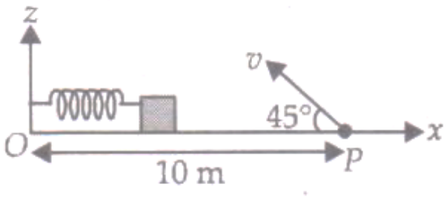
PHYSICS

Q.1 A small block is connected to one end of a massless spring of up-stretched length 4.9 m. The other end of the spring (see the figure) is fixed. The system lies on a horizontal frictionless surface. The block is stretched by 0.2 m and released from rest at $t = 0$. It then executes simple harmonic motion with angular frequency $\omega = \frac{\pi}{3} rad/s$. Simultaneously at $t = 0$, a small pebble is projected with speed v from point P at an angle of 45° as shown in the figure. Point P is at a horizontal distance of 10 m from O. If the pebble hits the block at $t = 1s$, the value of v is (Take $g = 10 m/s^2$)



(a) $\sqrt{50}\ m/s$

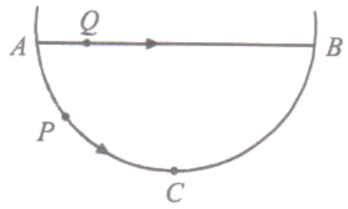
(b) $\sqrt{51}\ m/s$

(c) $\sqrt{52}\ m/s$

(d) $\sqrt{53}\ m/s$

Ans. (a)

Q.2 A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at $t = 0$. At this instant of time, the horizontal components of its velocity is v. A bead Q of the same mass as P is ejected from A at $t = 0$ along the horizontal string AB, with speed v. Friction between the bead and the string may be neglected. Let $t_p and\ t_Q$ be the respective times taken by P and Q to reach the point B. Then



(a) $t_p < t_Q$

(b) $t_p = t_Q$

(c) $t_p > t_Q$

(d) $\frac{t_p}{t_Q} = \frac{Length\ of\ arc\ ACB}{Length\ of\ chord\ AB}$

Ans. (a)

Q.3 A man on motor bike travels from Career Academy nahan towards hospitals. While taking a left turn he fell to towards Ranital gate (towards right). What can be the reason.

(a) Centrifugal force

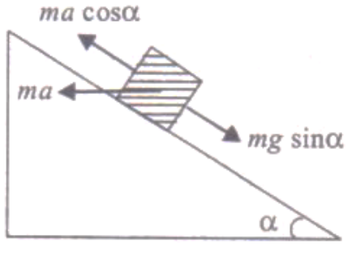
(b) Friction force

(c) Centripetal force

(d) Acceleration

Ans. (a)

Q.4 A block is kept on a frictionless inclined surface with angle of inclination α. The incline is given an acceleration a to keep the block stationary. Then a is equal to



(a) g

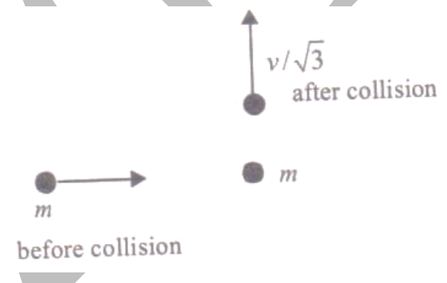
(b) $g \tan\alpha$

(c) $g / \tan\alpha$

(d) $g\ cosec\alpha$

Ans. (b)

Q.5 A mass m moves with a velocity v and collides inelastically with another identical mass. After collision the first mass moves with velocity in a direction perpendicular to the initial directions of motion. Find the speed of the 2nd mass after collision.



(a) $\frac{2}{\sqrt{3}} v$

(b) $\frac{v}{\sqrt{3}}$

(c) v

(d) $\sqrt{3} v$

Ans. (a)

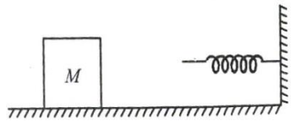
Q.6 The block of mass M moving on the frictionless horizontal surface collides with the spring of spring constant K and compresses it by length L. The maximum momentum of the block after collision is

(a) Zero

(b) $\frac{ML^2}{K}$

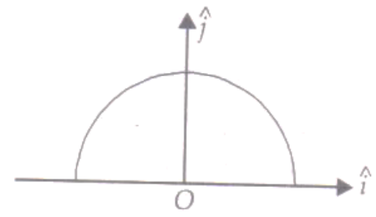
(c) $\sqrt{MK}\ L$

(d) $\frac{KL^2}{2M}$



Ans. (c)

Q.7 A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is



(a) $\frac{q}{2\pi^2 \varepsilon_0 r^2} \hat{j}$

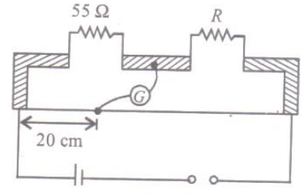
(b) $\frac{q}{4\pi^2 \varepsilon_0 r^2} \hat{j}$

(c) $-\frac{q}{4\pi^2 \varepsilon_0 r^2} \hat{j}$

(d) $-\frac{q}{2\pi^2 \varepsilon_0 r^2} \hat{j}$

Ans. (d)

Q.8 Shown in the figure below is a meter-bridge set up with null deflection in the galvanometer. The value of the unknown resistance R is



(a) 55Ω

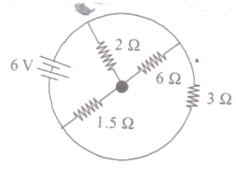
(b) 13.75Ω

(c) 220Ω

(d) 110Ω

Ans. (c)

Q.9 The total current supplied to the circuit by the battery is



(a) 1A

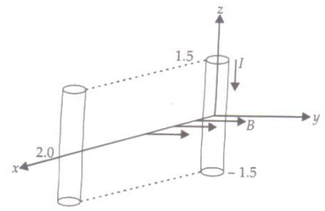
(b) 2A

(c) 4A

(d) 6A

Ans. (c)

Q.10 A conductor lies along the z-axis at $-1.5 \le z < 1.5\,m$ and carries a fixed current of 10.0 A in $-\hat{a}_z$ direction (see figure). For a field $\vec{B} = 3.0 \times 10^{-4} e^{-0.2x} \hat{a}_y T$, find the power required to move the conductor at constant speed to $x = 2.0\,m, y = 0m$ in $5 \times 10^{-3} s$. Assume parallel motion along x-axis.



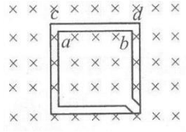
(a) 29.7 W
(b) 1.57 W
(c) 2.97 W
(d) 14.85 W

Ans. (c)

Q.11 The material suitable for making electromagnets should have
(a) High retentivity and high coercivity
(b) Low retentivity and low coercivity
(c) High retentivity and low coercivity
(d) Low retentivity and high coercivity

Ans. (b)

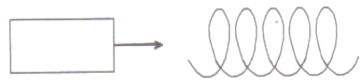
Q.12 The figure shows certain wire segments joined together to from a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure. The magnitude of the field increase with the time. I_1 and I_2 are the currents in the segments ab and cd. Then,



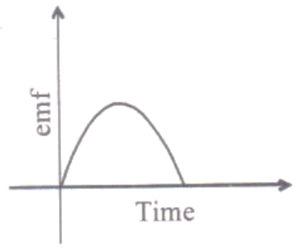
(a) $I_1 > I_2$
(b) $I_1 < I_2$
(c) I_1 is in the direction ba and I_2 is in the direction cd
(d) I_1 is in the direction ab and I_2 is in the direction dc

Ans. (d)

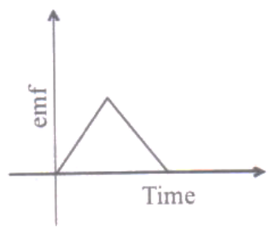
Q.13 A small bar magnet is being slowly inserted with constant velocity inside a solenoid as shown in figure. Which graph best represent the relationship between emf induced with time?



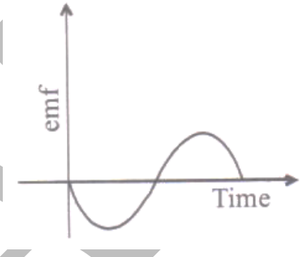
(a)



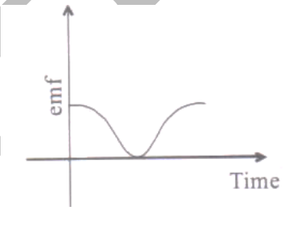
(b)



(c)

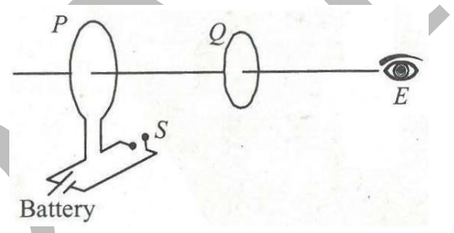


(d)



Ans. (c)

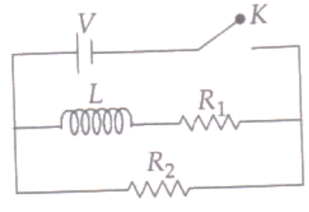
Q.14 A shown in the figure P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in P (as seen by E) and induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened a current I_{Q_2} flows in Q. The direction I_{Q_1} *and* I_{Q_2} (as seen by E) are



(a) Respectively clockwise and anti-clockwise
(b) Both clockwise
(c) Both anti-clockwise
(d) Respectively anti-clockwise and clockwise

Ans. (d)

Q.15 In the circuit shown below, the key K is closed at $t = 0$. The current through the battery is



(a) $\frac{V(R_1+R_2)}{R_1R_2}$ at $t = 0$ and $\frac{V}{R_2}$ at $t = \infty$
(b) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t = 0$ and $\frac{V}{R_2}$ at $t = \infty$
(c) $\frac{V}{R_2}$ at $t = 0$ and $\frac{V(R_1+R_2)}{R_1R_2}$ at $t = \infty$
(d) $\frac{V}{R_2}$ at $t = 0$ and) $\frac{VR_1R_2}{\sqrt{R_1^2+R_2^2}}$ at $t = \infty$

Ans. (c)

CHEMISTRY

Q.16 2.76 g of silver carbonate on being strongly heated yield a residue of weighing
(a) 2.16 g
(b) 2.48 g
(c) 2.64 g
(d) 2.32 g

Ans. (a)

Q.17 Match the Column I with Column II and III and select an appropriate option from the codes given below:

Column I (region)	Column II "(Frequency (Hz))	Column III (application)
A. Radiofrequency	1. 10^{10}	(i) Heating
B. Microwave	2. 10^{13}	(ii) Radar
C. Infrared	3. 10^{16}	(iii) Broadcasting
D. Ultraviolet	4. 10^{6}	(iv) Solar radiation

Codes

	A	B	C	D
(a)	3(i)	1(ii)	4(iii)	2(iv)
(b)	1(iv)	2(iii)	3(i)	4(ii)
(c)	4(iii)	1(ii)	2(i)	3(iv)
(d)	2(i)	4(ii)	3(iv)	1(iii)

Ans. (c)

Q.18 If the bond enthalpy of O_2, N_2 *and* H_2 are 498 KJ mol^{-1}, 946 KJ mol^{-1} and 435.8 KJ mol^{-1} respectively. Choose the correct order of decreasing bond strength.
(a) $H_2 > N_2 > O_2$
(b) $N_2 > O_2 > H_2$

(c) $O_2 > H_2 > N_2$

(d) $H_2 > O_2 > N_2$

Ans. (b)

Q.19 At 25°C and 750 mm of Hg pressure a gas occupies 600 mL volume. What will be its pressure at a height where temperature is 10°C had volume of the gas is 640 mL?

(a) 677 mm Hg

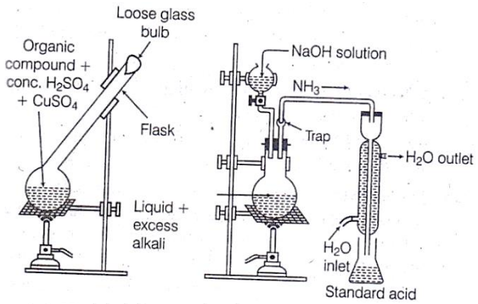
(b) 600 mm Hg

(c) 700 mm Hg

(d) 752 mm Hg

Ans. (a)

Q.20 Which method of estimation is represented by the figure given below?



(a) Kjeldahl's method

(b) Carius method

(c) Duma's method

(d) None of these

Ans. (a)

Q.21 A metal crystallises with a face-centred cubic lattice. The egde of the unit cell is 408 pm. The diameter of the metal atom is

(a) 288 pm

(b) 408 pm

(c) 144 pm

(d) 204 pm

Ans. (a)

Q.22 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2 g water . The vapour pressure of water (in torr) for this aqueous solution is

(a) 76.0

(b) 752.4

(c) 759.0

(d) 7.6

Ans. (b)

Q.23 A hydrogen gas electrode is made by dipping platinum wire in a solution of HCI and pH=10 and by passing hydrogen gas around the platinum wire at 1 atm pressure. The oxidation potential of electrode would be

(a) 0.059 V

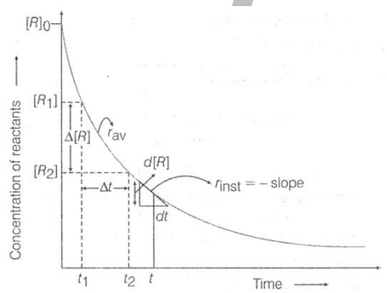
(b) 0.59 V

(c) 0.118 V

(d) 0.18 V

Ans. (b)

Q.24 Find the value of r_{av} from the graph shown below:



(a) $r_{av} = \frac{+\Delta[R]}{\Delta t}$

(b) $r_{av} = \frac{-[R_2]-[R_1]}{(t_1-t_2)}$

(c) $r_{av} = \frac{-d[R]}{dt}$

(d) $r_{av} = \frac{\{-[R_2]-[R_1]\}}{(t_2-t_1)}$

Ans. (d)

Q.25 Select the statement which is not true?

(a) A colloid is a heterogeneous system

(b) The substance which is depressed in another substance is called dispersed phase

(c) Depending upon the shape of particles, solution may be true solution or colloid or suspension

(d) The dispersed phase of colloid may contain a single macromolecules or an aggregate of many atom, ions or molecule.

Ans. (b)

Q.26 Match items of Column I with the item of Column II and assign the correct code

Column I	Column II
A. Cyanide process	1. Ultrapure Ge
B. Froth floatation process	2. Dressing of ZnS
C. Electrolytic reduction	3. Extraction of Al
D. Zone refining	4. Extraction of Au
	5. Purification of Ni

Codes

	A	B	C	D
(a)	4	2	3	1
(b)	2	3	1	5
(c)	1	2	3	4
(d)	3	4	5	1

Ans. (a)

Q.27 In cyclo trimetaphosphate ion, the number of O-atms, $P-O-P$ bonds and unit negative charges respectively are

(a) 3, 6, 3

(b) 9, 6, 3

(c) 6, 6, 3

(d) 9, 3, 3

Ans. (d)

Q.28 Crystal field stabilization energy for high spin d^4 octahedral complex is

(a) $-0.6\Delta_0$

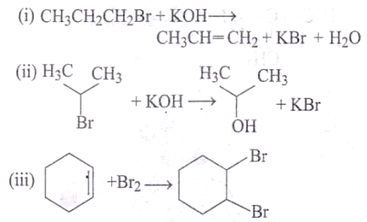
(b) $-1.8\Delta_0$

(c) $-1.6\Delta_0 + P$

(d) $-1.2\Delta_0$

Ans. (a)

Q.29 For the following reactions:



Which of the following statement is correct?

(a) (i) is elimination reaction (ii) is substitution and (iii) is addition reaction

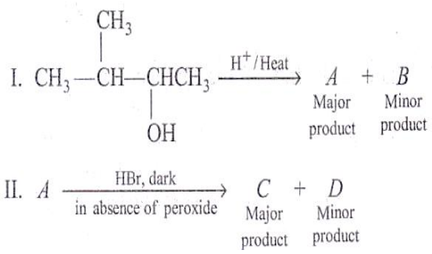
(b) (i) is elimination, (ii) and)iii) are substitution reactions

(c) (i) is substitutions, (ii) and (iii) are addition reactions

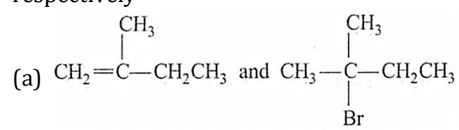
(d) (i) and (ii) are elimination reactions and (iii) is addition reaction

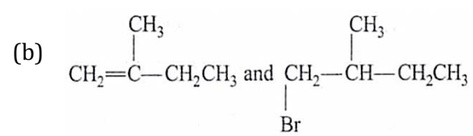
Ans. (a)

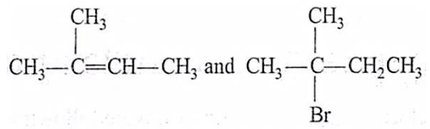
Q.30 In the following reactions:

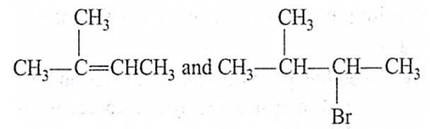


The major products (A) and (C) are, respectively

(a) 

(b) 

(c) 

(d) 

Ans. (c)

MATHEMATICS

Q.31 Let $f: R \to [1,\infty)$ be a function define by $f(x) = x^2 - 10ax + 5 - a + 25a^2$.
If (x) is surjective on R, then the value of a is
(a)0
(b)1
(c)2
(d)4

Ans. (d)

Q.32 If $f(x) = \begin{cases} px+q & ; \quad x \le -1 \\ px^3 + x + 2q & ; \quad x > -1 \end{cases}$ is differentiable for all $x \in R$, then the ordered pair (p, q) is

(a)$\left(\frac{1}{2}, 1\right)$
(b)(0,1)
(c)$\left(\frac{-1}{2}, 1\right)$
(d)$\left(\frac{-1}{2}, -1\right)$

Ans. (c)

Q.33 The intervals of increase of $f(x)$ defined by $f(x)=\int_{-1}^{x}(t^2+2t)(t^2-1)dt$ is equal to
(a)$\left(-\infty, \frac{-3}{2}\right) \cup (0,3) \cup (10,\infty)$
(b)$(-\infty,-2) \cup \left(\frac{-1}{2}, \frac{1}{2}\right) \cup (4,\infty)$
(c)$(-\infty,-2) \cup (-1,0) \cup (1,\infty)$
(d)$(-\infty,-2) \cup \left(\frac{-3}{4}, \frac{1}{4}\right) \cup (4,\infty)$

Ans. (c)

Q.34 For $n \in N$, the value of the definite integral $\int_0^{n\pi+v} \sqrt{\frac{1+cos2x}{2}}\, dx$; where $\frac{\pi}{2} < v < \pi$, is
(a)$2n + 1 - \cos v$
(b)$2n - \sin v$
(c)$2n + 2 - \sin v$
(d)$2n + 1 - sin\ v$

Ans. (c)

Q.35 Let the area enclosed by the curve $y = 1 - x^2$ and the line y=a, where $0 \le a \le 1$, be represented by A(a).
If $\frac{A(0)}{A\left(\frac{1}{2}\right)} = k$, then
(a)$1 < k < \frac{3}{2}$
(b)$\frac{3}{2} < k < 2$
(c)$2 < k < \frac{5}{2}$
(d)$\frac{5}{2} < k < 3$

Ans. (d)

Q.36 The equation of curve passing though origin and satisfying the differential equation $(1+x^2)\frac{dy}{dx} + 2xy = 4x^2$, is
(a)$3(1+x^2)y = 2x^3$
(b)$(1+x^2)y = x^3$
(c)$(1+x^2)y = 3x^3$
(d) $3(1+x^2)y = 4x^3$

Ans. (d)

Q.37 The value of $amp\ (i\omega) + amp\ (i\omega^2)$, (where $i = \sqrt{-1}$ and $\omega = \sqrt[3]{1}$) is
(a) 0
(b) $\frac{\pi}{2}$
(c) π
(d) None of these

Ans. (c)

Q.38 If $|z - i| \le 2$ and $z_0 = 5 + 3i$ then the maximum value of $|iz + z_0|$ is
(a) $2 + \sqrt{31}$
(b) 7
(c) $\sqrt{31} - 2$
(d) None of these

Ans. (b)

Q.39 If x, y, z are integers in AP, lying between 1 and 9, and x51, y41 and z31 are three – dight numbers then the value of $\begin{vmatrix} 5 & 4 & 3 \\ x51 & y41 & z31 \\ x & y & z \end{vmatrix}$ is
(a) $x + y + z$
(b) $x - y + z$
(c) 0
(d) None of these

Ans. (c)

Q.40 The system of equations
$ax + 4y + z = 0$
$bx + 3y + z = 0$
$cx + 2y + z = 0$
has nontrivial solutions if a, b, c are in
(a) AP
(b) GP
(c) HP
(d) None of these

Ans. (a)

Q.41 The sum of the coefficients of all the integral powers of x in the expansion of $(1 + 2\sqrt{x})^{40}$ is
(a) $3^{40} + 1$
(b) $3^{40} - 1$
(c) $\frac{1}{2}(3^{40} - 1)$
(d) $\frac{1}{2}(3^{40} + 1)$

Ans. (d)

Q.42 The point on the curve $x^2 = 2y$ which is nearest to the curve $(0,5)$ is
(a) $(0,0)$
(b) $(2\sqrt{2}, 0)$
(c) $(2\sqrt{2}, 4)$
(d) $(2, 2)$

Ans. (c)

Q.43 $\int \frac{dx}{\cos(x-a)\cos(x-b)}$ = ...
(a) $cosec\ (a-b) \log\left(\frac{\sin(x-a)}{\sin(x-b)}\right) + C$
(b) $cosec\ (a-b) \log\left(\frac{\cos(x-a)}{\cos(x-b)}\right) + C$
(c) $cosec\ (a-b) \log\left(\frac{\cos(x-a)}{\sin(x-b)}\right) + C$
(d) $cosec\ (a-b) \log\left(\frac{\sin(x-a)}{\cos(x-b)}\right) + C$

Ans. (b)

Q.44 Area bounded by the $y^2 = x$ and $2y = x$ is
(a) $\frac{1}{3}$
(b) $\frac{2}{3}$
(c) $\frac{4}{3}$
(d) 1

Ans. (c)

Q.45 The point on the curve $9y^2 = x^3$ where the normal to the curve makes equal intercepts with the axes are
(a) $\left(4, -\frac{8}{3}\right)$
(b) $\left(4, \pm\frac{3}{8}\right)$
(c) $\left(\pm 4, \frac{8}{3}\right)$
(d) $\left(4, \pm\frac{8}{3}\right)$

Ans. (d)