Set - A

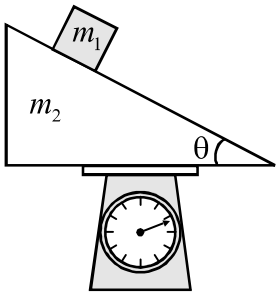
PART - I

PHYSICS

1. A balloon is filled with hydrogen at a given pressure at 20°C. What fraction of gas will escape out of the balloon if the temperature rises to 40°C at constant pressure ?

(a) 0.5 (b) 0.06 (c) 0.25 (d) 0.751

2. A wedge of mass m_2 sits at rest on a scale as shown in figure. A small block of mass m_1 slides down the frictionless incline of the wedge. Wedge does not move.Find the scale reading while the block slides :



(a) $(m_1 + m_2)g + m_1 g \sin^2\theta$ (b) $(m_1 + m_2)g - m_1 g \sin^2\theta$

(c) $(m_1 - m_2)g + m_1 g \sin^2\theta$ (d) none of the above

3. A copper (density of Cu = ρ_c) ball of diameter d is immersed in oil of density ρ_0. What is the charge on the ball if, in a homogeneous electric field E directed vertically upward, it is suspended in the oil? (ball is positively charged) $\left(k = \pi d^3 \frac{\rho_c g}{E}\right)$

(a) $\frac{1}{6}k\left(1-\frac{\rho_0}{\rho_c}\right)$ (b) $\frac{1}{3}k\left(1-\frac{\rho_0}{\rho_c}\right)$ (c) $\frac{1}{2}k\left(1-\frac{\rho_0}{\rho_c}\right)$ (d) $k\left(1-\frac{\rho_0}{\rho_c}\right)$

SPACE FOR ROUGH WORK

4. The linear density of a vibrating string is $10^{-4}\ kg\ m^{-1}$. A transverse wave is propagating on the string, which is described by the equation $y = 0.02\sin 9(x + 30t)$

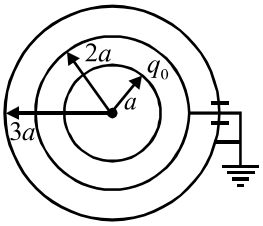
where x and y are in metres and time t is in seconds. The tension in the string is :

(a) $0.09\ N$ (b) $0.36\ N$ (c) $0.9\ N$ (d) $3.6\ N$

5. The three rods shown in figure have identical geometrical dimensions. Heat flows from the hot end at a rate of 40 W in the arrangement (i). Find the rates of heat flow when the rods are joined as in arrangement (ii). Thermal conductivities of aluminium and copper are $200 W/m-^{o}C$ and $400 W/m-^{o}C$ respectively.

(a) 40 W (b) 400 W (c) 120 W (d) 320 W

6. Three concentric conducting spherical shells are arranged as shown in fig. The innermost sphere is given a charge q_0 what are the charges in the middle and the outermost sphere respectively ?



(a) q_0 and $-q_0$ (b) $-q_0$ and zero

(c) zero and q_0 (d) $-q_0$ and $+q_0$

SPACE FOR ROUGH WORK

Set - A

7. In u – v method to find focal length of a concave mirror, if object distance was found to be 10.0 cm and image distance was found to be 40.0 cm then what will be the max – permissible error in f, due to error is u and v measurement.

(a) 1.25% (b) 1.65% (c) 2.65% (d) 2.85%

8. The width of one of the two slits in a Young's double slit experiment is double of the other slit. Assuming that the amplitude of the light coming from a slit is proportional to the slit width, find the ratio of the maximum to the minimum intensity in the interference pattern.

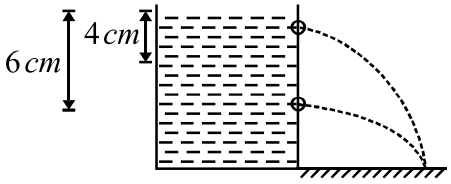
(a) 3 (b) 6 (c) 9 (d) 12

9. Two vessels A and B contain water at temperatures T_A and T_B of $10°C$ and $2°C$ respectively. If water in both the vessels is compressed adiabatically, then T_A and T_B will:

(a) increase and decrease respectively (b) decrease and increase respectively

(c) both increase (d) both decrease

10. Fig. shows two holes in a wide tank containing a liquid column. The water streams coming out of these holes strike the ground at the same point. The height of liquid column in the tank is



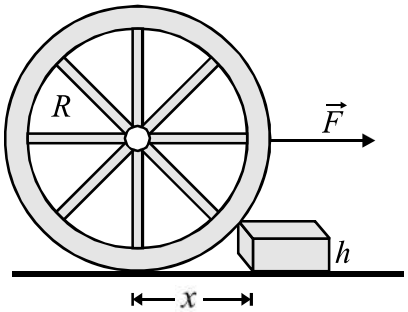
(a) 10 cm (b) 8 cm (c) 9.8 cm (d) 980 cm

SPACE FOR ROUGH WORK

11. A coil of inductance $5.0\,H$ and resistance $500\,\Omega$ is connected to a battery of emf $50\,V$. The energy stored in the magnetic field associated with the coil at an instant $10\,ms$ after the circuit is switched on, is :

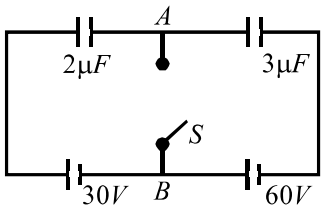
(a) $40\,mJ$ (b) $5\,mJ$ (c) $10\,mJ$ (d) $0.4\,mJ$

12. A wheel of mass M and radius R rests on a horizontal surface against a step of height $h(h < R)$. The wheel is to be raised over the step by a horizontal force $\vec{F}$ applied to the axle of the wheel as shown in figure. Find the minimum force $\vec{F}$ necessary to raise the wheel over the step :



(a) $\frac{Mg\sqrt{h(2R-h)}}{R-h}$ (b) $\frac{Mg\sqrt{h(2R+h)}}{R-h}$ (c) $\frac{2Mg\sqrt{h(2R+h)}}{R-h}$ (d) none of these

13. Find the charge which will flow from B to A when the switch S is closed.



(a) $+60\mu C$ (b) $+120\mu C$

(c) $-120\mu C$ (d) $+80\mu C$

SPACE FOR ROUGH WORK

Set - A

14. A charged particle, at any instant, has acceleration $\vec{a} = 2\hat{i} + y\hat{j} - 3\hat{k}$ in a magnetic field $\vec{B} = \hat{i} + 2\hat{j} + 4\hat{k}$ then the value of y is :

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

15. When two magnets held together in a vibration magnetometer are allowed to oscillate in the earth's magnetic field with like poles together 12 oscillations per minute are made, but for unlike poles together only 4 oscillations per minute are executed. The ratio of their magnetic moments is :

(a) $3:1$ (b) $1:3$ (c) $3:5$ (d) $5:4$

16. When an a.c. source is connected to a $100\,\Omega$ resistor, the power drawn is 300 watt. An inductance of $5\,H$ is now connected in series with the resistor such that the net impedance is $150\,\Omega$. Find the power drawn.

(a) $200\,W$ (b) $133.3\,W$ (c) $100\,W$ (d) $50\,W$

17. A plano-convex lens has a focal length of $30\,cm$. Its convex surface is silvered. Point object is placed at a distance of $15\,cm$ from it. Then, the magnification produced is : (given $\mu_g = 1.5$)

(a) 0.2 (b) 0.4 (c) 0.5 (d) 0.6

SPACE FOR ROUGH WORK

18. When light from a monochromatic discharge tube containing hydrogen atoms falls on sodium surface of work function $1.8\,eV$, the maximum kinetic energy of the emitted electrons is $0.9\,eV$.

(a) the energy of photons causing photoelectric emission is $2.9\,eV$

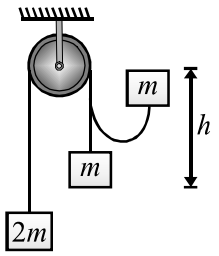
(b) the recoil speed of hydrogen atoms is $0.86\,ms^{-1}$

(c) the recoil speed of hydrogen atoms is $2.86\,ms^{-1}$

(d) Both (a) and (b) are correct

(Mass of hydrogen atom $=1.67\times10^{-27}\,kg$)

19. A mass $2\,m$ rests on a horizontal table. It is attached to a light inextensible string which passes over a smooth pulley and carries a mass m at the other end. If the mass m is raised vertically through a distance h and is then dropped, then the speed with which the mass $2\,m$ begins to rise is :



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

20. Axis of a solid cylinder of infinite length and radius R lies along y-axis, it carries a uniformly distributed current 'i' along +y direction. Magnetic field at a point $\left(\frac{R}{2}, y, \frac{R}{2}\right)$ is:

(a) $\frac{\mu_0 i}{4\pi R}(\hat{i}-\hat{k})$ (b) $\frac{\mu_0 i}{4\pi R}(\hat{j}-\hat{k})$ (c) $\frac{\mu_0 i}{4\pi R}\hat{j}$ (d) $\frac{\mu_0 i}{4\pi R}(\hat{i}+\hat{k})$

SPACE FOR ROUGH WORK

PART - II

CHEMISTRY

21. Select the **correct** statement :

(a) O-nitrophenol>p-nitrophenol (volatile nature)

(b) $CH_3Cl > CH_2Cl_2 > CHCl_3$ (dipole moment)

(c) $BF_3 > AlCl_3 > NCl_3$ (bond angle)

(d) (a) and (b) both

22. Which is **correctly** matched :

(a) Semiwater gas $\left[CO + H_2\right]$

(b) Pseudohalide $\left[CN^-\right]$

(c) Dry ice (solid CO_2)

(d) (b) and (c) both

23. Select the **correct** statement :

(a) O_2 is strong oxidising agent than O_3

(b) CO is obtained by reaction of $HCOOH$ and H_2SO_4

(c) HFO_3 exist

(d) All of them

SPACE FOR ROUGH WORK

24. Match the column :

Molecule	**Hybridisation**
(a) $XeOF_2$	sp^3d^2
(b) ICl_4^-	sp^3
(c) I_3^-	sp^3d
(d) $POCl_3$	sp^3d

25. Which one of the following statements is **not true**:

(a) Buna-S is a copolymer of butadiene and styrene

(b) Natural rubber is a 1,4-Polymer of isoprene

(c) In vulcanization, the formation of sulphur bridges between different chains make rubber harder and stronger

(d) Natural rubber has the trans configuration at every double bond

26. Arrange the following in increasing order of energy :

(i) $n = 4, \ell = 2, m = -1, s = +1/2$ (ii) $n = 3, \ell = 2, m = -1, s = -1/2$

(iii) $n = 4, \ell = 0, m = 0, s = +1/2$ (iii) $n = 5, \ell = 0, m = 0, s = -1/2$

(a) $i < ii < iii < iv$ (b) $iii < ii < iv < i$ (c) $iii < iv < ii < i$ (d) $ii < iii < i < iv$

SPACE FOR ROUGH WORK

Set - A

27. Ammonium chloride crystallizes in a body-centred cubic lattice with edge length of unit cell equal to 387 pm. If the radius of Cl^- ion is 181 pm, the radius of NH_4^+ ion would approximately:

(a) 116 pm (b) 154 pm (c) 174 pm (d) 206 pm

28. A 0.020 m solution of each of the following compounds is prepared. Which solution would you expect to freeze at $-0.149°C$?

K_f (water) = $1.86\,K\,kg.mol^{-1}$

(a) $\left[Co(en)_2Cl_2\right]Cl$ (b) $Na[Co(EDTA)]$ (c) $\left[Cr(py)_5Cl\right]Cl_2$ (d) $\left[Cr(NH_3)_6\right]Cl_3$

Where, py= pyridine (unidentate),

en = ethylenediamine (bidentate) and EDTA = ethylenediaminetetraacetic acid (hexadentate)

29. Rearrange the following (1 to 4) in the order of increasing masses :

(1) 0.5 mole of O_3 (2) 0.5 gm atom of oxygen

(3) 3.011×10^{23} molecule of O_2 (4) 5.6 Lt of CO_2 at STP

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

30. Which of the following reaction shows calcination process :

(a) $ZnS + O_2 \xrightarrow{\Delta} ZnO + CO_2$ (b) $FeO + SiO_2 \xrightarrow{\Delta} FeSiO_3$

(c) $CuFeS_2 \xrightarrow{\Delta} Cu_2S + FeS$ (d) $CuCO_3.Cu(OH)_2 \xrightarrow{\Delta} CuO + CO_2 + H_2O$

SPACE FOR ROUGH WORK

31. The **thermal stability** of IIA carbonate is :

(a) $BeCO_3 > MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$

(b) $BaCO_3 > SrCO_3 > MgCO_3 > CaCO_3 > BeCO_3$

(c) $BeCO_3 < MgCO_3 < SrCO_3 < CaCO_3 < BaCO_3$

(d) $BeCO_3 < MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

32. Calculate equilibrium constant (approx) at 25°C for the cell reaction

$$Fe_{(s)} + CuSO_4 \rightleftharpoons FeSO_4 + Cu_{(s)}$$

Given : $E^{\circ}_{Fe/Fe^{+2}} = +0.453\,volt$; $E^{\circ}_{Cu/Cu^{+2}} = -0.3435\,volt$

(a) 1.0×10^{25} (b) 1.0×10^{20} (c) 1.0×10^{27} (d) 1.0×10^{22}

33. Uncertainty in position and momentum are equal. Uncertainty in velocity is :

(a) $\sqrt{\frac{h}{\pi}}$ (b) $\frac{h}{2\pi}$ (c) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ (d) None of these

SPACE FOR ROUGH WORK

Set - A

34. The equilibrium constant K_{p1} and K_{p2} for the reactions $X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P+Q$; respectively are in the ratio of 1 : 9. If the degree of dissociation of X and Z be equal then calculate value of $\sqrt{\frac{P_2}{P_1}}$ where P_1 and P_2 are total pressure of given two reactions at their equilibrium

(a) 9 (b) 1/9 (c) 6 (d) 1/6

35. A complex is prepared by mixing $CoCl_3$ and NH_3, 0.1 M solution of this complex was found to freeze at $-0.372°C$. The formula of complex is (Molal depression constant of water = 1.86°C/m)

(a) $\left[Co(NH_3)_6\right]Cl_3$ (b) $\left[Co(NH_3)_5\right]Cl_2$

(c) $\left[Co(NH_3)_4Cl_2\right]Cl$ (d) $\left[Co(NH_3)_3Cl_3\right]$

36. Which of the following reaction represent the bond energy :

(a) $HCl(g) \rightarrow \frac{1}{2}H_2(g)+\frac{1}{2}Cl_2(g)$ (b) $HCl(g) \rightarrow H^+(g)+Cl^-(g)$

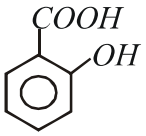
(c) $HCl(g) \rightarrow H(g)+Cl(g)$ (d) $2HCl(g) \rightarrow H_2(g)+Cl_2(g)$

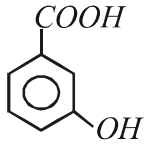
SPACE FOR ROUGH WORK

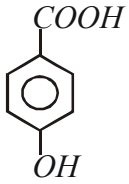
37. Compounds $Ni(CO)_x, Fe(CO)_y$ and $K_2[Fe(CN)_6]$ follow EAN rule then :

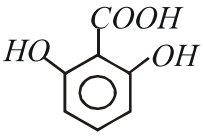
(a) $x < y < z$ (b) $x = y > z$ (c) $x = z < y$ (d) $x > y = z$

38. Which of following is maximum acidic ?

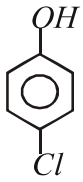
(a) 

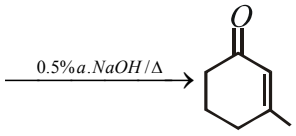
(b) 

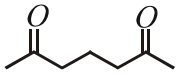
(c) 

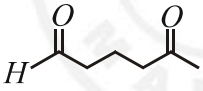
(d) 

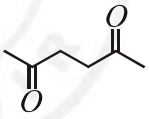
39. Which of the following compounds, conjugate base is stablized by d-orbital resonance :

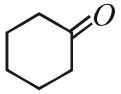
(a) $Cl_3C-CH_2CO_2H$ (b) Cl_3C-CO_2H (c) Cl_3CH (d) 

40. ? 

(a) 

(b) 

(c) 

(d) 

SPACE FOR ROUGH WORK

Set - A

PART - III

MATHEMATICS

41. Number of integer element(s) in the domain of the function f(x) = $\log_2\left(-\log_{1/2}\left(1+\frac{1}{\sqrt[4]{x}}\right)-1\right)$ is

(a) 0 (b) 1 (c) 2 (d) none of these

42. If $\lim_{x\to 0}\frac{\sin 2x - a\sin x}{x^3}$ exists then $a =$

(a) 2 (b) 1 (c) – 2 (d) 3

43. If $f(x) = \begin{cases} (1+|\sin x|)^{\frac{a}{|\sin x|}} & , -\frac{\pi}{6} < x < 0 \\ b & , x = 0 \\ e^{\frac{\tan 2x}{\tan 3x}} & , 0 < x < \frac{\pi}{6} \end{cases}$ is continuous function on $\left(-\frac{\pi}{6}, \frac{\pi}{6}\right)$. Then

(a) a = $\frac{1}{3}$, b = e (b) a = $\frac{1}{2}$, b = e^2 (c) a = $\frac{2}{3}$, b = $e^{2/3}$ (d) a = $\frac{2}{3}$, b = $\frac{2}{3}$

SPACE FOR ROUGH WORK

44. If $y^3 + 6x^2 + x^3 = 0$ and $\frac{d^2y}{dx^2} + \frac{k x^2}{y^5} = 0$, then k =

(a) 4 (b) 8 (c) 16 (d) none of these

45. The interval in which the function $f(x) = \int_0^x \left(\frac{t}{t+2} - \frac{1}{t} \right) dt$ will be non increasing is

(a) $(-2,-1] \cup (0,3]$ (b) $(-2,-1) \cup [0,2]$

(c) $(-2,-1] \cup (0,2]$ (d) none of these

46. The point on the line y = x such that the sum of the squares of its distances from the point (a, 0), (–a, 0) and (0, b) is minimum will be -

(a) (a/6, a/6) (b) (a, a) (c) (b/6, b/6) (d) none of these

47. The value of $\int_0^{\pi/2} \frac{\sin^2 x}{1+\sin x \cos x} dx$ is equal to

(a) $\frac{\pi}{3\sqrt{3}}$ (b) $\frac{\pi}{2}$ (c) $\frac{\log(\sqrt{2}+1)}{\sqrt{2}}$ (d) none of these

SPACE FOR ROUGH WORK

Set - A

48. Area of region $f(x)=\sqrt{x}+1$ enclosed by x-axis and lines $x=0$ to $x=4$ is

(a) $\frac{28}{3}$ (b) $\frac{20}{3}$ (c) $\frac{14}{3}$ (d) $\frac{56}{3}$

49. Solution of differential equation $\frac{dy}{dx}+\frac{1}{x}=\frac{e^y}{x}$ is

(a) $\frac{1}{xe^y}=-\frac{1}{x}+C$ (b) $\frac{1}{xe^y}=\frac{1}{x}+C$ (c) $\frac{1}{xe^y}=\frac{2}{x}+C$ (d) $\frac{1}{xe^y}=-\frac{2}{x}+C$

50. If a > 0, b > 0, c > 0 and minimum value of $a(b^2 + c^2) + b(c^2 + a^2) + c(a^2 + b^2)$ is λabc then $\lambda =$

(a) 2 (b) 1 (c) 6 (d) 3

51. The sum of the roots of the equation $(x-2)^2-2|x-2|-15=0$ is

(a) 2 (b) 4 (c) 3 (d) 7

SPACE FOR ROUGH WORK

52. If $z_r (r = 1, 2, ..., 6)$ are vertices of a regular hexagon and its circum centre is $1+i$ then $\sum_{r=1}^{6} z_r^{\,2} =$

(a) $12i$ (b) $6i$ (c) 12 (d) none of these

53. Value of the term independent of x in the expansion of $\left(4 + x + 7x^2\right)\left(x - \frac{3}{x}\right)^{11}$ is

(a) $3^6\left({}^{11}C_5\right)$ (b) $3^5\left({}^{11}C_6\right)$ (c) $3^3\left({}^{11}C_5\right)$ (d) none of these

54. Let 20 distinct balls have been randomly distributed in to 4 distinct boxes, 5 into each. Let 'A' be the event that two specific balls have been put into a particular box. The probability of occurrence of event 'A' is :

(a) $\frac{1}{19}$ (b) $\frac{4}{19}$ (c) $\frac{8}{19}$ (d) none of these

SPACE FOR ROUGH WORK

Set - A

55. If f(x) = tan x and A, B, C are the angles of ΔABC, then $\begin{vmatrix} f(A) & f(\pi/4) & f(\pi/4) \\ f(\pi/4) & f(B) & f(\pi/4) \\ f(\pi/4) & f(\pi/4) & f(C) \end{vmatrix}$ =

(a) 0 (b) – 2 (c) 2 (d) 1

56. If $A = \begin{bmatrix} 1 & 2 \\ 3 & -5 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$ and X is a matrix such that A = BX, then X equals -

(a) $\frac{1}{2}\begin{bmatrix} -2 & 4 \\ 3 & 5 \end{bmatrix}$ (b) $\frac{1}{2}\begin{bmatrix} 2 & 4 \\ 3 & -5 \end{bmatrix}$ (c) $\begin{bmatrix} 2 & 4 \\ 3 & -5 \end{bmatrix}$ (d) None of these

57. The radius of the circle with centre $\left(\frac{1}{k}, \frac{3}{2}\right)$ and the passes through point of intersection of $x^2 + y^2 - 2x = 0$ and $x^2 + y^2 - 4y - 4 = 0$ is

(a) $\frac{\sqrt{85}}{4}$ (b) $\frac{\sqrt{229}}{4}$ (c) $\frac{\sqrt{75}}{4}$ (d) none of these

SPACE FOR ROUGH WORK

58. In a model, an arc of a bridge is semi- elliptical with major axis horizontal. If the length of the base is $9m$ and the highest part of the bridge is $3m$ from the horizontal. The height of the arch at $2m$ from the centre of the base is

(a) $\frac{11}{4}m$ (b) $\frac{\sqrt{65}}{3}m$ (c) $\frac{7}{3}m$ (d) $2m$

59. If $15\sin^4 x+10\cos^4 x=6$, Then $\tan^2 x=$

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

60. Let vectors $\vec{a}=(3,-1,5)$ and $\vec{b}=(1,2,-3)$. If a vector $\vec{c}$ which is perpendicular to $z-$axis and satisfy $\vec{c}\cdot\vec{a}=9$ and $\vec{c}\cdot\vec{b}=-4$ then $|\vec{c}|=$

(a) $\sqrt{14}$ (b) $\sqrt{2}$ (c) $\sqrt{13}$ (d) none of these

SPACE FOR ROUGH WORK