JEE Main 2013 Paper 1 (B.E./B.Tech) Apr 25 Single slot Question Paper

Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: 3 Hours **Paper 1: B.E./B.Tech.** **Maximum Marks: 360**

General Instructions

(i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2013 - Annual**, conducted by the Central Board of Secondary Education (CBSE) in Computer Based Test (CBT) mode on 25 April 2013, Single slot (Online CBT). The total duration is **3 hours**.

(ii) The paper has **90 questions** and a maximum of **360 marks**: Mathematics, Physics and Chemistry carry 30 questions (120 marks) each, in that order.

(iii) Each subject has **30 multiple choice questions** (MCQs), with four options each. Select the most appropriate answer.

(iv) **All questions are compulsory**. Use only the constants given in the question while calculating.

(v) **Marking scheme**: **+4** for a correct answer, **−1** for an incorrect answer, and **0** for an unanswered or marked-for-review question.

(vi) All calculations and rough work are to be done on the rough sheets only. Calculators, log tables, slide rules and electronic gadgets are not allowed.

Mathematics - Multiple Choice Questions

1. If p and q are non-zero real numbers and $\alpha^3 + \beta^3 = -p, \alpha\beta = q$, then a quadratic equation whose roots are $\frac{\alpha^2}{\beta}, \frac{\beta^2}{\alpha}$ is :

(1) $px^2 - qx + p^2 = 0$ (2) $qx^2 + px + q^2 = 0$

(3) $px^2 + qx + p^2 = 0$ (4) $qx^2 - px + q^2 = 0$

2. Let z satisfy $|z| = 1$ and $z = 1 - \bar{z}$. Statement 1 : z is a real number. Statement 2 : Principal argument of z is $\frac{\pi}{3}$

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

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

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

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

3. 5 - digit numbers are to be formed using $2, 3, 5, 7, 9$ without repeating the digits. If p be the number of such numbers that exceed 20000 and q be the number of those that lie between 30000 and 90000 , then $p : q$ is:

(1) $6 : 5$ (2) $3 : 2$

(3) $4 : 3$ (4) $5 : 3$

4. Given a sequence of 4 numbers, first three of which are in G.P. and the last three are in A.P. with common difference six. If first and last terms of this sequence are equal, then the last term is :

(1) 16 (2) 8

(3) 4 (4) 2

5. The value of $1^2 + 3^2 + 5^2 + \ldots\ldots\ldots\ldots\ldots\ldots + 25^2$ is :

(1) 2925 (2) 1469

(3) 1728 (4) 1456

6. If for positive integers $r > 1, n > 2$, the coefficients of the $(3r)^{\text{th}}$ and $(r+2)^{\text{th}}$ powers of x in the expansion of $(1+x)^{2n}$ are equal, then n is equal to:

(1) $2r + 1$ (2) $2r - 1$

(3) $3r$ (4) $r + 1$

7. Let $\mathrm{A} = \{\theta : \sin(\theta) = \tan(\theta)\}$ and $\mathrm{B} = (\theta : \cos(\theta) = 1\backslash\}$ be two sets. Then:

(1) $\mathrm{A} = \mathrm{B}$ (2) $A \not\subset B$

(3) $B \not\subset A$ (4) $A \subset B$ and $B - A \neq \phi$

8. If the image of point $\mathrm{P}(2, 3)$ in a line L is $\mathrm{Q}(4, 5)$, then the image of point $\mathrm{R}(0, 0)$ in the same line is:

(1) $(2, 2)$ (2) $(4, 5)$

(3) $(3, 4)$ (4) $(7, 7)$

9. Let $x \in (0, 1)$. The set of all x such that $\sin^{-1} x > \cos^{-1} x$, is the interval:

(1) $\left(\frac{1}{2}, \frac{1}{\sqrt{2}}\right)$ (2) $\left(\frac{1}{\sqrt{2}}, 1\right)$

(3) $(0, 1)$ (4) $\left(0, \frac{\sqrt{3}}{2}\right)$

10. Statement 1: The only circle having radius $\sqrt{10}$ and a diameter along line $2x + y = 5$ is $x^2 + y^2 - 6x + 2y = 0$. Statement 2 : $2x + y = 5$ is a normal to the circle $x^2 + y^2 - 6x + 2y = 0$.

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

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

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

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

11. If a circle of unit radius is divided into two parts by an arc of another circle subtending an angle 60° on the circumference of the first circle, then the radius of the arc is:

(1) $\sqrt{3}$

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

(3) 1

(4) None of these

12. A point on the ellipse, $4x^2 + 9y^2 = 36$, where the normal is parallel to the line, $4x - 2y - 5 = 0$, is :

(1) $\left(\frac{9}{5}, \frac{8}{5}\right)$

(2) $\left(\frac{8}{5}, -\frac{9}{5}\right)$

(3) $\left(-\frac{9}{5}, \frac{8}{5}\right)$

(4) $\left(\frac{8}{5}, \frac{9}{5}\right)$

13. Consider the system of equations : $x + ay = 0, y + az = 0$ and $z + ax = 0$. Then the set of all real values of ' a ' for which the system has a unique solution is:

(1) R $- \{1\}$

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

(3) $\{1, -1\}$

(4) $\{1, 0, -1\}$

14. Let p and q be any two logical statements and r : p $\rightarrow (\sim p \vee q)$. If r has a truth value F, then the truth values of p and q are respectively:

(1) F, F

(2) T, T

(3) T, F

(4) F, T

15. In a set of $2n$ observations, half of them are equal to ' a ' and the remaining hall are equal to ' $-a$' '. If the standard deviation of all the observations is 2 ; then the value of $|a|$ is :

(1) 2

(2) $\sqrt{2}$

(3) 4

(4) $2\sqrt{2}$

16. A common tangent to the conics $x^2 = 6y$ and $2x^2 - 4y^2 = 9$ is:

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

(2) $x + y = 1$

(3) $x + y = \frac{9}{2}$

(4) $x - y = 1$

17. Let $S = \left\{ \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} : a_{ij} \in \{0, 1, 2\}, a_{11} = a_{22} \right\}$ Then the number of non-singular matrices in the set S is :

(1) 27

(2) 24

(3) 10

(4) 20

18. Consider the function : $f(x) = [x] + |1 - x|, -1 \le x \le 3$ where $[x]$ is the greatest integer function. Statement 1: f is not continuous at $x = 0, 1, 2$ and 3 Statement 2:f(x)= $= \begin{matrix} -x, & -1 \le x < 0 \\ 1-x, & 0 \le x < 1 \\ 1+x, & 1 \le x < 2 \\ 2+x, & 2 \le x \le 3 \end{matrix}$

(1) Statement 1 is true; Statement 2 is false,

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

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

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

19. A spherical balloon is being inflated at the rate of 35cc/min. The rate of increase in the surface area (in $\text{cm}^2/\text{min.}$) of the balloon when its diameter is 14 cm, is :

(1) 10

(2) $\sqrt{10}$

(3) 100

(4) $10\sqrt{10}$

20. Let $f(1) = -2$ and $f'(x) \ge 4.2$ for $1 \le x \le 6$. The possible value of $f(6)$ lies in the interval :

(1) $[15, 19)$

(2) $(-\infty, 12)$

(3) $[12, 15)$

(4) $[19, \infty)$

21. If an equation of a tangent to the curve, $y - \cos(x + f), -1 - 1 \le x \le 1 + \pi$, is $x + 2y = k$ then k is equal to :

(1) 1

(2) 2

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

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

22. If the integral

$$\int \frac{\cos 8x + 1}{\cot 2x - \tan 2x} dx = A \cos 8x + k$$

where k is an arbitrary constant, then A is equal to:

(1) $-\frac{1}{16}$

(2) $\frac{1}{16}$

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

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

23. For $0 \le x \le \frac{\pi}{2}$, the value of

$$\int_0^{\sin^2 x} \sin^{-1}(\sqrt{t}) dt + \int_0^{\cos^2 x} \cos^{-1}(\sqrt{t}) dt \text{ equals :}$$

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

(2) 0

(3) 1

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

24. Let $f:[-2,3] \to [0,\infty)$ be a continuous function such that $f(1-x)=f(x)$ for all $x \in [-2,3]$. If R_1 is the numerical value of the area of the region bounded by $y=f(x), x=-2, x=3$ and the axis of x and $R_2=\int_{-2}^{3} xf(x)dx$, then :

(1) $3R_1=2R_2$ (2) $2\mathrm{R}_1=3\mathrm{R}_2$

(3) $\mathrm{R}_1=\mathrm{R}_2$ (4) $\mathrm{R}_1=2\mathrm{R}_2$

25. The equation of the curve passing through the origin and satisfying the differential equation $\left(1+x^2\right)\frac{dy}{dx}+2xy=4x^2$ is

(1) $\left(1+x^2\right)y=x^3$ (2) $3\left(1+x^2\right)y=2x^3$

(3) $\left(1+x^2\right)y=3x^3$ (4) $3\left(1+x^2\right)y=4x^3$

26. Let $\vec{a}=2\hat{i}+\hat{j}-2\hat{k}, \vec{b}=\hat{i}+\hat{j}$. If $\vec{c}$ is a vector such that $\vec{a}\bullet\vec{c}=|\vec{c}|, |\vec{c}-\vec{a}|=2\sqrt{2}$ and the angle between $\vec{a}\times\vec{b}$ and $\vec{c}$ is 30°, then $|(\vec{a}\times\vec{b})\times\vec{c}|$ equals:

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

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

27. Let $A(-3,2)$ and $B(-2,1)$ be the vertices of a triangle ABC. If the centroid of this triangle lies on the line $3x+4y+2=0$, then the vertex C lies on the line :

(1) $4x+3y+5=0$ (2) $3x+4y+3=0$

(3) $4x+3y+3=0$ (4) $3x+4y+5=0$

28. Let ABC be a triangle with vertices at points A $(2,3,5)$, B $(-1,3,2)$ and C$(\lambda,5,\mu)$ in three dimensional space. If the median through A is equally inclined with the axes, then (λ,μ) is equal to:

(1) $(10,7)$ (2) $(7,5)$

(3) $(7,10)$ (4) $(5,7)$

29. The equation of a plane through the line of intersection of the planes $x+2y=3, y-2z+1=0$, and perpendicular to the first plane is :

(1) $2x-y-10z=9$ (2) $2x-y+7z=11$

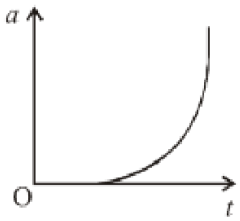
(3) $2x-y+10z=11$ (4) $2x-y-9z=10$

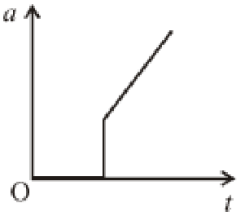
30. If the events A and B are mutually exclusive events such that $\mathrm{P(A)}=\frac{3x+1}{3}$ and $\mathrm{P(B)}=\frac{1-x}{4}$, then the set of possible values of x lies in the interval :

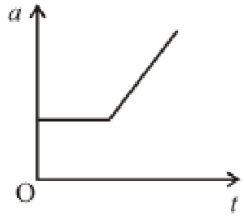
(1) $[0,1]$ (2) $\left[\frac{1}{3},\frac{2}{3}\right]$

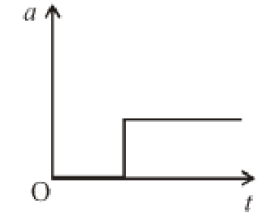
(3) $\left[-\frac{1}{3},\frac{5}{9}\right]$ (4) $\left[-\frac{7}{9},\frac{4}{9}\right]$

31. A block is placed on a rough horizontal plane. A time dependent horizontal force $F = kt$ acts on the block, where k is a positive constant. The acceleration - time graph of the block is :

(1) 

(2) 

(3) 

(4) 

32. The maximum range of a bullet fired from a toy pistol mounted on a car at rest is $R_0 = 40$ m. What will be the acute angle of inclination of the pistol for maximum range when the car is moving in the direction of firing with uniform velocity $v = 20$ m/s on a horizontal surface? $(g = 10\ m/s^2)$

(1) 30° (2) 60°

(3) 75° (4) 45°

33. A wind-powered generator converts wind energy into electrical energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be most likely proportional to

(1) v^4 (2) v^2

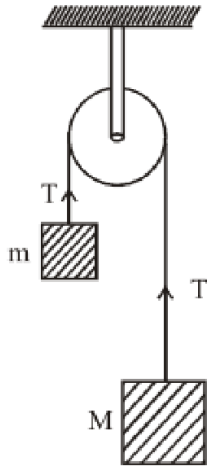
(3) v (4) v^3

34. A ring of mass M and radius R is rotating about its axis with angular velocity ω. Two identical bodies each of mass m are now gently attached at the two ends of a diameter of the ring. Because of this, the kinetic energy loss will be :

(1) $\frac{m(M+2m)}{M}\omega^2R^2$ (2) $\frac{Mm}{(M+m)}\omega^2R^2$

(3) $\frac{Mm}{(M+2m)}\omega^2R^2$ (4) $\frac{(M+m)M}{(M+2m)}\omega^2R^2$

35. Two blocks of masses m and M are connected by means of a metal wire of cross-sectional area A passing over a frictionless fixed pulley as shown in the figure. The system is then released. If $M = 2\ m$, then the stress



produced in the wire is:

(1) $\frac{2mg}{3\ A}$
(2) $\frac{4mg}{3\ A}$
(3) $\frac{mg}{A}$
(4) $\frac{3mg}{4\ A}$

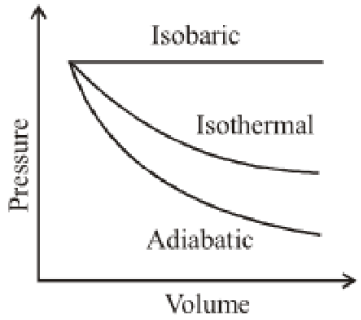
36. In an experiment, a small steel ball falls through a liquid at a constant speed of 10 cm/s. If the steel ball is pulled upward with a force equal to twice its effective weight, how fast will it move upward ?

(1) 5 cm/s
(2) Zero
(3) 10 cm/s
(4) 20 cm/s

37. A mass of 50 g of water in a closed vessel, with surroundings at a constant temperature takes 2 minutes to cool from 30°C to 25°C. A mass of 100 g of another liquid in an identical vessel with identical surroundings takes the same time to cool from 30°C to 25°C. The specific heat of the liquid is : (The water equivalent of the vessel is 30 g.)

(1) 2.0kcal/kg
(2) 7kcal/kg
(3) 3kcal/kg
(4) 0.5kcal/kg

38. A sample of gas expands from V_1 to V_2. In which of the following, the work done will be greatest?



(1) Same in all processes
(2) Isobaric process
(3) Isothermal process
(4) Adiabatic process

39. In the isothermal expansion of 10 g of gas from volume V to 2 V the work done by the gas is 575 J. What is the root mean square speed of the molecules of the gas at that temperature?

(1) 398 m/s
(2) 520 m/s
(3) 499 m/s
(4) 532 m/s

40. A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half submerged in a liquid of density σ at equilibrium position. When the cylinder is given a downward push and released, it starts oscillating vertically with a small amplitude. The time period T of the oscillations of the cylinder will be :

(1) Smaller than $2\pi\left[\frac{M}{(k+A\sigma g)}\right]^{1/2}$
(2) $2\pi\sqrt{\frac{M}{k}}$
(3) Larger than $2\pi\left[\frac{M}{(k+A\sigma g)}\right]^{1/2}$
(4) $2\pi\left[\frac{M}{(k+A\sigma g)}\right]^{1/2}$

41. In a transverse wave the distance between a crest and neighbouring trough at the same instant is 4.0 cm and the distance between a crest and trough at the same place is 1.0 cm. The next crest appears at the same place after a time interval of 0.4 s. The maximum speed of the vibrating particles in the medium is:

(1) $\frac{3\pi}{2}$ cm/s
(2) $\frac{5\pi}{2}$ cm/s
(3) $\frac{\pi}{2}$ cm/s
(4) 2 π cm/s

42. 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: No work is required to be done to move a test charge between any two points on an equipotential surface. Statement 2 : Electric lines of force at the equipotential surfaces are mutually perpendicular to each other.

(1) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.
(2) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.
(3) Statement 1 is true, Statement 2 is false.
(4) Statement 1 is false, Statement 2 is true.

43. The surface charge density of a thin charged disc of radius R is σ. The value of the electric field at the centre of the disc is $\frac{\sigma}{2\in_0}$. With respect to the field at the centre, the electric field along the axis at a distance R from the centre of the disc:

(1) reduces by 70.7%
(2) reduces by 29.3%
(3) reduces by 9.7%
(4) reduces by 14.6%

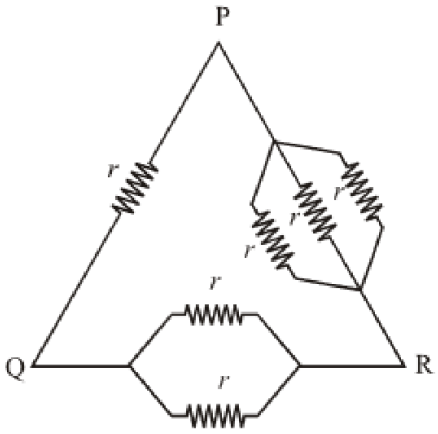
44. The gravitational field in a region is given by: $\vec{E} = (5N/kg)\hat{i} + (12N/kg)\hat{j}$ If the potential at the origin is taken to be zero, then the ratio of the potential at the points $(12\text{ m}, 0)$ and $(0, 5\text{ m})$ is :

(1) Zero
(2) 1
(3) $\frac{144}{25}$
(4) $\frac{25}{144}$

45. A parallel plate capacitor having a separation between the plates d, plate area A and material with dielectric constant K has capacitance C_0. Now one-third of the material is replaced by another material with dielectric constant 2 K, so that effectively there are two capacitors one with area $\frac{1}{3}$ A, dielectric constant 2 K and another with area $\frac{2}{3}$ A and dielectric constant K. If the capacitance of this new capacitor is C then $\frac{C}{C_0}$ is

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

46. Six equal resistances are connected between points P, Q and R as shown in figure. Then net resistance will be



maximum between :

(1) P and R
(2) P and Q
(3) Q and R
(4) Any two points

47. The earth's magnetic field lines resemble that of a dipole at the centre of the earth. If the magnetic moment of this dipole is close to $8 \times 10^{22} \mathrm{Am}^2$, the value of earth's magnetic field near the equator is close to (radius of the earth $= 6.4 \times 10^6$ m)

(1) 0.6 Gauss
(2) 1.2 Gauss
(3) 1.8 Gauss
(4) 0.32 Gauss

48. One of the two small circular coils, (none of them having any self - inductance) is suspended with a V-shaped copper wire, with plane horizontal. The other coil is placed just below the first one with plane horizontal. Both the coils are connected in series with a dc supply. The coils are found to attract each other with a force. Which one of the following statements is incorrect?

(1) Both the coils carry currents in the same direction.
(2) Coils will attract each other, even if the supply is an ac source.
(3) Force is proportional to d^{-1}
(4) Force is proportional to d^{-2}

49. A metal sample carrying a current along X− axis with density J_x is subjected to a magnetic field B_z (along z− axis). The electric field E_y developed along Y-axis is directly proportional to J_x as well as B_z. The constant of proportionality has SI unit.

(1) $\frac{m^2}{A}$
(2) $\frac{m^3}{As}$
(3) $\frac{m^2}{As}$
(4) $\frac{As}{m^3}$

50. When resonance is produced in a series LCR circuit, then which of the following is not correct?

(1) Current in the circuit is in phase with the applied voltage.

(2) Inductive and capacitive reactances are equal.

(3) If R is reduced, the voltage across capacitor will increase.

(4) Impedance of the circuit is maximum.

51. A series LR circuit is connected to an ac source of frequency ω and the inductive reactance is equal to 2R. A capacitance of capacitive reactance equal to R is added in series with L and R. The ratio of the new power factor to the old one is :

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

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

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

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

52. A printed page is pressed by a glass of water. The refractive index of the glass and water is 1.5 and 1.33, respectively. If the thickness of the bottom of glass is 1 cm and depth of water is 5 cm, how much the page will appear to be shifted if viewed from the top ?

(1) 1.033 cm

(2) 3.581 cm

(3) 1.3533 cm

(4) 1.90 cm

53. A thin glass plate of thickness is $\frac{2500}{3}\lambda$ (λ is wavelength of light used) and refractive index $\mu = 1.5$ is inserted between one of the slits and the screen in Young's double slit experiment. At a point on the screen equidistant from the slits, the ratio of the intensities before and after the introduction of the glass plate is :

(1) 2 : 1

(2) 1 : 4

(3) 4 : 1

(4) 4 : 3

54. The source that illuminates the double − slit in 'double - slit interference experiment' emits two distinct monochromatic waves of wavelength 500 nm and 600 nm, each of them producing its own pattern on the screen. At the central point of the pattern when path difference is zero, maxima of both the patterns coincide and the resulting interference pattern is most distinct at the region of zero path difference. But as one moves out of this central region, the two fringe systems are gradually out of step such that maximum due to on wavelength coincides with the minimum due to the other and the combined fringe system becomes completely indistinct. This may happen when path difference in nm is:

(1) 2000

(2) 3000

(3) 1000

(4) 1500

55. This question has Statement-1 and Statements2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement-1 : Out of radio waves and microwaves, the radio waves undergo more diffraction. Statement-2 : Radio waves have greater frequency compared to microwaves.

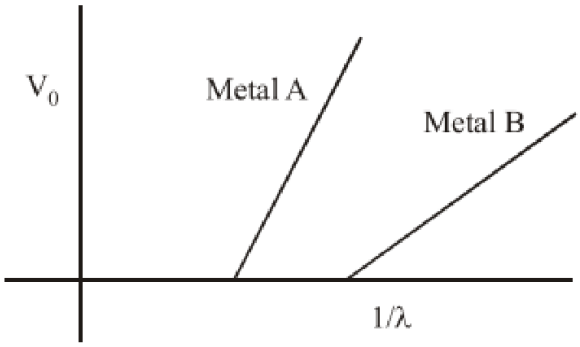
(1) Statement-1 is true, Statement-2 is true and Statement-2 is the correct explanation of Statement-1

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

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

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

56. In an experiment on photoelectric effect, a student plots stopping potential V_0 against reciprocal of the wavelength λ of the incident light for two different metals A and B. These are shown in the figure.



Looking at the graphs, you can most appropriately say that:

(1) Work function of metal B is greater than that of metal A

(2) For light of certain wavelength falling on both metal, maximum kinetic energy of electrons emitted from A will be greater than those emitted from B.

(3) Work function of metal A is greater than that of metal B

(4) Students data is not correct

57. A copper ball of radius 1 cm and work function 4.47 eV is irradiated with ultraviolet radiation of wavelength 2500 $\mathring{A}$. The effect of irradiation results in the emission of electrons from the ball. Further the ball will acquire charge and due to this there will be a finite value of the potential on the ball. The charge acquired by the ball is :

(1) 5.5×10^{-13} C

(2) 7.5×10^{-13} C

(3) 4.5×10^{-12} C

(4) 2.5×10^{-11} C

58. A 12.5eV electron beam is used to bombard gaseous hydrogen at room temperature. It will emit:

(1) 2 lines in the Lyman series and 1 line in the Balmar series

(2) 3 lines in the Lyman series

(3) 1 line in the Lyman series and 2 lines in the Balmar series

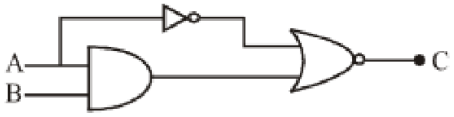
(4) 3 lines in the Balmer series

59.

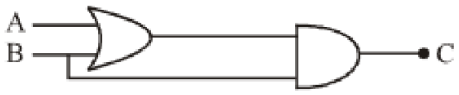
A	B	C
0	0	0
0	1	0
1	0	1
1	1	0

Which of the following circuits correctly represents the following truth table ?

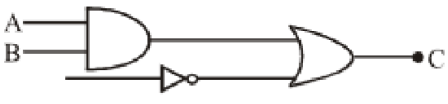
(1)



(2)



(3)



(4)



60. Which of the following modulated signal has the best noise-tolerance ?

(1) Long-wave
(2) Short-wave
(3) Medium-wave
(4) Amplitude-modulated

61. 6 litres of an alkene require 27 litres of oxygen at constant temperature and pressure for complete combustion. The alkene is :

(1) Ethene
(2) Propene
(3) 1−Butene
(4) 2−Butene

62. How many grams of methyl alcohol should be added to 10 litre tank of water to prevent its freezing at 268 K ? (K_f for water is 1.86 K kg mol^{-1})

(1) 880.07 g
(2) 899.04 g
(3) 886.02 g
(4) 868.06 g

63. 10 mL of 2(M) NaOH solution is added to 200 mL of 0.5 (M) of NaOH solution. What is the final concentration ?

(1) 0.57(M)
(2) 5.7(M)
(3) 11.4(M)
(4) 1.14(M)

64. Given (A) $n = 5,\ m_\ell = +1$ (B) $n = 2, \ell = 1,\ m_\ell = -1,\ m_s = -1/2$ The maximum number of electron(s) in an atom that can have the quantum numbers as given in (A) and (B) are respectively:

(1) 25 and 1
(2) 8 and 1
(3) 2 and 4
(4) 4 and 1

65. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in kJ mol^{-1}) of C − C, Si − Si and Ge − Ge bonds are respectively ;

(1) 348, 297, 260
(2) 297, 348, 260
(3) 348, 260, 297
(4) 260, 297, 348

66. Which one of the following cannot function as an oxidising agent?

(1) I^-
(2) S(s)
(3) $NO_3^-(aq)$
(4) $Cr_2O_7^{2-}$

67. In which of the following sets, all the given species are isostructural ?

(1) CO_2, NO_2, ClO_2, SiO_2
(2) $PCl_3, AlCl_3, BCl_3, SbCl_3$
(3) BF_3, NF_3, PF_3, AlF_3
(4) $BF_4^-, CCl_4, NH_4^+, PCl_4^+$

68. The internuclear distances in O − O bonds for O_2^+, O_2, O_2^- and O_2^{2-} respectively are :

(1) 1.30 Å, 1.49 Å, 1.12 Å, 1.21 Å
(2) 1.49 Å, 1.21 Å, 1.12 Å, 1.30 Å
(3) 1.21 Å, 1.12 Å, 1.49 Å, 1.30 Å
(4) 1.12 Å, 1.21 Å, 1.30 Å, 1.49 Å

69. The structure of which of the following chloro species can be explained on the basis of dsp^2 hybridization?

(1) $PdCl_4^{2-}$
(2) $FeCl_4^{2-}$
(3) $CoCl_4^{2-}$
(4) $NiCl_4^{2-}$

70. Which one of the following is the wrong assumption of kinetic theory of gases ?

(1) Momentum and energy always remain conserved.

(2) Pressure is the result of elastic collision of molecules with the container's wall.

(3) Molecules are separated by great distances compared to their sizes.

(4) All the molecules move in straight line between collision and with same velocity.

71. In which of the following exothermic reactions, the heat liberated per mole is the highest ?

(1) $CaO + H_2O \rightarrow Ca(OH)_2$

(2) $SrO + H_2O \rightarrow Sr(OH)_2$

(3) $BaO + H_2O \rightarrow Ba(OH)_2$

(4) $MgO + H_2O \rightarrow Mg(OH)_2$

72. Given that: (i) $\Delta_f H^\circ$ of N_2O is 82 kJ mol^{-1} (ii) Bond energies of $N \equiv N, N = N, O = O$ and $N = O$ are $946, 418, 498$ and 607 kJ mol^{-1} respectively, The resonance energy of N_2O is :

(1) -88 kJ

(2) -66 kJ

(3) -62 kJ

(4) -44 kJ

73. The ratio $\frac{K_p}{K_c}$ for the reaction $CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$ is:

(1) $\frac{1}{\sqrt{RT}}$

(2) $(RT)^{1/2}$

(3) RT

(4) 1

74. What would be the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetate and making the volume equal to 500 mL ? $\left(K_a = 1.75 \times 10^{-5}, pK_a = 4.76\right)$

(1) pH = 4.70

(2) pH < 4.70

(3) pH of solution will be equal to pH of acetic acid

(4) 4.76 < pH < 5.0

75. Which one of the following arrangements represents the correct order of the proton affinity of the given species :

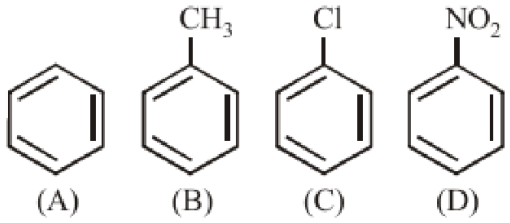
(1) $I^- < F^- < HS^- < NH_2^-$

(2) $HS^- < NH_2^- < F^- < I^-$

(3) $F^- < I^- < NH_2^- < HS^-$

(4) $NH_2^- < HS^- < I^- < F^-$

76. Given



In the above compounds correct order of reactivity in electrophilic substitution reactions will be:

(1) B > A > C > D

(2) D > C > B > A

(3) A > B > C > D

(4) B > C > A > D

77. Copper crystallises in fcc with a unit length of 361 pm. What is the radius of copper atom ?

(1) 157 pm

(2) 128 pm

(3) 108 pm

(4) 181 pm

78. The Gibbs energy for the decomposition of Al_2O_3 at 500 C is as follows :
$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2, \Delta_r G = +940 \text{ kJ mol}^{-1}$ The potential difference needed for the electrolytic reduction of aluminium oxide at $500^\circ C$ should be at least :

(1) 4.5 V (2) 3.0 V

(3) 5.0 V (4) 2.5 V

79. A solution of copper sulphate $(CuSO_4)$ is electrolysed for 10 minutes with a current of 1.5 amperes. The mass of copper deposited at the cathode (at. mass of Cu = 63u) is :

(1) 0.3892 g (2) 0.2938 g

(3) 0.2398 g (4) 0.3928 g

80. A radioactive isotope having a half - life period of 3 days was received after 12 days. If 3 g of the isotope is left in the container, what would be the initial mass of the isotope ?

(1) 12 g (2) 36 g

(3) 48 g (4) 24 g

81. In which of the following octahedral complex species the magnitude of Δ_0 will be maximum?

(1) $[Co(H_2O)_6]^{2+}$ (2) $[Co(CN)_6]^{3-}$

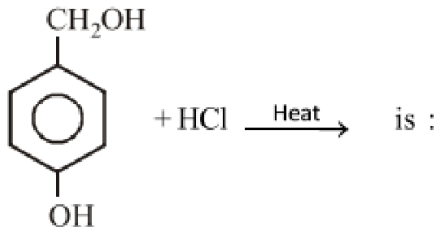
(3) $[Co(C_2O_4)_3]^{3-}$ (4) $[Co(NH_3)_6]^{3+}$

82. In nucleophilic substitution reaction, order of halogens as incoming (attacking) nucleophile is: $I^- > Br^- > Cl^-$ The order of halogens as departing nucleophile should be :

(1) $Br^- > I^- > Cl^-$ (2) $I^- > Br^- > Cl^-$

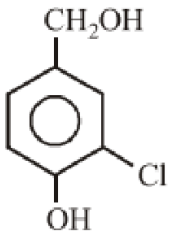
(3) $Cl^- > Br^- > I^-$ (4) $Cl^- > I^- > Br^-$

83.

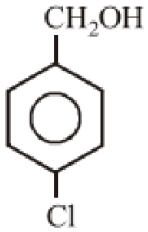


The major product in the following reaction

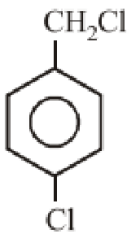
(1)



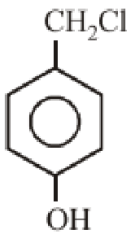
(2)



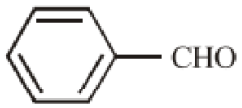
(3)

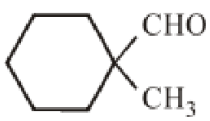


(4)



84. Cannizaro's reaction is not given by :

(1) 

(2) 

(3) CH_3CHO

(4) HCHO

85. Phenol on heating with $CHCl_3$ and NaOH gives salicylaldehyde. The reaction is called:

(1) Reimer - Tiemann reaction

(2) Claisen reaction

(3) Cannizzaro's reaction

(4) Hell - Volhard - Zelinsky reaction

86. Which of the following reagent(s) used for the conversion?



(1) glycol/$LiAlH_4/H_3O^+$

(2) glycol/ NaH/H_3O^+

(3) $LiAlH_4$

(4) $NaBH_4$

87. Carbylamine forms from aliphatic or aromatic primary amine via which of the following intermediates?

(1) Carbanion

(2) Carbene

(3) Carbocation

(4) Carbon radical

88. Which of the following statement is not correct?

(1) Amylopectin is a branched polymer of α - glucose.

(2) Cellulose is a linear polymer of β-glucose.

(3) Glycogen is the food reserve of plants.

(4) All proteins are polymers of α - amino acids.

89. Bakelite is obtained from phenol by reacting with:

(1) Acetal

(2) CH_3CHO

(3) HCHO

(4) Chlorobenzene

90. Among the following vitamins the one whose deficiency causes rickets (bone deficiency) is :

(1) Vitamin A

(2) Vitamin B

(3) Vitamin D

(4) Vitamin C