Central Board of Secondary Education

Question Paper Name :	JEE Main 2014 Paper 1 (B.E./B.Tech) Apr 6 Shift 1 (morning)
Subject Name :	Paper 1 (B.E./B.Tech)
Duration :	180
Total Marks :	360

Paper 1 (B.E./B.Tech)

Mathematics

Section Number :	1
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120

Question Number : 1 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $X=\{4^n-3n-1 : n \in N\}$ and $Y=\{9(n-1) : n \in N\}$, where N is the set of natural numbers, then $X \cup Y$ is equal to :

(1) X

(2) Y

(3) N

(4) $Y-X$

Question Number : 2 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If z is a complex number such that $|z| \geq 2$, then the minimum value of $\left|z+\frac{1}{2}\right|$:

(1) is strictly greater than $\frac{5}{2}$

(2) is strictly greater than $\frac{3}{2}$ but less than $\frac{5}{2}$

(3) is equal to $\frac{5}{2}$

(4) lies in the interval (1, 2)

Question Number : 3 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $a \in \mathbf{R}$ and the equation

$$-3(x-[x])^2+2\ (x-[x])+a^2=0$$

(where $[x]$ denotes the greatest integer $\leq x$) has no integral solution, then all possible values of a lie in the interval :

(1) $(-2,\ -1)$

(2) $(-\infty,\ -2) \cup (2,\ \infty)$

(3) $(-1,\ 0) \cup (0,\ 1)$

(4) $(1,\ 2)$

Question Number : 4 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let α and β be the roots of equation $px^2+qx+r=0,\ p\neq 0$. If p, q, r are in A.P. and $\frac{1}{\alpha}+\frac{1}{\beta}=4$, then the value of $|\alpha-\beta|$ is :

(1) $\frac{\sqrt{34}}{9}$

(2) $\frac{2\sqrt{13}}{9}$

(3) $\frac{\sqrt{61}}{9}$

(4) $\frac{2\sqrt{17}}{9}$

Question Number : 5 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $\alpha, \beta \neq 0$, and $f(n) = \alpha^n + \beta^n$ and

$$\begin{vmatrix} 3 & 1+f(1) & 1+f(2) \\ 1+f(1) & 1+f(2) & 1+f(3) \\ 1+f(2) & 1+f(3) & 1+f(4) \end{vmatrix}$$

$= K(1-\alpha)^2 \ (1-\beta)^2 \ (\alpha-\beta)^2$, then K is equal to :

(1) 1

(2) -1

(3) $\alpha\beta$

(4) $\frac{1}{\alpha\beta}$

Question Number : 6 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If A is an 3×3 non - singular matrix such that $AA' = A'A$ and $B = A^{-1} A'$, then BB' equals :

(1) B^{-1}

(2) $(B^{-1})'$

(3) $I + B$

(4) I

Question Number : 7 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If the coefficients of x^3 and x^4 in the expansion of $(1 + ax + bx^2)\ (1-2x)^{18}$ in powers of x are both zero, then (a, b) is equal to :

(1) $\left(14, \frac{272}{3}\right)$

(2) $\left(16, \frac{272}{3}\right)$

(3) $\left(16, \frac{251}{3}\right)$

(4) $\left(14, \frac{251}{3}\right)$

Question Number : 8 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $(10)^9 + 2(11)^1\ (10)^8 + 3(11)^2\ (10)^7 + \ldots$
$+10\ (11)^9 = k\ (10)^9$, then k is equal to :

(1) 100

(2) 110

(3) $\frac{121}{10}$

(4) $\frac{441}{100}$

Question Number : 9 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Three positive numbers form an increasing G.P. If the middle term in this G.P. is doubled, the new numbers are in A.P. Then the common ratio of the G.P. is :

(1) $2 - \sqrt{3}$

(2) $2 + \sqrt{3}$

(3) $\sqrt{2} + \sqrt{3}$

(4) $3 + \sqrt{2}$

Question Number : 10 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

$\lim\limits_{x \to 0} \frac{\sin(\pi \cos^2 x)}{x^2}$ is equal to :

(1) $-\pi$

(2) π

(3) $\frac{\pi}{2}$

(4) 1

Question Number : 11 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If g is the inverse of a function f and $f'(x) = \frac{1}{1+x^5}$, then $g'(x)$ is equal to :

(1) $\frac{1}{1+\{g(x)\}^5}$

(2) $1+\{g(x)\}^5$

(3) $1+x^5$

(4) $5x^4$

Question Number : 12 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If f and g are differentiable functions in $[0, 1]$ satisfying $f(0)=2=g(1)$, $g(0)=0$ and $f(1)=6$, then for some $c \in]0, 1[$:

(1) $f'(c)=g'(c)$

(2) $f'(c)=2g'(c)$

(3) $2f'(c)=g'(c)$

(4) $2f'(c)=3g'(c)$

Question Number : 13 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $x=-1$ and $x=2$ are extreme points of $f(x)=\alpha \log|x|+\beta x^2+x$ then :

(1) $\alpha=2,\ \beta=-\frac{1}{2}$

(2) $\alpha=2,\ \beta=\frac{1}{2}$

(3) $\alpha=-6,\ \beta=\frac{1}{2}$

(4) $\alpha=-6,\ \beta=-\frac{1}{2}$

Question Number : 14 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The integral $\int\left(1+x-\frac{1}{x}\right)e^{x+\frac{1}{x}}\,dx$ is

equal to :

(1) $(x+1)\ e^{x+\frac{1}{x}}+c$

(2) $-x\ e^{x+\frac{1}{x}}+c$

(3) $(x-1)\ e^{x+\frac{1}{x}}+c$

(4) $x\ e^{x+\frac{1}{x}}+c$

Question Number : 15 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The integral

$\int_0^{\pi}\sqrt{1+4\sin^2\frac{x}{2}-4\sin\frac{x}{2}}\,dx$ equals :

(1) $4\sqrt{3}-4$

(2) $4\sqrt{3}-4-\frac{\pi}{3}$

(3) $\pi-4$

(4) $\frac{2\pi}{3}-4-4\sqrt{3}$

Question Number : 16 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The area of the region described by $A=\{(x, y) : x^2+y^2 \le 1 \text{ and } y^2 \le 1-x\}$ is :

(1) $\frac{\pi}{2}-\frac{2}{3}$

(2) $\frac{\pi}{2}+\frac{2}{3}$

(3) $\frac{\pi}{2}+\frac{4}{3}$

(4) $\frac{\pi}{2}-\frac{4}{3}$

Question Number : 17 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let the population of rabbits surviving at a time t be governed by the differential equation $\frac{dp(t)}{dt}=\frac{1}{2}p(t)-200$.

If $p(0)=100$, then $p(t)$ equals :

(1) $600-500\ e^{t/2}$

(2) $400-300\ e^{-t/2}$

(3) $400-300\ e^{t/2}$

(4) $300-200\ e^{-t/2}$

Question Number : 18 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let PS be the median of the triangle with vertices P(2, 2), Q(6, −1) and R(7, 3). The equation of the line passing through (1, −1) and parallel to PS is :

(1) $4x+7y+3=0$

(2) $2x-9y-11=0$

(3) $4x-7y-11=0$

(4) $2x+9y+7=0$

Question Number : 19 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let a, b, c and d be non-zero numbers. If the point of intersection of the lines $4ax+2ay+c=0$ and $5bx+2by+d=0$ lies in the fourth quadrant and is equidistant from the two axes then :

(1) $3bc-2ad=0$

(2) $3bc+2ad=0$

(3) $2bc-3ad=0$

(4) $2bc+3ad=0$

Question Number : 20 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The locus of the foot of perpendicular drawn from the centre of the ellipse $x^2+3y^2=6$ on any tangent to it is :

(1) $(x^2+y^2)^2=6x^2+2y^2$

(2) $(x^2+y^2)^2=6x^2-2y^2$

(3) $(x^2-y^2)^2=6x^2+2y^2$

(4) $(x^2-y^2)^2=6x^2-2y^2$

Question Number : 21 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let C be the circle with centre at (1, 1) and radius $=1$. If T is the circle centred at $(0, y)$, passing through origin and touching the circle C externally, then the radius of T is equal to :

(1) $\frac{1}{2}$

(2) $\frac{1}{4}$

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

(4) $\frac{\sqrt{3}}{2}$

Question Number : 22 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The slope of the line touching both the parabolas $y^2=4x$ and $x^2=-32y$ is :

(1) $\frac{1}{8}$

(2) $\frac{2}{3}$

(3) $\frac{1}{2}$

(4) $\frac{3}{2}$

Question Number : 23 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The image of the line $\frac{x-1}{3}=\frac{y-3}{1}=\frac{z-4}{-5}$ in the plane $2x-y+z+3=0$ is the line :

(1) $\frac{x-3}{3}=\frac{y+5}{1}=\frac{z-2}{-5}$

(2) $\frac{x-3}{-3}=\frac{y+5}{-1}=\frac{z-2}{5}$

(3) $\frac{x+3}{3}=\frac{y-5}{1}=\frac{z-2}{-5}$

(4) $\frac{x+3}{-3}=\frac{y-5}{-1}=\frac{z+2}{5}$

Question Number : 24 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The angle between the lines whose direction cosines satisfy the equations $l+m+n=0$ and $l^2=m^2+n^2$ is :

(1) $\frac{\pi}{6}$

(2) $\frac{\pi}{2}$

(3) $\frac{\pi}{3}$

(4) $\frac{\pi}{4}$

Question Number : 25 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If $\left[\vec{a}\times\vec{b}\ \vec{b}\times\vec{c}\ \vec{c}\times\vec{a}\right]=\lambda\left[\vec{a}\ \vec{b}\ \vec{c}\right]^2$ then λ is equal to :

(1) 0

(2) 1

(3) 2

(4) 3

Question Number : 26 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let A and B be two events such that $P(\overline{A\cup B})=\frac{1}{6}$, $P(A\cap B)=\frac{1}{4}$ and $P(\overline{A})=\frac{1}{4}$, where $\overline{A}$ stands for the complement of the event A. Then the events A and B are :

(1) independent but not equally likely.

(2) independent and equally likely.

(3) mutually exclusive and independent.

(4) equally likely but not independent.

Question Number : 27 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The variance of first 50 even natural numbers is :

(1) 437

(2) $\frac{437}{4}$

(3) $\frac{833}{4}$

(4) 833

Question Number : 28 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Let $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$ where $x \in \mathbf{R}$ and $k \geq 1$. Then $f_4(x) - f_6(x)$ equals :

(1) $\frac{1}{4}$

(2) $\frac{1}{12}$

(3) $\frac{1}{6}$

(4) $\frac{1}{3}$

Question Number : 29 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A bird is sitting on the top of a vertical pole 20 m high and its elevation from a point O on the ground is 45°. It flies off horizontally straight away from the point O. After one second, the elevation of the bird from O is reduced to 30°. Then the speed (in m/s) of the bird is :

(1) $20\sqrt{2}$

(2) $20\left(\sqrt{3}-1\right)$

(3) $40\left(\sqrt{2}-1\right)$

(4) $40\left(\sqrt{3}-\sqrt{2}\right)$

Question Number : 30 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The statement $\sim(p \leftrightarrow \sim q)$ is :

(1) a tautology

(2) a fallacy

(3) equivalent to $p \leftrightarrow q$

(4) equivalent to $\sim p \leftrightarrow q$

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Physics

Section Number :	2
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120

Question Number : 31 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The current voltage relation of diode is given by $I = (e^{1000V/T} - 1)$ mA, where the applied voltage V is in volts and the temperature T is in degree Kelvin. If a student makes an error measuring ± 0.01 V while measuring the current of 5 mA at 300 K, what will be the error in the value of current in mA ?

(1) 0.2 mA

(2) 0.02 mA

(3) 0.5 mA

(4) 0.05 mA

Question Number : 32 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

From a tower of height H, a particle is thrown vertically upwards with a speed u. The time taken by the particle, to hit the ground, is n times that taken by it to reach the highest point of its path.

The relation between H, u and n is :

(1) $2\,g\,H = n^2u^2$

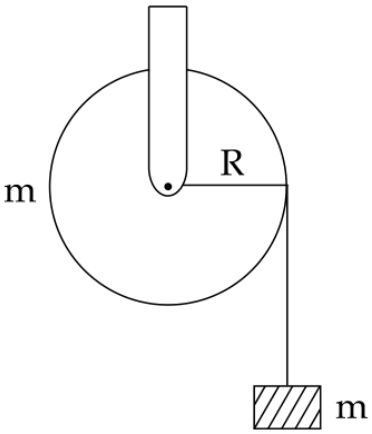
(2) $g\,H = (n-2)^2u^2$

(3) $2\,g\,H = nu^2(n-2)$

(4) $g\,H = (n-2)u^2$

Question Number : 33 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A mass 'm' is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what acceleration will the mass fall on release ?



(1) $\frac{2g}{3}$

(2) $\frac{g}{2}$

(3) $\frac{5g}{6}$

(4) g

Question Number : 34 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A block of mass m is placed on a surface with a vertical cross section given by $y=\frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is :

(1) $\frac{1}{6}$m

(2) $\frac{2}{3}$m

(3) $\frac{1}{3}$m

(4) $\frac{1}{2}$m

Question Number : 35 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

When a rubber-band is stretched by a distance x, it exerts a restoring force of magnitude $F = ax + bx^2$ where a and b are constants. The work done in stretching the unstretched rubber-band by L is :

(1) $aL^2 + bL^3$

(2) $\frac{1}{2}(aL^2 + bL^3)$

(3) $\frac{aL^2}{2} + \frac{bL^3}{3}$

(4) $\frac{1}{2}\left(\frac{aL^2}{2} + \frac{bL^3}{3}\right)$

Question Number : 36 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A bob of mass m attached to an inextensible string of length l is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the vertical. About the point of suspension :

(1) angular momentum is conserved.

(2) angular momentum changes in magnitude but not in direction.

(3) angular momentum changes in direction but not in magnitude.

(4) angular momentum changes both in direction and magnitude.

Question Number : 37 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Four particles, each of mass M and equidistant from each other, move along a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is :

(1) $\sqrt{\frac{GM}{R}}$

(2) $\sqrt{2\sqrt{2}\ \frac{GM}{R}}$

(3) $\sqrt{\frac{GM}{R}\left(1+2\sqrt{2}\right)}$

(4) $\frac{1}{2}\sqrt{\frac{GM}{R}\left(1+2\sqrt{2}\right)}$

Question Number : 38 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by 100°C is :

(For steel Young's modulus is 2×10^{11} N m^{-2} and coefficient of thermal expansion is 1.1×10^{-5} K^{-1})

(1) 2.2×10^{8} Pa

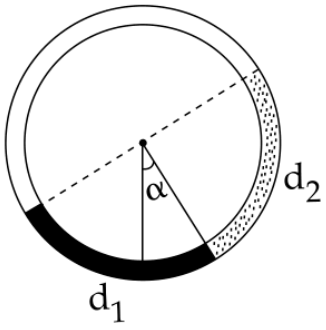
(2) 2.2×10^{9} Pa

(3) 2.2×10^{7} Pa

(4) 2.2×10^{6} Pa

Question Number : 39 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

There is a circular tube in a vertical plane. Two liquids which do not mix and of densities d_1 and d_2 are filled in the tube. Each liquid subtends 90° angle at centre. Radius joining their interface makes an angle α with vertical. Ratio $\frac{d_1}{d_2}$ is :



(1) $\frac{1+\sin\alpha}{1-\sin\alpha}$

(2) $\frac{1+\cos\alpha}{1-\cos\alpha}$

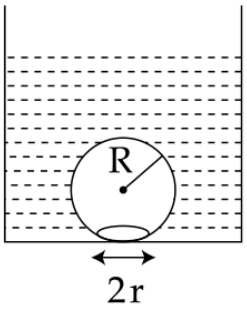
(3) $\frac{1+\tan\alpha}{1-\tan\alpha}$

(4) $\frac{1+\sin\alpha}{1-\cos\alpha}$

Question Number : 40 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

On heating water, bubbles being formed at the bottom of the vessel detatch and rise. Take the bubbles to be spheres of radius R and making a circular contact of radius r with the bottom of the vessel. If r << R, and the surface tension of water is T, value of r just before bubbles detatch is :

(density of water is ρ_w)



(1) $R^2\sqrt{\frac{\rho_w g}{3T}}$

(2) $R^2\sqrt{\frac{\rho_w g}{6T}}$

(3) $R^2\sqrt{\frac{\rho_w g}{T}}$

(4) $R^2\sqrt{\frac{3\rho_w g}{T}}$

Question Number : 41 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Three rods of Copper, Brass and Steel are welded together to form a Y - shaped structure. Area of cross - section of each rod = 4 cm^2. End of copper rod is maintained at 100°C where as ends of brass and steel are kept at 0°C. Lengths of the copper, brass and steel rods are 46, 13 and 12 cms respectively. The rods are thermally insulated from surroundings except at ends. Thermal conductivities of copper, brass and steel are 0.92, 0.26 and 0.12 CGS units respectively. Rate of heat flow through copper rod is :

(1) 1.2 cal/s

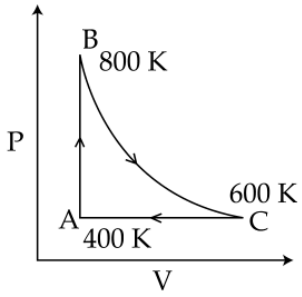
(2) 2.4 cal/s

(3) 4.8 cal/s

(4) 6.0 cal/s

Question Number : 42 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

One mole of diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperatures at A, B and C are 400 K, 800 K and 600 K respectively. Choose the correct statement :



(1) The change in internal energy in whole cyclic process is 250 R.

(2) The change in internal energy in the process CA is 700 R.

(3) The change in internal energy in the process AB is -350 R.

(4) The change in internal energy in the process BC is -500 R.

Question Number : 43 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

An open glass tube is immersed in mercury in such a way that a length of 8 cm extends above the mercury level. The open end of the tube is then closed and sealed and the tube is raised vertically up by additional 46 cm. What will be length of the air column above mercury in the tube now ?

(Atmospheric pressure $=76$ cm of Hg)

(1) 16 cm

(2) 22 cm

(3) 38 cm

(4) 6 cm

Question Number : 44 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A particle moves with simple harmonic motion in a straight line. In first τ s, after starting from rest it travels a distance a, and in next τ s it travels 2a, in same direction, then :

(1) amplitude of motion is 3a

(2) time period of oscillations is 8τ

(3) amplitude of motion is 4a

(4) time period of oscillations is 6τ

Question Number : 45 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A pipe of length 85 cm is closed from one end. Find the number of possible natural oscillations of air column in the pipe whose frequencies lie below 1250 Hz. The velocity of sound in air is 340 m/s.

(1) 12

(2) 8

(3) 6

(4) 4

Question Number : 46 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Assume that an electric field $\vec{E} = 30x^2\hat{i}$ exists in space. Then the potential difference $V_A - V_O$, where V_O is the potential at the origin and V_A the potential at $x = 2$ m is :

(1) 120 J

(2) -120 J

(3) -80 J

(4) 80 J

Question Number : 47 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A parallel plate capacitor is made of two circular plates separated by a distance of 5 mm and with a dielectric of dielectric constant 2.2 between them. When the electric field in the dielectric is 3×10^4 V/m, the charge density of the positive plate will be close to :

(1) 6×10^{-7} C/m^2

(2) 3×10^{-7} C/m^2

(3) 3×10^4 C/m^2

(4) 6×10^4 C/m^2

Question Number : 48 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW. The voltage of the electric mains is 220 V. The minimum capacity of the main fuse of the building will be :

(1) 8 A

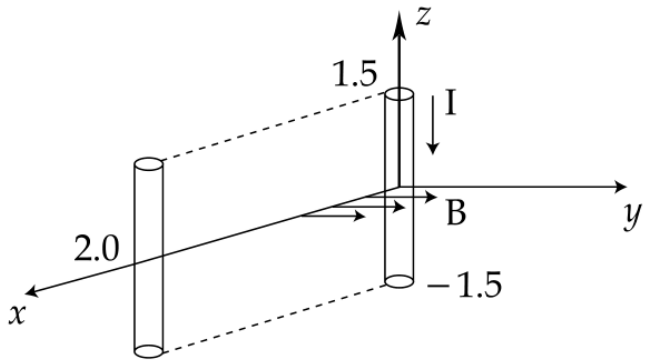
(2) 10 A

(3) 12 A

(4) 14 A

Question Number : 49 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

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, $y = 0$ m in 5×10^{-3} s. Assume parallel motion along the x-axis.



(1) 1.57 W

(2) 2.97 W

(3) 14.85 W

(4) 29.7 W

Question Number : 50 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The coercivity of a small magnet where the ferromagnet gets demagnetized is 3×10^3 A m^{-1}. The current required to be passed in a solenoid of length 10 cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is :

(1) 30 mA

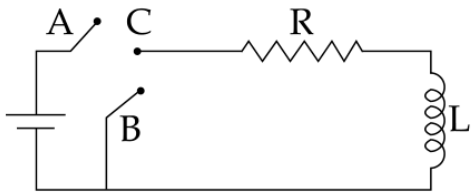
(2) 60 mA

(3) 3 A

(4) 6 A

Question Number : 51 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In the circuit shown here, the point 'C' is kept connected to point 'A' till the current flowing through the circuit becomes constant. Afterward, suddenly, point 'C' is disconnected from point 'A' and connected to point 'B' at time $t=0$. Ratio of the voltage across resistance and the inductor at $t=L/R$ will be equal to :



(1) $\frac{e}{1-e}$

(2) 1

(3) -1

(4) $\frac{1-e}{e}$

Question Number : 52 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

During the propagation of electromagnetic waves in a medium :

(1) Electric energy density is double of the magnetic energy density.

(2) Electric energy density is half of the magnetic energy density.

(3) Electric energy density is equal to the magnetic energy density.

(4) Both electric and magnetic energy densities are zero.

Question Number : 53 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A thin convex lens made from crown glass $\left(\mu = \frac{3}{2}\right)$ has focal length f. When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal lengths f_1 and f_2 respectively. The correct relation between the focal lengths is :

(1) $f_1 = f_2 < f$

(2) $f_1 > f$ and f_2 becomes negative

(3) $f_2 > f$ and f_1 becomes negative

(4) f_1 and f_2 both become negative

Question Number : 54 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A green light is incident from the water to the air - water interface at the critical angle(θ). Select the **correct** statement.

(1) The entire spectrum of visible light will come out of the water at an angle of 90° to the normal.

(2) The spectrum of visible light whose frequency is less than that of green light will come out to the air medium.

(3) The spectrum of visible light whose frequency is more than that of green light will come out to the air medium.

(4) The entire spectrum of visible light will come out of the water at various angles to the normal.

Question Number : 55 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Two beams, A and B, of plane polarized light with mutually perpendicular planes of polarization are seen through a polaroid. From the position when the beam A has maximum intensity (and beam B has zero intensity), a rotation of polaroid through 30° makes the two beams appear equally bright. If the initial intensities of the two beams are I_A and I_B respectively, then $\frac{I_A}{I_B}$ equals :

(1) 3

(2) $\frac{3}{2}$

(3) 1

(4) $\frac{1}{3}$

Question Number : 56 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of 3×10^{-4} T. If the radius of the largest circular path followed by these electrons is 10.0 mm, the work function of the metal is close to :

(1) 1.8 eV

(2) 1.1 eV

(3) 0.8 eV

(4) 1.6 eV

Question Number : 57 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Hydrogen $({}_1H^1)$, Deuterium $({}_1H^2)$, singly ionised Helium $({}_2He^4)^+$ and doubly ionised lithium $({}_3Li^6)^{++}$ all have one electron around the nucleus. Consider an electron transition from $n=2$ to $n=1$. If the wave lengths of emitted radiation are λ_1, λ_2, λ_3 and λ_4 respectively then approximately which one of the following is **correct** ?

(1) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

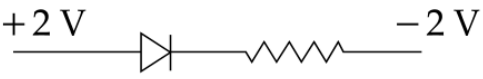
(2) $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

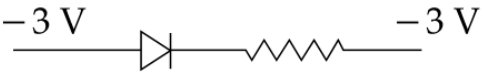
(3) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$

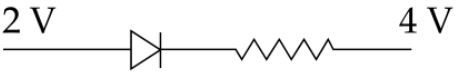
(4) $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

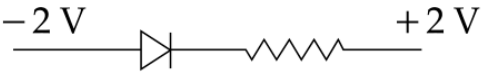
Question Number : 58 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The forward biased diode connection is :

(1) 

(2) 

(3) 

(4) 

Question Number : 59 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Match **List - I** (Electromagnetic wave type) with **List - II** (Its association/application) and select the correct option from the choices given below the lists :

List - I		**List - II**	
(a)	Infrared waves	(i)	To treat muscular strain
(b)	Radio waves	(ii)	For broadcasting
(c)	X - rays	(iii)	To detect fracture of bones
(d)	Ultraviolet rays	(iv)	Absorbed by the ozone layer of the atmosphere

	(a)	**(b)**	**(c)**	**(d)**
(1)	(iv)	(iii)	(ii)	(i)
(2)	(i)	(ii)	(iv)	(iii)
(3)	(iii)	(ii)	(i)	(iv)
(4)	(i)	(ii)	(iii)	(iv)

Question Number : 60 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

A student measured the length of a rod and wrote it as 3.50 cm. Which instrument did he use to measure it ?

(1) A meter scale.

(2) A vernier calliper where the 10 divisions in vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm.

(3) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm.

(4) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm.

Chemistry

Section Number : 3
Number of Questions : 30
Number of Questions to be attempted : 30
Section Marks : 120

Question Number : 61 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The correct set of four quantum numbers for the valence electrons of rubidium atom $(Z=37)$ is :

(1) $5, 0, 0, +\frac{1}{2}$

(2) $5, 1, 0, +\frac{1}{2}$

(3) $5, 1, 1, +\frac{1}{2}$

(4) $5, 0, 1, +\frac{1}{2}$

Question Number : 62 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

If Z is a compressibility factor, van der Waals equation at low pressure can be written as :

(1) $Z=1+\frac{RT}{Pb}$

(2) $Z=1-\frac{a}{VRT}$

(3) $Z=1-\frac{Pb}{RT}$

(4) $Z=1+\frac{Pb}{RT}$

Question Number : 63 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

CsCl crystallises in body centred cubic lattice. If 'a' is its edge length then which of the following expressions is correct ?

(1) $r_{Cs^+} + r_{Cl^-} = 3a$

(2) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

(3) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$

(4) $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$

Question Number : 64 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For the estimation of nitrogen, 1.4 g of an organic compound was digested by Kjeldahl method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is :

(1) 6%

(2) 10%

(3) 3%

(4) 5%

Question Number : 65 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.4 S m^{-1}. The resistance of 0.5 M solution of the same electrolyte is 280 Ω. The molar conductivity of 0.5 M solution of the electrolyte in S m^2 mol^{-1} is :

(1) 5×10^{-4}

(2) 5×10^{-3}

(3) 5×10^{3}

(4) 5×10^{2}

Question Number : 66 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For complete combustion of ethanol,
$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$,
the amount of heat produced as measured in bomb calorimeter, is 1364.47 kJ mol^{-1} at 25°C. Assuming ideality the Enthalpy of combustion, $\Delta_c H$, for the reaction will be :
$(R = 8.314 \text{ kJ mol}^{-1})$

(1) $-1366.95 \text{ kJ mol}^{-1}$

(2) $-1361.95 \text{ kJ mol}^{-1}$

(3) $-1460.50 \text{ kJ mol}^{-1}$

(4) $-1350.50 \text{ kJ mol}^{-1}$

Question Number : 67 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_C and λ_∞, respectively. The correct relationship between λ_C and λ_∞ is given as :
(where the constant B is positive)

(1) $\lambda_C = \lambda_\infty + (B)C$

(2) $\lambda_C = \lambda_\infty - (B)C$

(3) $\lambda_C = \lambda_\infty - (B)\sqrt{C}$

(4) $\lambda_C = \lambda_\infty + (B)\sqrt{C}$

Question Number : 68 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Consider separate solutions of 0.500 M $C_2H_5OH(aq)$, 0.100 M $Mg_3(PO_4)_2(aq)$, 0.250 M KBr(aq) and 0.125 M $Na_3PO_4(aq)$ at 25°C. Which statement is **true** about these solutions, assuming all salts to be strong electrolytes ?

(1) They all have the same osmotic pressure.

(2) 0.100 M $Mg_3(PO_4)_2(aq)$ has the highest osmotic pressure.

(3) 0.125 M $Na_3PO_4(aq)$ has the highest osmotic pressure.

(4) 0.500 M $C_2H_5OH(aq)$ has the highest osmotic pressure.

Question Number : 69 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For the reaction $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$, if $K_P = K_C(RT)^x$ where the symbols have usual meaning then the value of x is : (assuming ideality)

(1) -1

(2) $-\frac{1}{2}$

(3) $\frac{1}{2}$

(4) 1

Question Number : 70 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For the non - stoichiometre reaction $2A + B \rightarrow C + D$, the following kinetic data were obtained in three separate experiments, all at 298 K.

Initial Concentration (A)	Initial Concentration (B)	Initial rate of formation of C (mol $L^{-}S^{-}$)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for the formation of C is :

(1) $\frac{dc}{dt} = k[A]\ [B]$

(2) $\frac{dc}{dt} = k[A]^2\ [B]$

(3) $\frac{dc}{dt} = k[A]\ [B]^2$

(4) $\frac{dc}{dt} = k[A]$

Question Number : 71 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Among the following oxoacids, the correct decreasing order of acid strength is :

(1) $HOCl > HClO_2 > HClO_3 > HClO_4$

(2) $HClO_4 > HOCl > HClO_2 > HClO_3$

(3) $HClO_4 > HClO_3 > HClO_2 > HOCl$

(4) $HClO_2 > HClO_4 > HClO_3 > HOCl$

Question Number : 72 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The metal that cannot be obtained by electrolysis of an aqueous solution of its salts is :

(1) Ag

(2) Ca

(3) Cu

(4) Cr

Question Number : 73 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is :

(1) $L_4 < L_3 < L_2 < L_1$

(2) $L_1 < L_3 < L_2 < L_4$

(3) $L_3 < L_2 < L_4 < L_1$

(4) $L_1 < L_2 < L_4 < L_3$

Question Number : 74 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which one of the following properties is **not** shown by NO ?

(1) It is diamagnetic in gaseous state

(2) It is a neutral oxide

(3) It combines with oxygen to form nitrogen dioxide

(4) It's bond order is 2.5

Question Number : 75 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In which of the following reactions H_2O_2 acts as a reducing agent ?

(a) $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$

(b) $H_2O_2 - 2e^- \rightarrow O_2 + 2H^+$

(c) $H_2O_2 + 2e^- \rightarrow 2OH^-$

(d) $H_2O_2 + 2OH^- - 2e^- \rightarrow O_2 + 2H_2O$

(1) (a), (b)

(2) (c), (d)

(3) (a), (c)

(4) (b), (d)

Question Number : 76 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The correct statement for the molecule, CsI_3, is :

(1) it is a covalent molecule.

(2) it contains Cs^+ and I_3^- ions.

(3) it contains Cs^{3+} and I^- ions.

(4) it contains Cs^+, I^- and lattice I_2 molecule.

Question Number : 77 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The ratio of masses of oxygen and nitrogen in a particular gaseous mixture is 1 : 4. The ratio of number of their molecule is :

(1) 1 : 4

(2) 7 : 32

(3) 1 : 8

(4) 3 : 16

Question Number : 78 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Given below are the half - cell reactions :

$Mn^{2+} + 2e^- \rightarrow Mn$; $E^o = -1.18$ V

$2(Mn^{3+} + e^- \rightarrow Mn^{2+})$; $E^o = +1.51$ V

The E^o for $3Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ will be :

(1) -2.69 V ; the reaction will not occur

(2) -2.69 V ; the reaction will occur

(3) -0.33 V ; the reaction will not occur

(4) -0.33 V ; the reaction will occur

Question Number : 79 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which series of reactions correctly represents chemical relations related to iron and its compound ?

(1) $Fe \xrightarrow{\text{dil } H_2SO_4} FeSO_4 \xrightarrow{H_2SO_4, O_2} Fe_2(SO_4)_3 \xrightarrow{\text{heat}} Fe$

(2) $Fe \xrightarrow{O_2, \text{heat}} FeO \xrightarrow{\text{dil } H_2SO_4} FeSO_4 \xrightarrow{\text{heat}} Fe$

(3) $Fe \xrightarrow{Cl_2, \text{heat}} FeCl_3 \xrightarrow{\text{heat, air}} FeCl_2 \xrightarrow{Zn} Fe$

(4) $Fe \xrightarrow{O_2, \text{heat}} Fe_3O_4 \xrightarrow{CO, 600°C} FeO \xrightarrow{CO, 700°C} Fe$

Question Number : 80 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The equation which is balanced and represents the correct product(s) is :

(1) $Li_2O + 2KCl \rightarrow 2LiCl + K_2O$

(2) $[CoCl(NH_3)_5]^+ + 5H^+ \rightarrow Co^{2+} + 5NH_4^+ + Cl^-$

(3) $[Mg(H_2O)_6]^{2+} + (EDTA)^{4-} \xrightarrow{\text{excess NaOH}} [Mg(EDTA)]^{2+} + 6H_2O$

(4) $CuSO_4 + 4KCN \rightarrow K_2[Cu(CN)_4] + K_2SO_4$

Question Number : 81 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In S_N2 reactions, the correct order of reactivity for the following compounds : CH_3Cl, CH_3CH_2Cl, $(CH_3)_2CHCl$ and $(CH_3)_3CCl$ is :

(1) $CH_3Cl > (CH_3)_2CHCl > CH_3CH_2Cl > (CH_3)_3CCl$

(2) $CH_3Cl > CH_3CH_2Cl > (CH_3)_2CHCl > (CH_3)_3CCl$

(3) $CH_3CH_2Cl > CH_3Cl > (CH_3)_2CHCl > (CH_3)_3CCl$

(4) $(CH_3)_2CHCl > CH_3CH_2Cl > CH_3Cl > (CH_3)_3CCl$

Question Number : 82 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

On heating an aliphatic primary amine with chloroform and ethanolic potassium hydroxide, the organic compound formed is :

(1) an alkanol

(2) an alkanediol

(3) an alkyl cyanide

(4) an alkyl isocyanide

Question Number : 83 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The most suitable reagent for the conversion of $R-CH_2-OH \rightarrow R-CHO$ is :

(1) $KMnO_4$

(2) $K_2Cr_2O_7$

(3) CrO_3

(4) PCC (Pyridinium Chlorochromate)

Question Number : 84 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

The major organic compound formed by the reaction of 1, 1, 1− trichloroethane with silver powder is :

(1) Acetylene

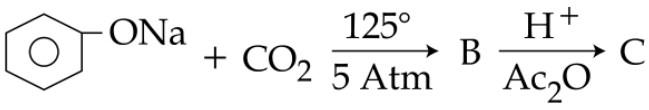
(2) Ethene

(3) 2 - Butyne

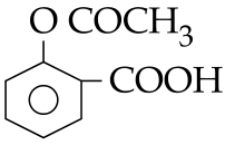
(4) 2 - Butene

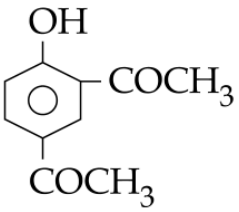
Question Number : 85 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

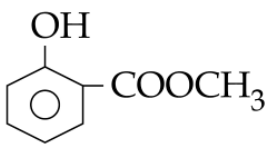
Sodium phenoxide when heated with CO_2 under pressure at 125°C yields a product which on acetylation produces C.

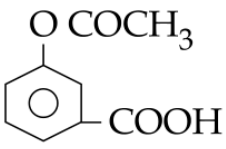


The major product C would be :

(1) 

(2) 

(3) 

(4) 

Question Number : 86 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Considering the basic strength of amines in aqueous solution, which one has the smallest pK_b value ?

(1) $(CH_3)_2NH$

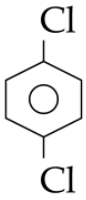
(2) CH_3NH_2

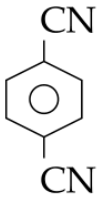
(3) $(CH_3)_3N$

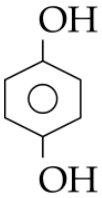
(4) $C_6H_5NH_2$

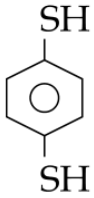
Question Number : 87 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

For which of the following molecule significant $\mu \neq 0$?

(a) 

(b) 

(c) 

(d) 

(1) Only (a)

(2) (a) and (b)

(3) Only (c)

(4) (c) and (d)

Question Number : 88 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which one is classified as a condensation polymer ?

(1) Dacron

(2) Neoprene

(3) Teflon

(4) Acrylonitrile

Question Number : 89 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

Which one of the following bases is **not** present in DNA ?

(1) Quinoline

(2) Adenine

(3) Cytosine

(4) Thymine

Question Number : 90 Question Type : MCQ Correct Marks : 4 Wrong Marks : 1

In the reaction,

$$CH_3COOH \xrightarrow{LiAlH_4} A \xrightarrow{PCl_5} B \xrightarrow{\text{Alc. KOH}} C,$$

the product C is :

(1) Acetaldehyde

(2) Acetylene

(3) Ethylene

(4) Acetyl chloride