Central Board of Secondary Education

Question Paper Name :	B Tech 23 Apr 2013 Single slot
Subject Name :	B. Tech
Duration :	180
Total Marks :	360
Display Marks:	Yes

B. Tech

Group Number :	1
Group Maximum Duration :	0
Group Minimum Duration :	180
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	360

Mathematics Section A

Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 1 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The least integral value α of x such that $\frac{x-5}{x^2+5x-14} > 0$, satisfies :

(1) $\alpha^2 + 3\alpha - 4 = 0$ (2) $\alpha^2 - 5\alpha + 4 = 0$

(3) $\alpha^2 - 7\alpha + 6 = 0$ (4) $\alpha^2 + 5\alpha - 6 = 0$

Question Number : 2 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $a = \text{Im}\left(\frac{1+z^2}{2iz}\right)$, where z is any non-zero complex number. The set $\text{A} = \{a : |z| = 1 \text{ and } z \neq \pm 1\}$ is equal to:

(1) $(-1, 1)$ (2) $[-1, 1]$

(3) $[0, 1)$ (4) $(-1, 0]$

Question Number : 3 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The sum of the series : $(2)^2 + 2(4)^2 + 3(6)^2 + \ldots$ upto 10 terms is :

(1) 11300 (2) 11200

(3) 12100 (4) 12300

Question Number : 4 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $a_1, a_2, a_3, \ldots, a_n, \ldots$ are in A.P. such that $a_4 - a_7 + a_{10} = m$, then the sum of first 13 terms of this A.P., is :

(1) 10 m

(2) 12 m

(3) 13 m

(4) 15 m

Question Number : 5 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The sum of the rational terms in the binomial expansion of $\left(2^{\frac{1}{2}} + 3^{\frac{1}{5}}\right)^{10}$ is :

(1) 25

(2) 32

(3) 9

(4) 41

Question Number : 6 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The number of solutions of the equation $\sin 2x - 2\cos x + 4\sin x = 4$ in the interval $[0, 5\pi]$ is :

(1) 3

(2) 5

(3) 4

(4) 6

Question Number : 7 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If two lines L_1 and L_2 in space, are defined by

$$L_1 = \{x = \sqrt{\lambda}y + (\sqrt{\lambda} - 1),$$
$$z = (\sqrt{\lambda} - 1)y + \sqrt{\lambda}\} \text{ and}$$
$$L_2 = \{x = \sqrt{\mu}y + (1 - \sqrt{\mu}),$$
$$z = (1 - \sqrt{\mu})y + \sqrt{\mu}\}$$

then L_1 is perpendicular to L_2, for all nonnegative reals λ and μ, such that :

(1) $\sqrt{\lambda} + \sqrt{\mu} = 1$

(2) $\lambda \neq \mu$

(3) $\lambda + \mu = 0$

(4) $\lambda = \mu$

Question Number : 8 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let θ_1 be the angle between two lines $2x + 3y + c_1 = 0$ and $-x + 5y + c_2 = 0$ and θ_2 be the angle between two lines $2x + 3y + c_1 = 0$ and $-x + 5y + c_3 = 0$, where c_1, c_2, c_3 are any real numbers : Statement-1: If c_2 and c_3 are proportional, then $\theta_1 = \theta_2$. Statement-2: $\theta_1 = \theta_2$ for all c_2 and c_3.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation of Statement-1.

(2) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation of Statement-1.

(3) Statement-1 is false; Statement- 2 is true.

(4) Statement-1 is true; Statement- 2 is false.

Question Number : 9 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the circle $x^2 + y^2 - 6x - 8y + \left(25 - a^2\right) = 0$ touches the axis of x, then a equals.

(1) 0

(2) ± 4

(3) ± 2

(4) ± 3

Question Number : 10 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The point of intersection of the normals to the parabola $y^2 = 4x$ at the ends of its latus rectum is :

(1) $(0, 2)$

(2) $(3, 0)$

(3) $(0, 3)$

(4) $(2, 0)$

Question Number : 11 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A tangent to the hyperbola $\frac{x^2}{4} - \frac{y^2}{2} = 1$ meets x-axis at P and y-axis at Q. Lines PR and QR are drawn such that OPRQ is a rectangle (where O is the origin). Then R lies on :

(1) $\frac{4}{x^2} + \frac{2}{y^2} = 1$

(2) $\frac{2}{x^2} - \frac{4}{y^2} = 1$

(3) $\frac{2}{x^2} + \frac{4}{y^2} = 1$

(4) $\frac{4}{x^2} - \frac{2}{y^2} = 1$

Question Number : 12 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

For integers m and n, both greater than 1, consider the following three statements : P : m divides n Q : m divides n^2 R : m is prime, then

(1) $Q \wedge R \rightarrow P$

(2) $P \wedge Q \rightarrow R$

(3) $Q \rightarrow R$

(4) $Q \rightarrow P$

Question Number : 13 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the median and the range of four numbers $\{x, y, 2x + y, x - y\}$, where $0 < y < x < 2y$, are 10 and 28 respectively, then the mean of the numbers is :

(1) 18

(2) 10

(3) 5

(4) 14

Question Number : 14 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the extremities of the base of an isosceles triangle are the points $(2a, 0)$ and $(0, a)$ and the equation of one of the sides is $x = 2a$, then the area of the triangle, in square units, is :

(1) $\frac{5}{4}a^2$

(2) $\frac{5}{2}a^2$

(3) $\frac{25a^2}{4}$

(4) $5a^2$

Question Number : 15 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

On the sides AB, BC, CA of a $\triangle$ABC, 3, 4, 5 distinct points (excluding vertices A, B, C) are respectively chosen. The number of triangles that can be constructed using these chosen points as vertices are :

(1) 210

(2) 205

(3) 215

(4) 220

Question Number : 16 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let $\mathrm{R} = \{(x, y) : x, y \in N \text{ and } x^2 - 4xy + 3y^2 = 0\}$, where N is the set of all natural numbers. Then the relation R is :

(1) reflexive but neither symmetric nor transitive.

(2) symmetric and transitive.

(3) reflexive and symmetric,

(4) reflexive and transitive.

Question Number : 17 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let A, other than I or $-$I, be a 2×2 real matrix such that $\mathrm{A}^2 = \mathrm{I}$, I being the unit matrix. Let $\mathrm{Tr}(\mathrm{A})$ be the sum of diagonal elements of A. Statement-1: $\mathrm{Tr}(\mathrm{A}) = 0$ Statement-2: $\det(\mathrm{A}) = -1$

(1) Statement-1 is true; Statement- 2 is false.

(2) Statement-1 is true; Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.

(3) Statement-1 is true; Statement-2 is true; Statement-2 is a correct explanation for Statement-1.

(4) Statement-1 is false; Statement- 2 is true.

Question Number : 18 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Statement-1: The system of linear equations

$$x + (\sin\alpha)y + (\cos\alpha)z = 0$$
$$x + (\cos\alpha)y + (\sin\alpha)z = 0$$
$$x - (\sin\alpha)y - (\cos\alpha)z = 0$$

has a non-trivial solution for only one value of α lying in the interval $\left(0, \frac{\pi}{2}\right)$. Statement-2: The equation in α

$$\begin{vmatrix} \cos\alpha & \sin\alpha & \cos\alpha \\ \sin\alpha & \cos\alpha & \sin\alpha \\ \cos\alpha & -\sin\alpha & -\cos\alpha \end{vmatrix} = 0$$

has only one solution lying in the interval $\left(0, \frac{\pi}{2}\right)$

(1) Statement-1 is true, Statement-2 is true, Statement-2 is not correct explantion for Statement-1.

(2) Statement-1 is true, Statement-2 is true, Statement-2 is a correct explantion for Statement-1.

(3) Statement-1 is true, Statement- 2 is false.

(4) Statememt-1 is false, Statement-2 is true.

Question Number : 19 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

$S = \tan^{-1}\left(\frac{1}{n^2+n+1}\right) + \tan^{-1}\left(\frac{1}{n^2+3n+3}\right) + \ldots + \tan^{-1}\left(\frac{1}{1+(n+19)(n+20)}\right)$, then $\tan S$ is equal to :

(1) $\frac{20}{401+20n}$

(2) $\frac{n}{n^2+20n+1}$

(3) $\frac{20}{n^2+20n+1}$

(4) $\frac{n}{401+20n}$

Question Number : 20 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Let f be a composite function of x defined by $f(u) = \frac{1}{u^2+u-2}, u(x) = \frac{1}{x-1}$. Then the number of points x where f is discontinuous is :

(1) 4

(2) 3

(3) 2

(4) 1

Question Number : 21 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $f(x) = \sin(\sin x)$ and $f''(x) + \tan x f'(x) + g(x) = 0$, then $g(x)$ is :

(1) $\cos^2 x \cos(\sin x)$

(2) $\sin^2 x \cos(\cos x)$

(3) $\sin^2 x \sin(\cos x)$

(4) $\cos^2 x \sin(\sin x)$

Question Number : 22 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the curves $\frac{x^2}{\alpha} + \frac{y^2}{4} = 1$ and $y^3 = 16x$ intersect at right angles, then a value of α is :

(1) 2

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

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

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

Question Number : 23 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The cost of running a bus from A to B is Rs. $(av + b/v)$ where vkm/h is the average speed of the bus. When the bus travels at 30 km/h, the cost comes out to be Rs. 75 while at 40 km/h, it is Rs. 65. Then the most economical speed (in km/h) of the bus is :

(1) 45

(2) 50

(3) 60

(4) 40

Question Number : 24 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If a curve passes through the point $\left(2, \frac{7}{2}\right)$ and has slope $\left(1-\frac{1}{x^2}\right)$ at any point (x, y) on it, then the ordinate of the point on the curve whose abscissa is -2 is :

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

(3) $\frac{5}{2}$ (4) $-\frac{5}{2}$

Question Number : 25 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The integral $\int \frac{x dx}{2-x^2+\sqrt{2-x^2}}$ equals :

(1) $\log \left|1+\sqrt{2+x^2}\right|+c$ (2) $-\log \left|1+\sqrt{2-x^2}\right|+c$

(3) $-x \log \left|1-\sqrt{2-x^2}\right|+c$ (4) $x \log \left|1-\sqrt{2+x^2}\right|+c$

Question Number : 26 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The value of $\int_{-\pi/2}^{\pi/2} \frac{\sin^2 x}{1+2^x} dx$ is :

(1) π (2) $\frac{\pi}{2}$

(3) 4π (4) $\frac{\pi}{4}$

Question Number : 27 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The area under the curve $y=|\cos x-\sin x|$, $0 \leq x \leq \frac{\pi}{2}$, and above x-axis is :

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

(3) $2\sqrt{2}+2$ (4) 0

Question Number : 28 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If $\vec{a}$ and $\vec{b}$ are non-collinear vectors, then the value of α for which the vectors $\vec{u}=(\alpha-2)\vec{a}+\vec{b}$ and $\vec{v}=(2+3\alpha)\vec{a}-3\vec{b}$ are collinear is :

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

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

Question Number : 29 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the projections of a line segment on the x, y and z-axes in 3-dimensional space are 2, 3 and 6 respectively, then the length of the line segment is :

(1) 12 (2) 7

(3) 9 (4) 6

Question Number : 30 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A, B, C try to hit a target simultaneously but independently. Their respective probabilities of hitting the targets are $\frac{3}{4}, \frac{1}{2}, \frac{5}{8}$. The probability that the target is hit by A or B but not by C is :

(1) $21/64$ (2) $7/8$

(3) $7/32$ (4) $9/64$

Physics Section A

Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120

Maximum Instruction Time : 0
Sub-Section Number : 1
Question Shuffling Allowed : Yes
Is Section Default? : No

Question Number : 31 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

If the time period t of the oscillation of a drop of liquid of density d, radius r, vibrating under surface tension s is given by the formula $t = \sqrt{r^{2b}s^c d^{a/2}}$. It is observed that the time period is directly proportional to $\sqrt{\frac{d}{s}}$. The value of b should therefore be :

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

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

Question Number : 32 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A 70 kg man leaps vertically into the air from a crouching position. To take the leap the man pushes the ground with a constant force F to raise himself. The center of gravity rises by 0.5 m before he leaps. After the leap the c.g. rises by another 1 m. The maximum power delivered by the muscles is : (Take $g = 10\ ms^{-2}$)

(1) 6.26×10^3 Watts at the start (2) 6.26×10^3 Watts at take off

(3) 6.26×10^4 Watts at the start (4) 6.26×10^4 Watts at take off

Question Number : 33 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A boy of mass 20 kg is standing on a 80 kg free to move long cart. There is negligible friction between cart and ground. Initially, the boy is standing 25 m from a wall. If he walks 10 m on the cart towards the wall, then the final distance of the boy from the wall will be

(1) 15 m (2) 12.5 m

(3) 15.5 m (4) 17 m

Question Number : 34 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A projectile of mass M is fired so that the horizontal range is 4 km. At the highest point the projectile explodes in two parts of masses $M/4$ and $3M/4$ respectively and the heavier part starts falling down vertically with zero initial speed. The horizontal range (distance from point of firing) of the lighter part is :

(1) 16 km (2) 1 km

(3) 10 km (4) 2 km

Question Number : 35 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A particle of mass 2 kg is moving such that at time t, its position, in meter, is given by $\vec{r}(t) = 5\hat{i} - 2t^2\hat{j}$. The angular momentum of the particle at $t = 2s$ about the origin in $kgm^{-2}\ s^{-1}$ is :

(1) $-80\hat{k}$ (2) $(10\hat{i} - 16\hat{j})$

(3) $-40\hat{k}$ (4) $40\hat{k}$

Question Number : 36 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A body of mass ' m ' is tied to one end of a spring and whirled round in a horizontal plane with a constant angular velocity. The elongation in the spring is 1 cm. If the angular velocity is doubled, the elongation in the spring is 5 cm. The original length of the spring is :

(1) 15 cm (2) 12 cm

(3) 16 cm (4) 10 cm

Question Number : 37 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A copper wire of length 1.0 m and a steel wire of length 0.5 m having equal cross-sectional areas are joined end to end. The composite wire is stretched by a certain load which stretches the copper wire by 1 mm. If the Young's modulii of copper and steel are respectively $1.0 \times 10^{11}\ \mathrm{Nm}^{-2}$ and $2.0 \times 10^{11}\mathrm{Nm}^{-2}$, the total extension of the composite wire is :

(1) 1.75 mm

(2) 2.0 mm

(3) 1.50 mm

(4) 1.25 mm

Question Number : 38 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Wax is coated on the inner wall of a capillary tube and the tube is then dipped in water. Then, compared to the unwaxed capillary, the angle of contact θ and the height h upto which water rises change. These changes are :

(1) θ increases and h also increases

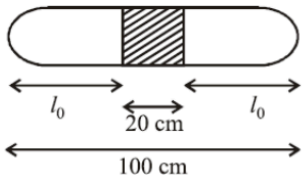
(2) θ decreases and h also decreases

(3) θ increases and h decreases

(4) θ decreases and h increases

Question Number : 39 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A thin tube sealed at both ends is 100 cm long. It lies horizontally, the middle 20 cm containing mercury and two equal ends containing air at standard atmospheric pressure. If the tube is now turned to a vertical position, by what amount will the mercury be displaced ?



(Given : cross-section of the tube can be assumed to be uniform)

(1) 2.95 cm

(2) 5.18 cm

(3) 8.65 cm

(4) 0.0 cm

Question Number : 40 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The ratio of the coefficient of volume expansion of a glass container to that of a viscous liquid kept inside the container is 1 : 4. What fraction of the inner volume of the container should the liquid occupy so that the volume of the remaining vacant space will be same at all temperatures ?

(1) 2 : 5

(2) 1 : 4

(3) 1 : 64

(4) 1 : 8

Question Number : 41 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

500 g of water and 100 g of ice at $0^{\circ}\mathrm{C}$ are in a calorimeter whose water equivalent is 40 g.10 g of steam at $100^{\circ}\mathrm{C}$ is added to it. Then water in the calorimeter is : (Latent heat of ice $= 80\mathrm{cal/g}$, Latent heat of steam $= 540\mathrm{cal/g}$)

(1) 580 g

(2) 590 g

(3) 600 g

(4) 610 g

Question Number : 42 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

This question has Statement-1 and Statement-2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: The internal energy of a perfect gas is entirely kinetic and depends only on absolute temperature of the gas and not on its pressure or volume. Statement 2: A perfect gas is heated keeping pressure constant and later at constant volume. For the same amount of heat the temperature of the gas at constant pressure is lower than that at constant volume.

(1) Statement-1 is true, Statement- 2 is true and Statement -2 is the correct explanation of Statement-1.

(2) Statement-1 is true, Statement-2 is false.

(3) Statement-1 is true, Statement-2 is true but Statement-2 is not the correct explanation of Statement-1.

(4) Statement-1 is false, Statement-2 is true.

Question Number : 43 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Bob of a simple pendulum of length l is made of iron. The pendulum is oscillating over a horizontal coil carrying direct current. If the time period of the pendulum is T then :

(1) $T < 2\pi\sqrt{\frac{l}{g}}$ and damping is smaller than in air alone.

(2) $T = 2\pi\sqrt{\frac{l}{g}}$ and damping is larger than in air alone.

(3) $T > 2\pi\sqrt{\frac{l}{g}}$ and damping is smaller than in air alone.

(4) $T < 2\pi\sqrt{\frac{l}{g}}$ and damping is larger than in air alone.

Question Number : 44 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A sonometer wire of length 114 cm is fixed at both the ends. Where should the two bridges be placed so as to divide the wire into three segments whose fundamental frequencies are in the ratio $1 : 3 : 4$?

(1) At 36 cm and 84 cm from one end

(2) At 24 cm and 72 cm from one end

(3) At 48 cm and 96 cm from one end

(4) At 72 cm and 96 cm from one end

Question Number : 45 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Consider a finite insulated, uncharged conductor placed near a finite positively charged conductor. The uncharged body must have a potential :

(1) less than the charged conductor and more than at infinity.

(2) more than the charged conductor and less than at infinity.

(3) more than the charged conductor and more than at infinity.

(4) less than the charged conductor and less than at infinity.

Question Number : 46 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A liquid drop having 6 excess electrons is kept stationary under a uniform electric field of $25.5\ \mathrm{kVm^{-1}}$. The density of liquid is $1.26 \times 10^3\ \mathrm{kg\ m^{-3}}$. The radius of the drop is (neglect buoyancy).

(1) $4.3 \times 10^{-7}\ \mathrm{m}$

(2) $7.8 \times 10^{-7}\ \mathrm{m}$

(3) $0.078 \times 10^{-7}\ \mathrm{m}$

(4) $3.4 \times 10^{-7}\ \mathrm{m}$

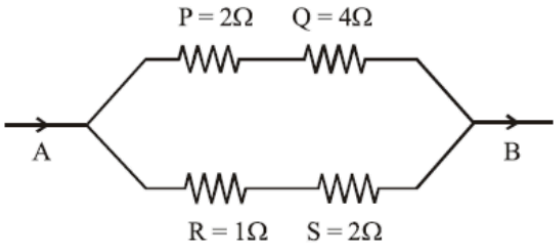
Question Number : 47 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A parallel plate capacitor of area 60 cm^2 and separation 3 mm is charged initially to $90\mu\text{C}$. If the medium between the plate gets slightly conducting and the plate loses the charge initially at the rate of $2.5 \times 10^{-8}\text{C/s}$, then what is the magnetic field between the plates ?

(1) 2.5×10^{-8} T
(2) 2.0×10^{-7} T
(3) 1.63×10^{-11} T
(4) Zero

Question Number : 48 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the four resistances P, Q, R and S generate the greatest amount of heat when a current flows from A

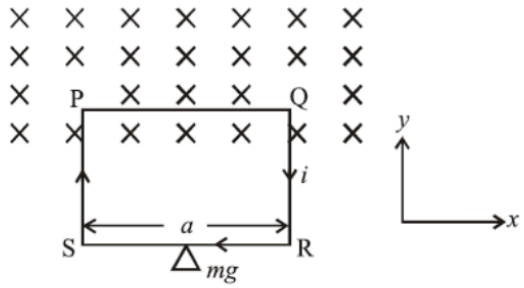


to B ?

(1) Q
(2) S
(3) P
(4) R

Question Number : 49 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A rectangular loop of wire, supporting a mass m, hangs with one end in a uniform magnetic field $\vec{B}$ pointing out of the plane of the paper. A clockwise current is set up such that $i > mg/Ba$, where a is the width of the



loop. Then :

(1) The weight rises due to a vertical force caused by the magnetic field and work is done on the system.
(2) The weight do not rise due to vertical for caused by the magnetic field and work is done on the system.
(3) The weight rises due to a vertical force caused by the magnetic field but no work is done on the system.
(4) The weight rises due to a vertical force caused by the magnetic field and work is extracted from the magnetic field.

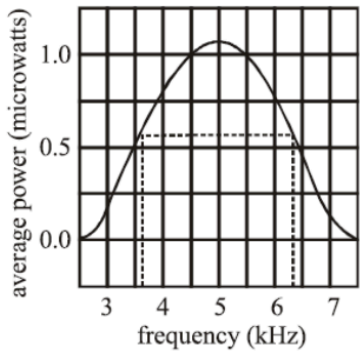
Question Number : 50 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A particle of charge $16 \times 10^{-16}\text{C}$ moving with velocity 10 ms^{-1} along x-axis enters a region where magnetic field of induction $\vec{B}$ is along the y-axis and an electric field of magnitude 10^4Vm^{-1} is along the negative z-axis. If the charged particle continues moving along x-axis, the magnitude of $\vec{B}$ is :

(1) 16×10^3 Wb m^{-2}
(2) 2×10^3 Wb m^{-2}
(3) 1×10^3 Wb m^{-2}
(4) 4×10^3 Wb m^{-2}

Question Number : 51 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The plot given below is of the average power delivered to an LRC circuit versus frequency. The quality factor



of the circuit is :

(1) 5.0

(2) 2.0

(3) 2.5

(4) 0.4

Question Number : 52 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Select the correct statement from the following :

(1) Electromagnetic waves cannot travel in vacuum.

(2) Electromagnetic waves are longitudinal waves.

(3) Electromagnetic waves are produced by charges moving with uniform velocity.

(4) Electromagnetic waves carry both energy and momentum as they propagate through space.

Question Number : 53 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

This question has Statement-1 and Statement-2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: Very large size telescopes are reflecting telescopes instead of refracting telescopes. Statement 2: It is easier to provide mechanical support to large size mirrors than large size lenses.

(1) Statement-1 is true and Statement-2 is false.

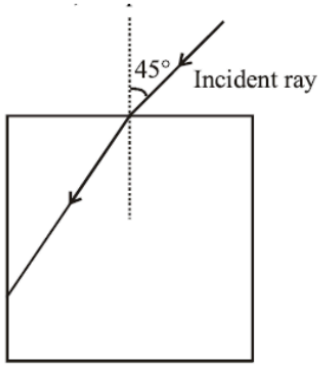
(2) Statement-1 is false and Statement-2 is true.

(3) Statement-1 and statement-2 are true and Statement-2 is correct explanation for statement-1.

(4) Statements-1 and statement-2 are true and Statement-2 is not the correct explanation for statement-1.

Question Number : 54 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A light ray falls on a square glass slab as shown in the diagram. The index of refraction of the glass, if total



internal reflection is to occur at the vertical face, is equal to :

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

(2) $\sqrt{\frac{5}{2}}$

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

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

Question Number : 55 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

n identical waves each of intensity I_0 interfere with each other. The ratio of maximum intensities if the interference is (i) coherent and (ii) incoherent is :

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

(3) $\frac{1}{n^2}$ (4) n

Question Number : 56 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Electrons are accelerated through a potential difference V and protons are accelerated through a potential difference 4 V. The de-Broglie wavelengths are λ_e and λ_p for electrons and protons respectively. The ratio of $\frac{\lambda_e}{\lambda_p}$ is given by: (given m_e is mass of electron and m_p is mass of proton).

(1) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$ (2) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_e}{m_p}}$

(3) $\frac{\lambda_e}{\lambda_p} = \frac{1}{2}\sqrt{\frac{m_e}{m_p}}$ (4) $\frac{\lambda_e}{\lambda_p} = 2\sqrt{\frac{m_p}{m_e}}$

Question Number : 57 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

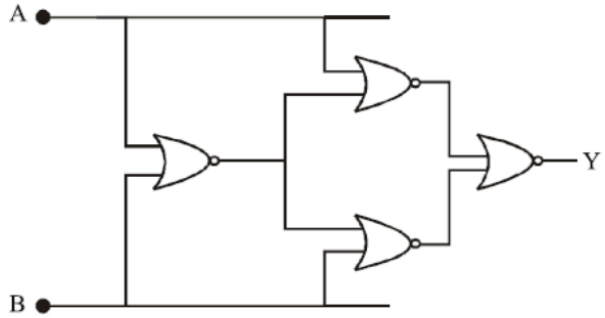
In the Bohr's model of hydrogen-like atom the force between the nucleus and the electron is modified as $F = \frac{e^2}{4\pi\varepsilon_0}\left(\frac{1}{r^2} + \frac{\beta}{r^3}\right)$, where β is a constant. For this atom, the radius of the n^{th} orbit in terms of the Bohr radius $\left(a_0 = \frac{\varepsilon_0 h^2}{m\pi e^2}\right)$ is :

(1) $r_n = a_0 n - \beta$ (2) $r_n = a_0 n^2 + \beta$

(3) $r_n = a_0 n^2 - \beta$ (4) $r_n = a_0 n + \beta$

Question Number : 58 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

A system of four gates is set up as shown. The 'truth table' corresponding to this system is :



(1)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(2)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

(3)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(4)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

Question Number : 59 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following statement is NOT correct?

(1) Ground wave signals are more stable than the sky wave signals.

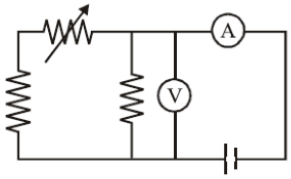
(2) The critical frequency of an ionospheric layer is the highest frequency that will be reflected back by the layer when it is vertically incident.

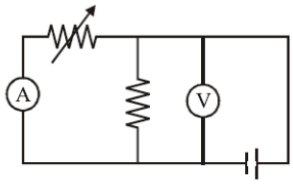
(3) Electromagnetic waves of frequencies higher than about 30MHz cannot penetrate the ionosphere.

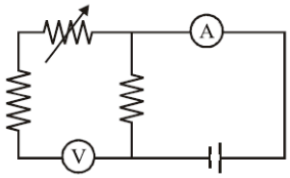
(4) Sky wave signals in the broadcast frequency range are stronger at night than in the day time.

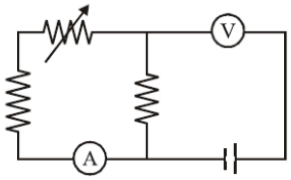
Question Number : 60 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Correct set up to verify Ohm's law is :

(1) 

(2) 

(3) 

(4) 

Chemistry Section A

Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	30
Number of Questions to be attempted :	30
Section Marks :	120
Maximum Instruction Time :	0
Sub-Section Number :	1
Question Shuffling Allowed :	Yes
Is Section Default? :	No

Question Number : 61 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Number of atoms in the following samples of substances is largest in:

(1) 4.0 g of hydrogen

(2) 71.0 g of chlorine

(3) 127.0 g of iodine

(4) 48.0 g of magnesium

Question Number : 62 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The de Broglie wavelength of a car of mass 1000 kg and velocity 36 km/hr is :

(1) 6.626×10^{-34} m

(2) 6.626×10^{-38} m

(3) 6.626×10^{-31} m

(4) 6.626×10^{-30} m

Question Number : 63 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which is the correct order of second ionization potential of C, N, O and F in the following ?

(1) O > N > F > C

(2) O > F > N > C

(3) F > O > N > C

(4) C > N > O > F

Question Number : 64 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The shape of IF_6^- is :

(1) Trigonally distorted octahedron

(2) Pyramidal

(3) Octahedral

(4) Square antiprism

Question Number : 65 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Bond distance in HF is 9.17×10^{-11} m. Dipole moment of HF is 6.104×10^{-30}Cm. The percentage ionic character in HF will be : (electron charge $= 1.60 \times 10^{-19}$C)

(1) 61.0% (2) 38.0%

(3) 35.5% (4) 41.5%

Question Number : 66 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The correct order of viscosity of the following liquids will be :

(1) Water $<$ methyl alcohol $<$ dimethyl ether $<$ glycerol

(2) methyl alcohol $<$ glycerol $<$ water $<$ dimethyl ether

(3) dimethyl ether $<$ methyl alcohol $<$ water $<$ glycerol

(4) glycerol $<$ dimethyl ether $<$ water $<$ methyl alcohol

Question Number : 67 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following statements/relationships is not correct in thermodynamic changes ?

(1) $\Delta \mathrm{U} = 0$ (isothermal reversible expansion of a gas)

(2) $\mathrm{w} = -\mathrm{nRT} \ln \frac{\mathrm{V_2}}{\mathrm{V_1}}$ (isothermal reversible expansion of an ideal gas)

(3) $\mathrm{w} = \mathrm{nRT} \ln \frac{\mathrm{V_2}}{\mathrm{V_1}}$ (isothermal reversible expansion of an ideal gas)

(4) For a system of constant volume heat involved directly changes to internal energy.

Question Number : 68 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

(1) $\mathrm{N_2(\,g) + 3H_2(\,g) \rightleftharpoons 2NH_3(\,g), K_1}$ (2) $\mathrm{N_2(\,g) + O_2(\,g) \rightleftharpoons 2NO(g), K_2}$ (3) $\mathrm{H_2(\,g) + \frac{1}{2}O_2(\,g) \rightleftharpoons H_2O(g), K_3}$ The equation for the equilibrium constant of the reaction

$$\mathrm{2NH_3(\,g) + \frac{5}{2}O_2(\,g) \rightleftharpoons 2NO(g) + 3H_2O(g),}$$

(K_4) in terms of $\mathrm{K_1}$, $\mathrm{K_2}$ and $\mathrm{K_3}$ is :

(1) $\frac{\mathrm{K_1 \cdot K_2}}{\mathrm{K_3}}$ (2) $\frac{\mathrm{K_1 \cdot K_3^2}}{\mathrm{K_2}}$

(3) $\mathrm{K_1\ K_2\ K_3}$ (4) $\frac{\mathrm{K_2 \cdot K_3^3}}{\mathrm{K_1}}$

Question Number : 69 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

What is the pH of a $10^{-4}\mathrm{MOH^-}$solution at 330 K, if $\mathrm{K_w}$ at 330 K is $10^{-13.6}$?

(1) 4 (2) 9.0

(3) 10 (4) 9.6

Question Number : 70 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The numbers of protons, electrons and neutrons in a molecule of heavy water are respectively :

(1) $8, 10, 11$ (2) $10, 10, 10$

(3) $10, 11, 10$ (4) $11, 10, 10$

Question Number : 71 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Equimolar solutions of the following compounds are prepared separately in water. Which will have the lowest pH value ?

(1) $\mathrm{BeCl_2}$ (2) $\mathrm{SrCl_2}$

(3) $\mathrm{CaCl_2}$ (4) $\mathrm{MgCl_2}$

Question Number : 72 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Monocarboxylic acids are functional isomers of:

(1) Ethers
(2) Amines
(3) Esters
(4) Alcohols

Question Number : 73 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

In a face centred cubic lattice, atoms of A form the corner points and atoms of B form the face centred points. If two atoms of A are missing from the corner points, the formula of the ionic compound is :

(1) AB_3
(2) AB_4
(3) A_2B_5
(4) AB_2

Question Number : 74 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Vapour pressure of pure benzene is 119 torr and that of toluene is 37.0 torr at the same temperature. Mole fraction of toluene in vapour phase which is in equilibrium with a solution of benzene and toluene having a mole fraction of toluene 0.50, will be :

(1) 0.137
(2) 0.237
(3) 0.435
(4) 0.205

Question Number : 75 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Given :

$$E^{o}_{\frac{1}{2}Cl_2/Cl^-} = 1.36\ V, E^{o}_{Cr^{3+}/Cr} = -0.74\ V$$
$$E^{o}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\ V, E^{o}_{MnO_4^-/Mn^{2+}} = 1.51\ V$$

The correct order of reducing power of the species $\left(Cr, Cr^{3+}, Mn^{2+} \text{ and } Cl^-\right)$ will be:

(1) $Mn^{2+} < Cl^- < Cr^{3+} < Cr$
(2) $Mn^{2+} < Cl^{3+} < Cl^- < Cr$
(3) $Cr^{3+} < Cl^- < Mn^{2+} < Cr$
(4) $Cr^{3+} < Cl^- < Cr < Mn^{2+}$

Question Number : 76 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The rate constant of a zero order reaction is 2.0×10^{-2} mol L^{-1} s^{-1}. If the concentration of the reactant after 25 seconds is 0.5M. What is the initial concentration?

(1) 0.5M
(2) 1.25M
(3) 12.5M
(4) 1.0M

Question Number : 77 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Smoke is an example of:

(1) Solid dispersed in solid
(2) Gas dispersed in liquid
(3) Solid dispersed in gas
(4) Gas dispersed in solid

Question Number : 78 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which has trigonal bipyramidal shape ?

(1) $XeOF_4$
(2) XeO_3
(3) XeO_3F_2
(4) $XeOF_2$

Question Number : 79 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

When a small amount of $KMnO_4$ is added to concentrated H_2SO_4, a green oily compound is obtained which is highly explosive in nature. Compound may be :

(1) $MnSO_4$ (2) Mn_2O_7

(3) MnO_2 (4) Mn_2O_3

Question Number : 80 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Identify incorrect statement :

(1) Cu_2O is colourless. (2) Copper (I) compounds are colourless except when colour results from charge transfer.

(3) Copper (I) compounds are diamagnetic. (4) Cu_2 S is black.

Question Number : 81 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The magnetic moment of the complex anion $[Cr(NO)\,(NH_3)(CN)_4]^{2-}$ is :

(1) 5.91BM (2) 3.87BM

(3) 1.73BM (4) 2.82BM

Question Number : 82 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Identify the incorrect statement:

(1) In $(Si_3O_9)^{6-}$, tetrahedral SiO_4 units share two oxygen atoms. (2) Trialkylchlorosilane on hydrolysis gives R_3SiOH .

(3) $SiCl_4$ undergoes hydrolysis to give H_4SiO_4. (4) $(Si_3O_9)^{6-}$ has cyclic structure.

Question Number : 83 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The order of reactivity of the given haloalkanes towards nucleophile is :

(1) RI > RBr > RCl (2) RCl > RBr > RI

(3) RBr > RCl > RI (4) RBr > RI > RCl

Question Number : 84 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

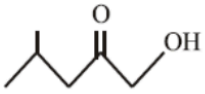
The reaction of phenol with benzoyl chloride to give phenyl benzoate is known as :

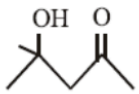
(1) Claisen reaction (2) Schotten-Baumann reaction

(3) Reimer-Tiemann reaction (4) Gatterman-Koch reaction

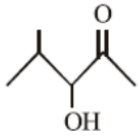
Question Number : 85 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following is the product of aldol condensation?

(1) 

(2) 

(3)

(4) 

Question Number : 86 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

The order of basicity of amines in gaseous state is :

(1) $1^\circ > 2^\circ > 3^\circ > NH_3$ (2) $3^\circ > 2^\circ > NH_3 > 1^\circ$

(3) $3^\circ > 2^\circ > 1^\circ > NH_3$ (4) $NH_3 > 1^\circ > 2^\circ > 3^\circ$

Question Number : 87 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Which of the following polymer is a polyamide ?

(1) Terylene

(2) Nylon

(3) Rubber

(4) Vulcanised rubber

Question Number : 88 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

H_1- Receptor antagonists is a term associated with :

(1) Antiseptics

(2) Antihistamins

(3) Antacids

(4) Analgesics

Question Number : 89 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Glycosidic linkage is actually an :

(1) Carbonyl bond

(2) Ether bond

(3) Ester bond

(4) Amide bond

Question Number : 90 Question Type : MCQ Option Shuffling : Yes Display Question Number : Yes Is Question Mandatory : No Single Line Question Option : No

Natural glucose is termed D-glucose because :

(1) $-OH$ on the second carbon is on the right side in Fischer projection

(2) $-OH$ on the sixth carbon is on the right side in Fischer projection.

(3) $-OH$ on the fifth carbon is on the right side in Fischer projection.

(4) It is dextrorotatory.