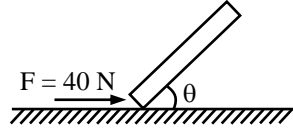
21. Two inductors  $L_1$  (inductance  $1\text{ mH}$ , internal resistance  $3\Omega$ ) and  $L_2$  (inductance  $2\text{ mH}$ , internal resistance  $4\Omega$ ), and a resistor  $R$  (resistance  $12\Omega$ ) are all conducted in parallel across a  $5\text{V}$  battery. The circuit is switched on at time  $t = 0$ . The ratio of the maximum to the minimum current ( $I_{\text{max}}/I_{\text{min}}$ ) drawn from the battery is
22. A particle having charge that of an electron and mass  $1.6 \times 10^{-30}\text{ kg}$  is projected with an initial speed  $u$  at an angle  $45^\circ$  to the horizontal from the lower plate of a parallel-plate capacitor as shown in the figure. The plates are sufficiently long and have separation  $2\text{ cm}$ . the maximum value of velocity of particle not to hit the upper plate is  $\sqrt{W} \times 10^6\text{ m/s}$ . take electric field between the plates as  $10^3\text{ V/m}$  directed upward. Find  $W$



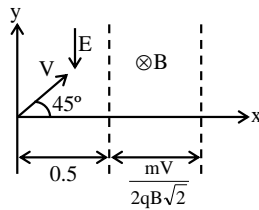
23. A boy is pushing a ring of mass  $2\text{ kg}$  and radius  $0.5\text{ m}$  with a stick as shown in the figure. The stick applies a force of  $2\text{ N}$  on the ring and rolls it without slipping with an acceleration of  $0.3\text{ m/s}^2$ . The coefficient of friction between the ground and the ring is large enough that rolling always occurs and the coefficient of friction between the stick and the ring is  $(P/10)$ . The value of  $P$  is



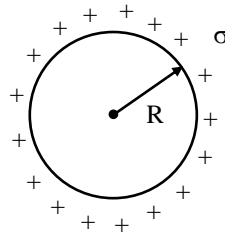
24. The activity of a freshly prepared radioactive sample is  $10^{10}$  disintegration per second, whose mean life is  $10^{-9}$ s. The mass of an atom of this radioisotope is  $10^{-25}$  kg. The mass (in mg) of the radioactive sample is
25. In a square cut, the speed of the cricket ball changes from 30 m/s to 40 m/s during the time of its contact  $\Delta t = 0.01$  s with the bat. If the ball is deflected by the bat through an angle of  $\theta = 90^\circ$ , find the magnitude of the average acceleration (in  $\times 10^2 \text{ m/s}^2$ ) of the ball during the square cut
26. A point P is located on the rim of wheel of radius  $r = 0.5$  m which rolls without slipping along a horizontal surface then the total distance traversed by the point P in meters between two successive moments it touches the surface.
27. A homogeneous rod of mass 3 kg is pushed along smooth horizontal surface by a horizontal force  $F = 40$  N. The angle ' $\theta$ ' (in degree) for which rod has pure translation motion minus 30 degree is  $(g = 10 \text{ m/s}^2)$  –



28. A charge particle of charge  $q$  and mass  $m$  is projected in a region which contains electric and magnetic field as shown in figure with velocity  $V$  at an angle  $45^\circ$  with  $x$ -direction. If  $V = \sqrt{\frac{qE}{m}}$ , then net deviation in particle motion will be (neglect the effect of gravity) in clockwise direction approx in radian .....



29. Consider a uniformly charged spherical shell of radius  $R$  as shown in figure. Calculate the force experienced by the upper half of shell



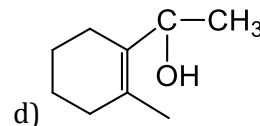
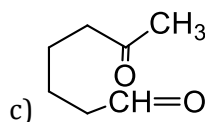
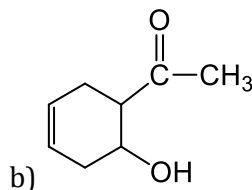
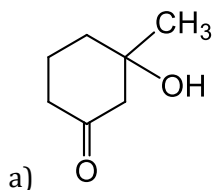
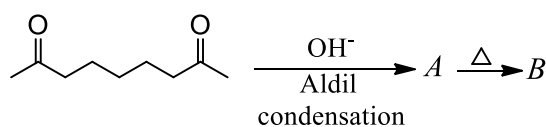
30. A ball is thrown upwards from the foot of a tower. The ball crosses the top of tower twice after an interval of 4 seconds and the ball reaches ground after 8 seconds, then the height of tower in meters is :  $(g = 10 \text{ m/s}^2)$

# CHEMISTRY

## Single Correct Answer Type

- Pb and Sn are extracted from their Chief ores by:
  - Carbon reduction and self reduction
  - Self reduction and carbon reduction
  - Electrolysis and self reduction
  - Self reduction and electrolysis
- What weight of  $\text{HNO}_3$  is required to make 1 litre of 2 N solution to be used as an oxidising agent in the reaction?  $3\text{Cu} + 8\text{HNO}_3 \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$ 
  - 63 g
  - 21 g
  - 42 g
  - 84 g

- Which has the minimum bond energy?
  - $\text{H}-\text{Br}$
  - $\text{H}-\text{I}$
  - $\text{I}-\text{I}$
  - $\text{H}-\text{H}$
- Predict the product for the following



- Number of acidic hydrogen atom in butyne-1 is:
  - 2
  - 3
  - 1
  - 4
- The correct order of decreasing polarity is
  - $\text{HF} > \text{SO}_2 > \text{H}_2\text{O} > \text{NH}_3$
  - $\text{HF} > \text{H}_2\text{O} > \text{SO}_2 > \text{NH}_3$
  - $\text{HF} > \text{NH}_3 > \text{SO}_2 > \text{H}_2\text{O}$
  - $\text{H}_2\text{O} > \text{NH}_3 > \text{SO}_2 > \text{HF}$
- The correct order of  $E^\circ_{M^{2+}/M}$  values with negative sign for the four successive elements Cr, Mn, Fe and Co is
  - $\text{Mn} > \text{Cr} > \text{Fe} > \text{Co}$
  - $\text{Cr} > \text{Fe} > \text{Mn} > \text{Co}$
  - $\text{Fe} > \text{Mn} > \text{Cr} > \text{Co}$
  - $\text{Cr} > \text{Mn} > \text{Fe} > \text{Co}$
- Schottky defects occurs mainly in electrovalent compounds where
  - Positive ions and negative ions are of different size
  - Positive ions and negative ions are of same size
  - Positive ions are small and negative ions are big
  - Positive ions are big and negative ions are small
- Weight of 112 mL of oxygen at NTP on liquefaction would be:
  - 0.32 g
  - 0.64 g
  - 0.96 g
  - 0.16 g
- The chemistry of lithium is very much similar to that of magnesium even though they are placed in different groups. The reason is:
  - Both have nearly the same size
  - The ratio of their charge to size is nearly the same
  - Both have similar electronic configuration
  - Both are found together in nature
- The solubility order for the following gases is :
  - $\text{NH}_3 > \text{CO}_2 > \text{O}_2 > \text{H}_2$

- b)  $H_2 > O_2 > NH_3 > CO_2$   
 c)  $CO_2 > NH_3 > O_2 > N_2$   
 d)  $O_2 > H_2 > NH_3 > CO_2$

12. Anti-allergy drugs are

- a) Antimicrobials      b) Antihistamines      c) Antivirals      d) Antifungals

13. Soaps are generally prepared from :

- a) Linseed oil      b) Coconut oil      c) Groundnut oil      d) Mustard oil

14. HA is a weak acid. The pH of 0.1 M HA solution is 2. What is the degree of dissociation ( $\alpha$ ) of HA?

- a) 0.5      b) 0.2      c) 0.1      d) 0.301

15.  $H_2O_2$  acts as an oxidizing agent in:

- a) Neutral medium  
 b) Acidic medium  
 c) Alkaline medium  
 d) acidic as well as in alkaline medium

16. Grignard reagent shows addition on:

- a)  $>C=O$       b)  $-C\equiv N$       c)  $>C=S$       d) All of these

17. Which is planar molecule?

- a)  $XeO_4$       b)  $XeF_4$       c)  $XeOF_4$       d)  $XeO_2F_2$

18. Thiokol is a

- a) fibre      b) Plastic      c) Rubber      d) Monomer

19. The molecular formula of benzonitrile is

- a)  $C_6H_5CN$       b)  $C_6H_5NC$       c)  $C_6H_5CNO$       d)  $C_6H_5NCO$

20. How many moles of lead (II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g of HCl?

- a) 0.333      b) 0.011      c) 0.029      d) 0.044

### Integer Answer Type

21. What is order of reaction for which rate becomes half if volume of the container having same amount of reactant is doubled? Assume gaseous phase reaction

22.  ${}_{92}^{238}U$  nucleus absorbs a neutron and disintegrates into  ${}_{54}^{139}Xe$ ,  ${}_{38}^{94}Sr$ , and  $x$ . What will be the product  $x$ ?

- a) 3 neutrons      b) 2 neutrons      c) 2  $\alpha$ -particles      d) 2  $\beta$ -particles

23. There are ..... electron in  $e_g$  orbitals is  $[CoF_6]^{3-}$

24. Out of the following properties how many are path functions?

Heat enthalpy, internal energy, Temperature, Work, Heat, Specific heat

25.  $E^\circ$  for a cell having 2 electrons involved in redox change is 0.2655 V. The equilibrium constant for the redox change is  $10^a$ . The value of  $a$  is ...

26. At  $27^\circ C$ ,  $\Delta H_{\text{combustion}}(\text{sucrose}) = -6000 \text{ kJ/mol}$  &  $\Delta G_{\text{combustion}}(\text{sucrose}) = -6600 \text{ kJ/mol}$ .

Calculate additional work (in kJ/mol) that may be obtained by metabolism of sucrose in blood when blood temperature is raised to 310 K.

27. A room, cubic in shape has an edge length of 500 cm. The room temperature is  $27^{\circ}\text{C}$  and the relative humidity inside the room is 40%. How many killo-grams of anhydrous calcium oxide are required to keep the air dry in the room ? Assume ideal behaviour for water vapour.  
(Given  $\rightarrow$  vapour pressure of water at  $27^{\circ}\text{C}$   
 $= 19$  torr ; give your answer in the form of nearest integer)
28. The basicity of boric acid is .....
29. P toluidine reacts with benzene diazonium chloride to form compound which on boiling with Aq.  $\text{H}_2\text{SO}_4$  give How many product.
30. In borax ( $\text{Na}_2\text{B}_4\text{O}_7, 10\text{H}_2\text{O}$ ) the number of B-O-B bonds is .....

# MATHEMATICS

## Single Correct Answer Type

1. The order and degree of the following differential equation  $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{5/2} = \frac{d^3y}{dx^3}$  are respectively  
 a) 3,2                                      b) 3,10                                      c) 2,3                                      d) 3,5
2. Let  $f(x)$  be a function satisfying  $f(x + y) = f(x) + f(y)$  and  $f(x) = x g(x)$  for all  $x, y \in R$ , where  $g(x)$  is continuous. Then,  
 a)  $f'(x) = g'(x)$                                       b)  $f'(x) = g(x)$                                       c)  $f'(x) = g(0)$                                       d) None of these
3. The equation of the tangent to the parabola  $y^2 = 8x$  which is perpendicular to the line  $x - 3y + 8 = 0$  is  
 a)  $9x + 3y + 2 = 0$                                       b)  $3x + y + 2 = 0$                                       c)  $3x - y - 1 = 0$                                       d)  $9x - 3y + 2 = 0$
4. Let  $\alpha, \beta$  be the roots of  $x^2 - 2x \cos \phi + 1 = 0$ , then the equation whose roots are  $\alpha^n, \beta^n$ , is  
 a)  $x^2 - 2x \cos n\phi - 1 = 0$                                       b)  $x^2 - 2x \cos n\phi + 1 = 0$   
 c)  $x^2 - 2x \sin n\phi + 1 = 0$                                       d)  $x^2 + 2x \sin n\phi - 1 = 0$
5. In a right angled triangle, the hypotenuse is four times as long as the perpendicular drawn to it from the opposite vertex. One of the acute angle is  
 a)  $15^\circ$     b)  $30^\circ$     c)  $45^\circ$     d) None of these
6. The area bounded by the  $x$ -axis, part of the curve  $y = 1 + \frac{8}{x^2}$  and the ordinates  $x = 2$  and  $x = 4$ , is divided into two equal parts by the ordinate  $x = a$ , then the value of 'a' is  
 a)  $2\sqrt{2}$                                       b)  $\pm 2\sqrt{2}$                                       c)  $\pm\sqrt{2}$                                       d)  $\pm 2$
7. The set of all real  $x$  satisfying the inequality  $\frac{3-|x|}{4-|x|} > 0$   
 a)  $[-3, 3] \cup (-\infty, -4) \cup (4, \infty)$                                       b)  $(-\infty, -4) \cup (4, \infty)$   
 c)  $(-\infty, -3) \cup (4, \infty)$                                       d)  $(-\infty, -3) \cup (3, \infty)$
8. The value of  $b$  for which the function  $f(x) = \sin x - bx + c$  is decreasing in the interval  $(-\infty, \infty)$  is given by  
 a)  $b < 1$     b)  $b \geq 1$     c)  $b > 1$     d)  $b \leq 1$
9. If  $\sin^{-1} x + \sin^{-1} y + \sin^{-1} z = \frac{3\pi}{2}$  and  $f(1) = 2$ ,  
 $f(p + q) = f(p) \cdot f(q), \forall p, q \in R$ , then  
 $x^{f(1)} + y^{f(2)} + z^{f(3)} - \frac{(x+y+z)}{x^{f(1)+y^{f(2)}+z^{f(3)}}}$  is equal to  
 a) 0                                      b) 1                                      c) 2                                      d) 3
10. For the LPP Min  $z = 2x + y$  subject to constraints  $5x + 10y \leq 50, x + y \geq 1, y \leq 4$  and  $x, y \geq 0$ , then  $z$  is  
 a) 0    b) 1    c) 2    d) 12
11. A line makes acute angles of  $\alpha, \beta$  and  $\gamma$  with the coordinate axes such that  
 $\cos \alpha \cos \beta = \cos \beta \cos \gamma = \frac{2}{9}$   
 And  $\cos \gamma \cos \alpha = \frac{4}{9}$ ,  
 Then  $\cos \alpha + \cos \beta + \cos \gamma$  is equal  
 To  
 a)  $\frac{25}{9}$                                       b)  $\frac{5}{9}$                                       c)  $\frac{5}{3}$                                       d)  $\frac{2}{3}$
12. The value of  $\frac{1}{81^n} = \frac{10}{81^n} {}^{2n}C_1 + \frac{10^2}{81^n} {}^{2n}C_2 - \frac{10^3}{81^n} {}^{2n}C_3 + \dots + \frac{10^{2n}}{81^n}$ , is  
 a) 2                                      b) 0                                      c)  $1/2$                                       d) 1



13. If  $y = ae^x + be^{-x} + c$  where  $a, b, c$  are parameters, then  $y'$  is equal to  
 a)  $yb)$   $y'c)$   $0$  d)  $y''$
14. If  $A = \begin{bmatrix} 4 & 2 \\ 3 & 4 \end{bmatrix}$ ,  $|\text{adj } A|$  is equal to  
 a) 6 b) 16 c) 10 d) None of these
15.  $\int \frac{\sin x}{\sin(x-\alpha)} dx$  is  
 a)  $x \sin \alpha + \cos \alpha \log \sin(x + \alpha) + c$  b)  $x \sin \alpha + \cos \alpha \log \sin(x - \alpha) + c$   
 c)  $x \cos \alpha + \sin \alpha \log \cos(x + \alpha) + c$  d)  $x \cos \alpha + \sin \alpha \log \sin(x - \alpha) + c$
16. If the line  $\frac{x}{a} + \frac{y}{b} = 1$  moves such that  $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{c^2}$  where  $c$  is a constant, then the locus of the foot of the perpendicular from the origin to the line is  
 a) Straight line b) Circle c) Parabola d) Ellipse
17. The points  $(1, 3)$  and  $(5, 1)$  are the opposite vertices of a rectangle. The other two vertices lie on the line  $y = 2x + c$ , then the value of  $c$  will be  
 a) 4 b) -4 c) 2 d) -2
18.  $p \vee q$  is true when  
 a) Both  $p$  and  $q$  are true b)  $p$  is true and  $q$  is false c)  $p$  is false and  $q$  is true d) All of these
19. An anti-aircraft gun can take a maximum of four shots at any plane moving away from it. The probabilities of hitting the plane at the 1st, 2nd, 3rd and 4th shots are 0.4, 0.3, 0.2 and 0.1 respectively. What is the probability that at least one shot hits the plane?  
 a) 0.6976 b) 0.3024 c) 0.72 d) 0.6431
20. How many 10 digit numbers can be written by using the digits 1 and 2?  
 a)  ${}^{10}C_1 + {}^{10}C_2$  b)  $2^{10}$  c)  ${}^{10}C_2$  d)  $10!$

### Integer Answer Type

21. The value of  $\begin{vmatrix} 2x_1y_1 & x_1y_2 + x_2y_1 & x_1y_3 + x_3y_1 \\ x_1y_2 + x_2y_1 & 2x_2y_2 & x_2y_3 + x_3y_2 \\ x_1y_3 + x_3y_1 & x_2y_3 + x_3y_2 & 2x_3y_3 \end{vmatrix}$  is
22. If  $\vec{a}, \vec{b}$  and  $\vec{c}$  are unit vectors satisfying  $|\vec{a} - \vec{b}|^2 + |\vec{b} - \vec{c}|^2 + |\vec{c} - \vec{a}|^2 = 9$ , then  $|2\vec{a} + 5\vec{b} + 5\vec{c}|$  is equal to
23. Let  $S$  denote sum of the series  $\frac{3}{2^3} + \frac{4}{2^4 \cdot 3} + \frac{5}{2^6 \cdot 3} + \frac{6}{2^7 \cdot 5} + \dots \infty$ . Then the value of  $S^{-1}$  is
24. If  $f(x) = \sqrt{4-x^2} + \sqrt{x^2-1}$ , then the maximum value of  $(f(x))^2$  is
25. The largest value of the non-negative integer  $a$  for which  $\lim_{x \rightarrow 1} \left\{ \frac{-ax + \sin(x-1) + a}{x + \sin(x-1) - 1} \right\}^{\frac{1-x}{1-\sqrt{x}}} = \frac{1}{4}$  is
26. In a triangle ABC, if P, Q, R divides AB, BC, CA respectively in  $k : 1$  (in order) &  $\frac{\text{ar}(\Delta PQR)}{\text{ar}(\Delta ABC)} = \frac{1}{3}$  then  $k$  is.....
27. Find all positive values of 'a' for which the equation  $\log(ax) = 2 \log(x+1)$  has the unique root.
28. Find number of real roots of the equation  $e^x + 3x + 2 = 0$ .
29. Two rays with common end point 'O' form a  $30^\circ$  angle. Point A lies on one ray. Point B on the other ray and  $AB = 1$ . Find the maximum possible length of OB.
30. Let  $P(x)$  be a polynomial of degree 4, with

$P(2) = -1$ ,  $P'(2) = 0$ ,  $P''(2) = 2$ ,  $P'''(2) = -12$  and  $P^{iv}(2) = 24$ . Calculate  $P''(1)$ .