

JEE Main 2020 Paper 1 (B.E./B.Tech) 9 January 2020 Shift 1 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

Paper 1: B.E./B.Tech.

Maximum Marks: 300

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2020 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 9 January 2020, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **75 questions** and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 25 questions (100 marks) each, in that order.
- (iii) Each subject has **two sections**. **Section A** has **20 multiple choice questions** (MCQs) with four options each. Select the most appropriate answer. **Section B** has **5 numerical value questions**.
- (iv) **All questions are compulsory**. For Section B, enter the numerical answer in the format requested in the question. Use only the constants given in the question while calculating.
- (v) **Marking scheme**: MCQs carry **+4** for a correct answer and **-1** for an incorrect answer. Numerical questions carry **+4** for a correct answer and **0** for an incorrect answer. Unanswered questions carry **0**.
- (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.

1. If the number of five digit numbers with distinct digits and 2 at the 10^{th} place is 336 k, then k is equal to :

- (A) 6 (B) 8
(C) 4 (D) 7

2. The value of

$$\cos^3\left(\frac{\pi}{8}\right) + \cos\left(\frac{3\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) + \sin\left(\frac{3\pi}{8}\right)$$

is :

- (A) $\frac{1}{\sqrt{2}}$
(B) $\frac{1}{2}$
(C) $\frac{1}{4}$
(D) $\frac{1}{2\sqrt{2}}$

3. If for all real triplets (a, b, c), $f(x) = a + bx + cx^2$; then

$$\int_0^1 f(x) dx$$

is equal to :

- (A) $\frac{1}{6} \left\{ f(0) + f(1) + 4f\left(\frac{1}{2}\right) \right\}$
(B) $2 \left\{ 3f(1) + 2f\left(\frac{1}{2}\right) \right\}$
(C) $\frac{1}{3} \left\{ f(0) + f\left(\frac{1}{2}\right) \right\}$
(D) $\frac{1}{2} \left\{ f(1) + 3f\left(\frac{1}{2}\right) \right\}$

4. A spherical iron ball of 10 cm radius is coated with a layer of ice of uniform thickness the melts at a rate of $50 \text{ cm}^3/\text{min}$. When the thickness of ice is 5 cm, then the rate (in cm/min.) at which of the thickness of ice decreases, is :

- (A) $\frac{1}{18\pi}$
(B) $\frac{1}{36\pi}$
(C) $\frac{1}{54\pi}$
(D) $\frac{5}{6\pi}$

5. Let z be complex number such that

$$\left| \frac{z-i}{z+2i} \right| = 1$$

and $|z| = \frac{5}{2}$.

Then the value of $|z + 3i|$ is :

- (A) $2\sqrt{3}$
(B) $\sqrt{10}$
(C) $\frac{15}{4}$
(D) $\frac{7}{2}$

6. The value of

$$\int_0^{2\pi} \frac{x \sin^8 x}{\sin^8 x + \cos^8 x} dx$$

is equal to :

- (A) 4π (B) 2π
(C) π^2 (D) $2\pi^2$

7. The integral

$$\int \frac{dx}{(x+4)^{\frac{8}{7}}(x-3)^{\frac{6}{7}}}$$

is equal to :

(where C is a constant of integration)

- (A) $\frac{1}{2} \left(\frac{x-3}{x+4} \right)^{\frac{3}{7}} + C$
- (B) $\left(\frac{x-3}{x+4} \right)^{\frac{1}{7}} + C$
- (C) $-\frac{1}{13} \left(\frac{x-3}{x+4} \right)^{\frac{13}{7}} + C$
- (D) $-\left(\frac{x-3}{x+4} \right)^{\frac{1}{7}} + C$

8. Let f be any function continuous on $[a, b]$ and twice differentiable on (a, b) . If for all $x \in (a, b)$, $f'(x) > 0$ and $f''(x) < 0$, then for any $c \in (a, b)$,

$$\frac{f(c) - f(a)}{f(b) - f(c)}$$

is greater than :

- (A) 1
- (B) $\frac{b-c}{c-a}$
- (C) $\frac{b+a}{b-a}$
- (D) $\frac{c-a}{b-c}$

9. In a box, there are 20 cards, out of which 10 are labelled as A and the remaining 10 are labelled as B. Cards are drawn at random, one after the other and with replacement, till a second A-card is obtained. The probability that the second A-card appears before the third B-card is :

- (A) $\frac{13}{16}$
- (B) $\frac{11}{16}$
- (C) $\frac{15}{16}$
- (D) $\frac{9}{16}$

10. If

$$f(x) = \begin{cases} \frac{\sin(a+2)x + \sin x}{x}; & x < 0 \\ b & x = 0 \\ \frac{(x+3x^2)^{\frac{1}{3}} - x^{\frac{1}{3}}}{x^{\frac{4}{3}}}; & x > 0 \end{cases}$$

is continuous at $x = 0$, then $a + 2b$ is equal to :

- (A) 0 (B) -1
- (C) -2 (D) 1

11. Let C be the centroid of the triangle with vertices $(3, -1)$, $(1, 3)$ and $(2, 4)$. Let P be the point of intersection of the lines $x + 3y - 1 = 0$ and $3x - y + 1 = 0$. Then the line passing through the points C and P also passes through the point :

- (A) $(-9, -7)$ (B) $(9, 7)$
- (C) $(7, 6)$ (D) $(-9, -6)$

12. The number of real roots of the equation, $e^{4x} + e^{3x} - 4e^{2x} + e^x + 1 = 0$ is :

- (A) 1 (B) 2
- (C) 3 (D) 4

13. Let the observations x_i ($1 \leq i \leq 10$) satisfy the equations,

$$\sum_{i=1}^{10} (x_i - 5) = 10 \text{ and}$$

$$\sum_{i=1}^{10} (x_i - 5)^2 = 40.$$

If μ and λ are the mean and the variance of the observations, $x_1 - 3, x_2 - 3, \dots, x_{10} - 3$, then the ordered pair (μ, λ) is equal to :

- (A) $(6, 6)$ (B) $(3, 3)$
- (C) $(3, 6)$ (D) $(6, 3)$

14. If $f'(x) = \tan^{-1}(\sec x + \tan x)$,
 $-\frac{\pi}{2} < x < \frac{\pi}{2}$

, and $f(0) = 0$, then $f(1)$ is equal to :

- (A) $\frac{1}{4}$
 (B) $\frac{\pi - 1}{4}$
 (C) $\frac{\pi + 1}{4}$
 (D) $\frac{\pi + 2}{4}$

15. If for some α and β in $\mathbb{R}$, the intersection of the following three planes

$$x + 4y - 2z = 1$$

$$x + 7y - 5z = b$$

$$x + 5y + \alpha z = 5$$

is a line in $\mathbb{R}^3$, then $\alpha + \beta$ is equal to :

- (A) -10 (B) 0
 (C) 10 (D) 2

16. If e_1 and e_2 are the eccentricities of the ellipse,

$$\frac{x^2}{18} + \frac{y^2}{4} = 1$$

and the hyperbola,

$$\frac{x^2}{9} - \frac{y^2}{4} = 1$$

respectively and (e_1, e_2) is a point on the ellipse, $15x^2 + 3y^2 = k$, then k is equal to :

- (A) 17 (B) 16
 (C) 15 (D) 14

17. A circle touches the y-axis at the point (0, 4) and passes through the point (2, 0). Which of the following lines is not a tangent to this circle?

- (A) $3x - 4y - 24 = 0$ (B) $4x + 3y - 8 = 0$
 (C) $3x + 4y - 6 = 0$ (D) $4x - 3y + 17 = 0$

18. If the matrices $A =$

$$\begin{bmatrix} 1 & 1 & 2 \\ 1 & 3 & 4 \\ 1 & -1 & 3 \end{bmatrix}$$

, $B = \text{adj}A$ and $C = 3A$, then

$$\frac{|\text{adj}B|}{|C|}$$

is equal to :

- (A) 8 (B) 2
 (C) 72 (D) 16

19. Negation of the statement :

$\sqrt{5}$ is an integer or 5 is an irrational is :

- (A) $\sqrt{5}$ is not an integer and 5 is not irrational. (B) $\sqrt{5}$ is irrational or 5 is an integer.
 (C) $\sqrt{5}$ is an integer and 5 is irrational. (D) $\sqrt{5}$ is not an integer or 5 is not irrational.

20. The product

$$2^{\frac{1}{4}} \cdot 4^{\frac{1}{16}} \cdot 8^{\frac{1}{48}} \cdot 16^{\frac{1}{128}}$$

... to ∞ is equal to :

- (A) $2^{\frac{1}{4}}$
 (B) $2^{\frac{1}{2}}$
 (C) 1
 (D) 2

21. The number of distinct solutions of the equation

$$\log_{\frac{1}{2}} |\sin x| = 2 - \log_{\frac{1}{2}} |\cos x|$$

in the interval $[0, 2\pi]$, is ____.

22. The projection of the line segment joining the points $(1, -1, 3)$ and $(2, -4, 11)$ on the line joining the points $(-1, 2, 3)$ and $(3, -2, 10)$ is ____.

23. The coefficient of x^4 in the expansion of $(1 + x + x^2)^{10}$ is ____.

24. If for $x \geq 0$, $y = y(x)$ is the solution of the differential equation

$(x + 1)dy = ((x + 1)^2 + y - 3)dx$, $y(2) = 0$, then $y(3)$ is equal to ____.

25. If the vectors,

$$\vec{p} = (a + 1)\hat{i} + a\hat{j} + a\hat{k}$$

,

$$\vec{q} = a\hat{i} + (a + 1)\hat{j} + a\hat{k}$$

and

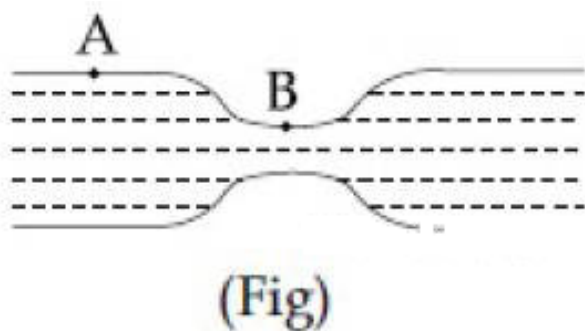
$$\vec{r} = a\hat{i} + a\hat{j} + (a + 1)\hat{k} (a \in R)$$

are coplanar and

$$3(\vec{p} \cdot \vec{q})^2 - \lambda |\vec{r} \times \vec{q}|^2 = 0$$

, then the value of λ is ____.

26. Water flows in a horizontal tube (see figure). The pressure of water changes by 700 Nm^{-2} between A and B where the area of cross section are 40 cm^2 and 20 cm^2 , respectively. Find the rate of flow of water through the tube. (density of water = 1000 kgm^{-3})



- (A) $1810 \text{ cm}^3/\text{s}$ (B) $2420 \text{ cm}^3/\text{s}$
(C) $3020 \text{ cm}^3/\text{s}$ (D) $2720 \text{ cm}^3/\text{s}$

27. An electric dipole of moment

$$\vec{p} = (-\hat{i} - 3\hat{j} + 2\hat{k}) \times 10^{-29}$$

C.m is

at the origin (0, 0, 0). The electric field due to this dipole at

$$\vec{r} = +\hat{i} + 3\hat{j} + 5\hat{k}$$

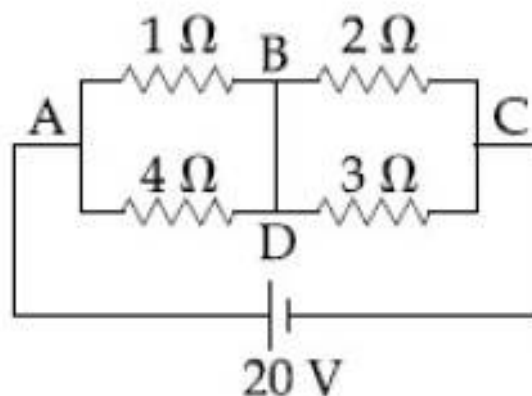
(note that

$$\vec{r} \cdot \vec{p} = 0$$

) is parallel to :

- (A) $(+\hat{i} + 3\hat{j} - 2\hat{k})$
(B) $(+\hat{i} - 3\hat{j} - 2\hat{k})$
(C) $(-\hat{i} + 3\hat{j} - 2\hat{k})$
(D) $(-\hat{i} - 3\hat{j} + 2\hat{k})$

28. In the given circuit diagram, a wire is joining points B and D. The current in this wire is :



- (A) 4 A (B) 2 A
(C) zero (D) 0.4 A

29. Two particles of equal mass m have respective

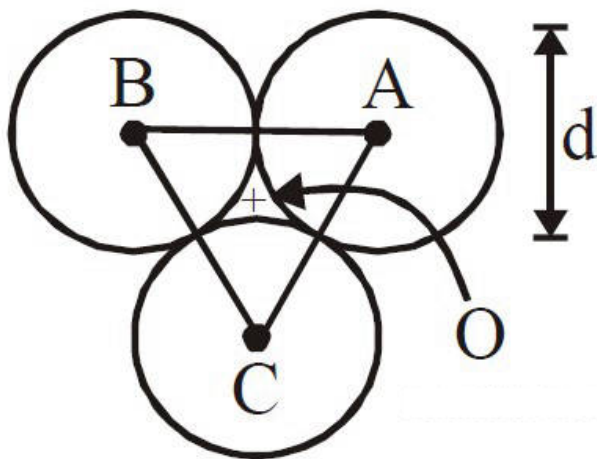
initial velocities $u\hat{i}$ and

$$u\left(\frac{\hat{i} + \hat{j}}{2}\right)$$

They collide completely inelastically. The energy lost in the process is :

- (A) $\frac{1}{3}mu^2$
(B) $\frac{1}{8}mu^2$
(C) $\frac{3}{4}mu^2$
(D) $\sqrt{\frac{2}{3}}mu^2$

30.



Three solid spheres each of mass m and diameter d are stuck together such that the lines connecting the centres form an equilateral triangle of side of length d . The ratio I_O/I_A of moment of inertia I_O of the system about an axis passing the centroid and about center of any of the spheres I_A and perpendicular to the plane of the triangle is :

- (A) $\frac{13}{23}$
 (B) $\frac{23}{13}$
 (C) $\frac{15}{13}$
 (D) $\frac{13}{15}$

31. Three harmonic waves having equal frequency ν and same intensity I_0 , have phase angles $0, \frac{\pi}{4}$ and

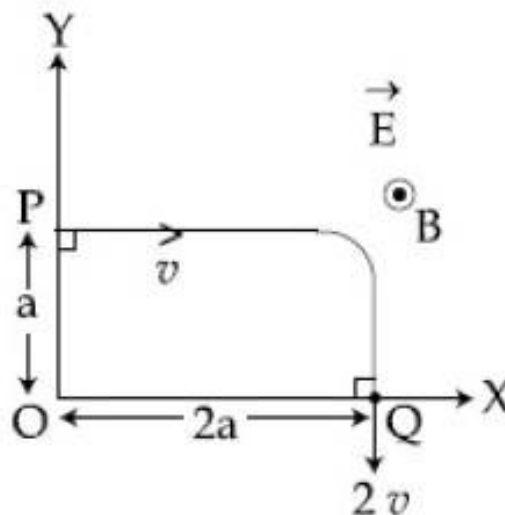
$$-\frac{\pi}{4}$$

respectively. When they are superimposed the intensity of the resultant wave is close to :

- (A) $5.8 I_0$ (B) $3 I_0$
 (C) $0.2 I_0$ (D) I_0

32. A charged particle of mass ' m ' and charge ' q ' moving under the influence of uniform electric field $E\vec{i}$ and a uniform magnetic field $B\vec{k}$ follows a trajectory from point P to Q as shown in figure. The velocities at P and Q are respectively, $v\vec{i}$ and $-2v\vec{j}$. Then which of the following statements (A, B, C, D) are the correct ?

(Trajectory shown is schematic and not to scale) :



(A) $E =$

$$\frac{3}{4} \left(\frac{mv^2}{qa} \right)$$

(B) Rate of work done by the electric field at P is

$$\frac{3}{4} \left(\frac{mv^3}{a} \right)$$

(C) Rate of work done by both the fields at Q is zero

(D) The difference between the magnitude of angular momentum of the particle at P and Q is $2mav$.

- (A) (A), (B), (C), (D) (B) (A), (B), (C)
 (C) (A), (C), (D) (D) (B), (C), (D)

33. A vessel of depth $2h$ is half filled with a liquid of refractive index $2\sqrt{2}$ and the upper half with another liquid of refractive index $\sqrt{2}$. The liquids are immiscible. The apparent depth of the inner surface of the bottom of vessel will be :

- (A) $\frac{h}{\sqrt{2}}$
 (B) $\frac{h}{3\sqrt{2}}$
 (C) $\frac{3}{4}h\sqrt{2}$
 (D) $\frac{h}{2(\sqrt{2} + 1)}$

34. Consider two ideal diatomic gases A and B at some temperature T . Molecules of the gas A are rigid, and have a mass m . Molecules of the gas B have an additional vibrational mode, and have a mass $\frac{m}{4}$. The ratio of the specific heats (C_V^A and C_V^B) of gas A and B, respectively is :

- (A) 7 : 9 (B) 5 : 7
 (C) 3 : 5 (D) 5 : 9

35. The electric fields of two plane electromagnetic plane waves in vacuum are given by

$$\vec{E}_1 = E_0 \hat{j} \cos(\omega t - kx)$$

and

$$\vec{E}_2 = E_0 \hat{k} \cos(\omega t - ky)$$

At $t = 0$, a particle of charge q is at origin with a velocity

$$\vec{v} = 0.8c \hat{j}$$

(c is the speed of light in vacuum). The instantaneous force experienced by the particle is :

- (A) $E_0 q (0.8\hat{i} - \hat{j} + 0.4\hat{k})$
 (B) $E_0 q (-0.8\hat{i} + \hat{j} + \hat{k})$
 (C) $E_0 q (0.8\hat{i} + \hat{j} + 0.2\hat{k})$
 (D) $E_0 q (0.4\hat{i} - 3\hat{j} + 0.8\hat{k})$

36. Radiation, with wavelength $6561 \text{ \AA}$

falls on a metal surface to produce photoelectrons. The electrons are made to enter a uniform magnetic field of $3 \times 10^{-4} \text{ T}$. If the radius of the largest circular path followed by the electrons is 10 mm , the work function of the metal is close to :

- (A) 1.8 eV (B) 0.8 eV
 (C) 1.1 eV (D) 1.6 eV

37. A particle moving with kinetic energy E has de Broglie wavelength λ . If energy ΔE is added to its energy, the wavelength become $\lambda/2$. Value of ΔE , is :

- (A) E (B) $3E$
 (C) $2E$ (D) $4E$

38. The aperture diameter of a telescope is 5 m . The separation between the moon and the earth is $4 \times 10^5 \text{ km}$. With light of wavelength of $5500 \text{ \AA}$

, the minimum separation between objects on the surface of moon, so that they are just resolved, is close to :

- (A) 20 m (B) 200 m
 (C) 600 m (D) 60 m

39. A quantity f is given by

$$f = \sqrt{\frac{hc^5}{G}}$$

where c is speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of :

- (A) Energy (B) Momentum
 (C) Area (D) Volume

40. If the screw on a screw-gauge is given six rotations, it moves by 3 mm on the main scale. If there are 50 divisions on the circular scale the least count of the screw gauge is :

- (A) 0.001 mm (B) 0.01 cm
(C) 0.02 mm (D) 0.001 cm

41. A body A of mass m is moving in a circular orbit of radius R about a planet. Another body B of mass $\frac{m}{2}$ collides with A with a velocity which is half

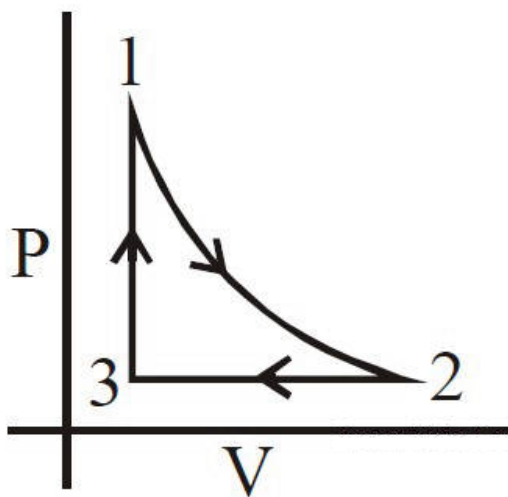
$$\left(\frac{\vec{v}}{2}\right)$$

the instantaneous velocity $\vec{v}$ of A. The collision is completely inelastic. Then, the combined body :

- (A) starts moving in an elliptical orbit around the planet. (B) Falls vertically downwards towards the planet
(C) Escapes from the Planet's Gravitational field. (D) continues to move in a circular orbit

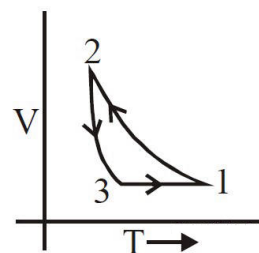
42. Which of the following is an equivalent cyclic process corresponding to the thermodynamic cyclic given in the figure ? where, $1 \rightarrow 2$ is adiabatic.

(Graphs are schematic and are not to scale)

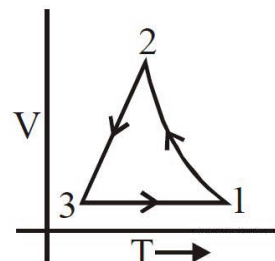


42. (continued)

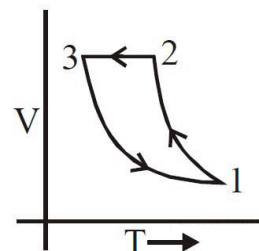
(A)



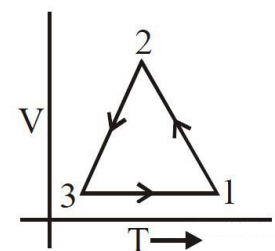
(B)



(C)



(D)



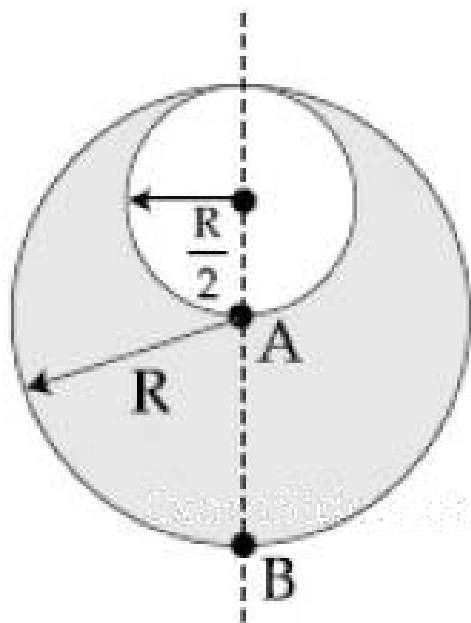
43. A long, straight wire of radius a carries a current distributed uniformly over its cross-section. The ratio of the magnetic fields due to the wire at distance $\frac{a}{3}$ and $2a$, respectively from the axis of the wire is :

- (A) 2
(B) $\frac{1}{2}$
(C) $\frac{3}{2}$
(D) $\frac{2}{3}$

44. Consider a sphere of radius R which carries a uniform charge density ρ . If a sphere of radius $\frac{R}{2}$ is carved out of it, as shown, the ratio

$$\frac{|\vec{E}_A|}{|\vec{E}_B|}$$

of magnitude of electric field $\vec{E}_A$ and $\vec{E}_B$, respectively, at points A and B due to the remaining portion is :

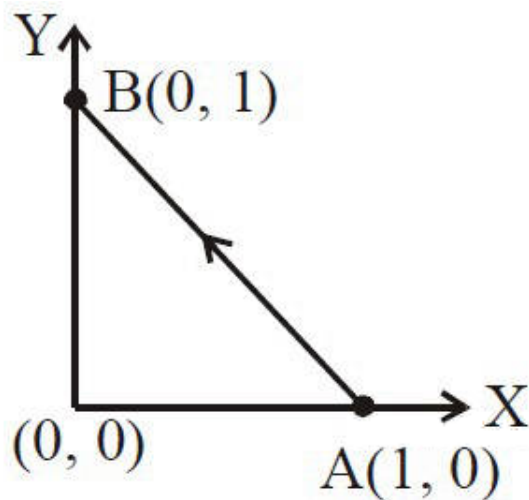


- (A) $\frac{17}{54}$
 (B) $\frac{18}{54}$
 (C) $\frac{18}{34}$
 (D) $\frac{21}{34}$

45. Consider a force

$$\vec{F} = -x\hat{i} + y\hat{j}$$

. The work done by this force in moving a particle from point A(1, 0) to B(0, 1) along the line segment is : (all quantities are in SI units)

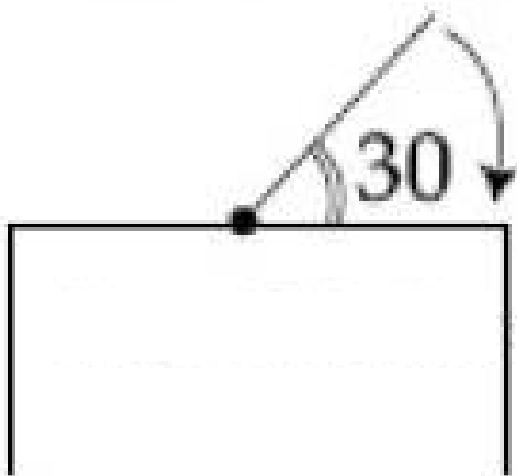


- (A) 2
 (B) $\frac{1}{2}$
 (C) 1
 (D) $\frac{3}{2}$

46. In a fluorescent lamp choke (a small transformer) 100 V of reverse voltage is produced when the choke current changes uniformly from 0.25 A to 0 in a duration of 0.025 ms. The self-inductance of the choke (in mH) is estimated to be _____.

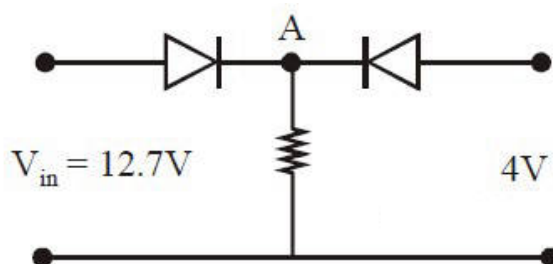
47. A body of mass $m = 10$ kg is attached to one end of a wire of length 0.3 m. The maximum angular speed (in rad s^{-1}) with which it can be rotated about its other end in space station is :
(Breaking stress of wire = $4.8 \times 10^7 \text{ Nm}^{-2}$ and area of cross-section of the wire = 10^{-2} cm^2) is:

48. One end of a straight uniform 1m long bar is pivoted on horizontal table. It is released from rest when it makes an angle 30° from the horizontal (see figure). Its angular speed when it hits the table is given as $\sqrt{n} \text{ s}^{-1}$, where n is an integer. The value of n is _____.

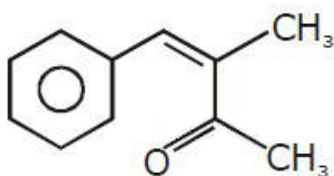
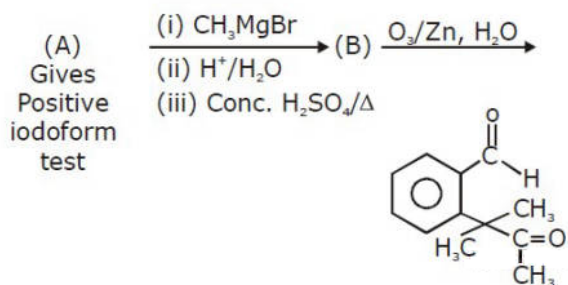


49. The distance x covered by a particle in one dimensional motion varies with time t as $x^2 = at^2 + 2bt + c$. If the acceleration of the particle depends on x as x^{-n} , where n is an integer, the value of n is _____.

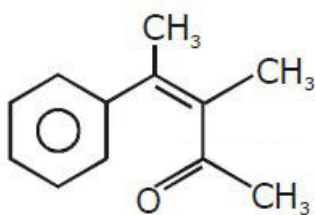
50. Both the diodes used in the circuit shown are assumed to be ideal and have negligible resistance when these are forward biased. Built in potential in each diode is 0.7 V. For the input voltages shown in the figure, the voltage (in Volts) at point A is _____.



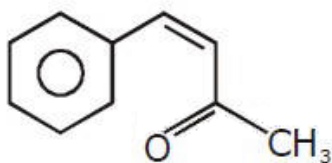
51. Identify (A) in the following reaction sequence :



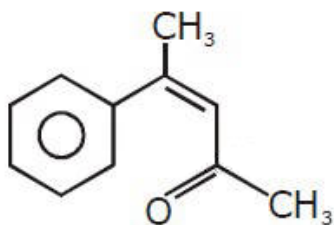
(A)



(B)



(C)



(D)

52. B has a smaller first ionization enthalpy than Be. Consider the following statements :

(I) It is easier to remove 2p electron than 2s electron

(II) 2p electron of B is more shielded from the nucleus by the inner core of electrons than the 2s electrons of Be.

(III) 2s electron has more penetration power than 2p electron.

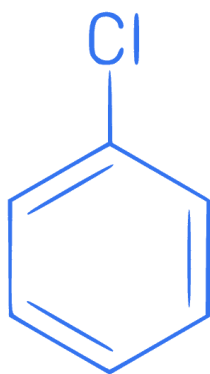
(IV) atomic radius of B is more than Be (Atomic number B = 5, Be = 4)

The correct statements are :

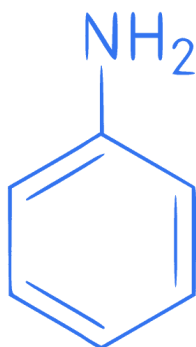
(A) (I), (III) and (IV) (B) (II), (III) and (IV)

(C) (I), (II) and (IV) (D) (I), (II) and (III)

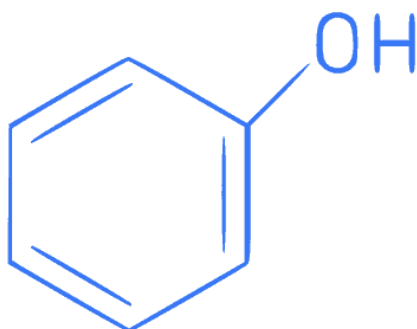
53. Which of these will produce the highest yield in Friedel Crafts reaction?



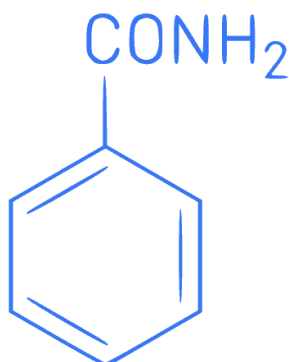
(A)



(B)

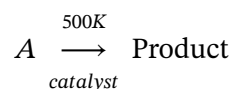
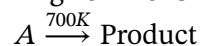


(C)



(D)

54. For the following reactions

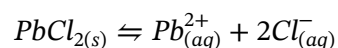


it was found that E_a is decreased by 30 kJ/mol in the presence of catalyst.

If the rate remains unchanged, the activation energy for catalysed reaction is (Assume pre exponential factor is same):

- (A) 198 kJ/mol (B) 135 kJ/mol
(C) 105 kJ/mol (D) 75 kJ/mol

55. The K_{sp} for the following dissociation is 1.6×10^{-5}



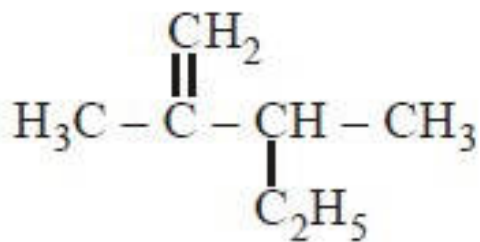
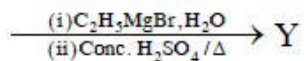
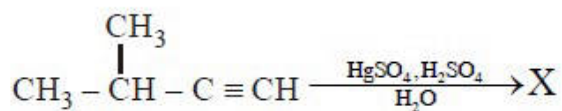
Which of the following choices is correct for a mixture of 300 mL 0.134 M $Pb(NO_3)_2$ and 100 mL 0.4 M NaCl ?

- (A) $Q > K_{sp}$ (B) Not enough data provided
(C) $Q < K_{sp}$ (D) $Q = K_{sp}$

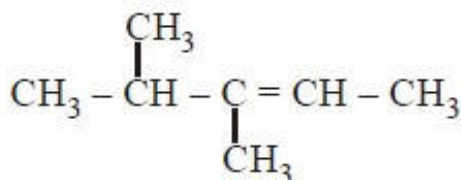
56. The de Broglie wavelength of an electron in the 4th Bohr orbit is :

- (A) $2\pi a_0$ (B) $6\pi a_0$
(C) $8\pi a_0$ (D) $4\pi a_0$

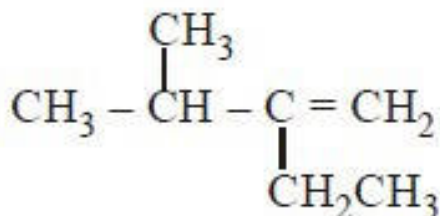
57. The major product (Y) in the following reactions is :



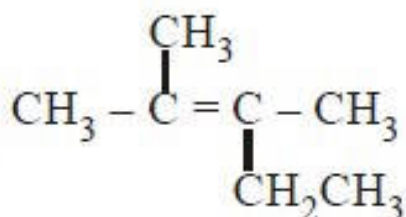
(A)



(B)



(C)



(D)

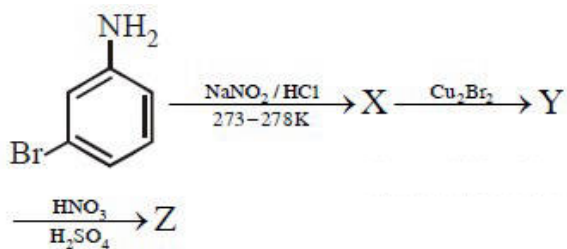
58. If the magnetic moment of a dioxygen species is 1.73 B.M, it may be :

- (A) O_2^- or O_2^+ (B) O_2 , O_2^- or O_2^+
(C) O_2 or O_2^+ (D) O_2 or O_2^-

59. Complex X of composition $\text{Cr}(\text{H}_2\text{O})_6\text{Cl}_n$ has a spin only magnetic moment of 3.83 BM. It reacts with AgNO_3 and shows geometrical isomerism. The IUPAC nomenclature of X is :

- (A) Hexaaqua chromium (III) chloride (B) Tetraaquadichlorido chromium(IV) chloride dihydrate
(C) Tetraaquadichlorido chromium (III) chloride dihydrate (D) Dichloridotetraaqua chromium (IV) chloride dihydrate

60. The major product Z obtained in the following reaction scheme is :

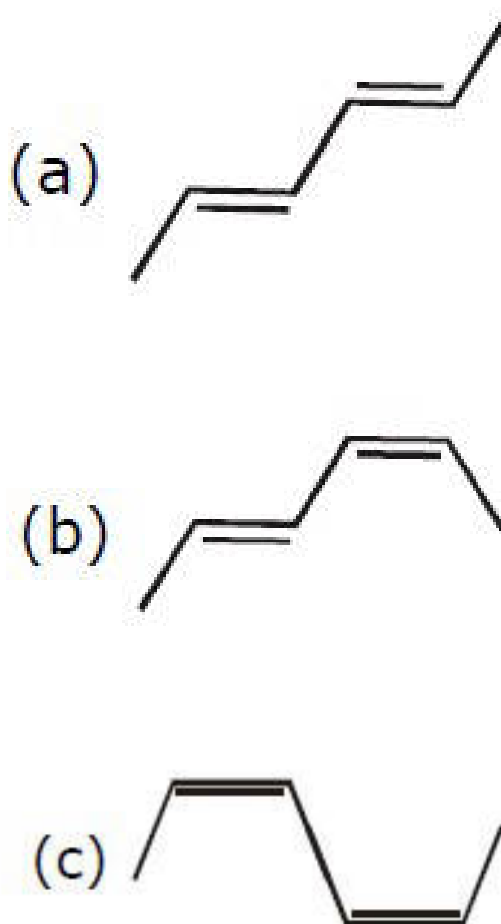


- (A)
- (B)
- (C)
- (D)

61. If enthalpy of atomisation for $\text{Br}_{2(l)}$ is x kJ/mol and bond enthalpy for Br_2 is y kJ/mol, the relation between them :

- (A) does not exist (B) is $x < y$
 (C) is $x > y$ (D) is $x = y$

62. The correct order of heat of combustion for following alkadienes is :



- (A) (b) < (c) < (a) (B) (a) < (c) < (b)
 (C) (a) < (b) < (c) (D) (c) < (b) < (a)

63. The compound that cannot act both as oxidising and reducing agent is :

- (A) H_3PO_4 (B) H_2SO_3
(C) H_2O_2 (D) HNO_2

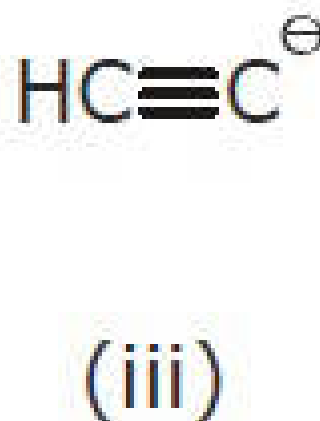
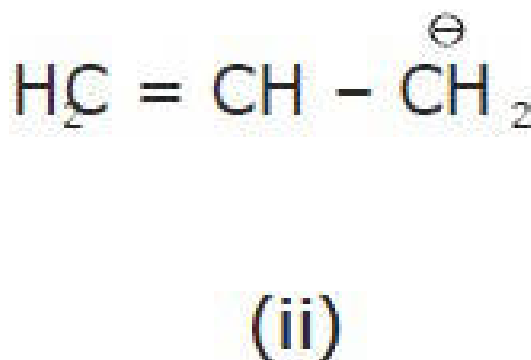
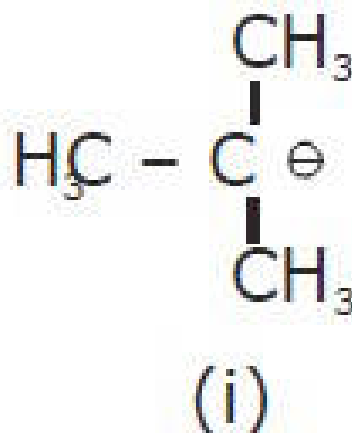
64. The acidic, basic and amphoteric oxides, respectively, are :

- (A) Cl_2O , CaO , P_4O_{10} (B) N_2O_3 , Li_2O , Al_2O_3
(C) MgO , Cl_2O , Al_2O_3 (D) Na_2O , SO_3 , Al_2O_3

65. The electronic configurations of bivalent europium and trivalent cerium are
(atomic number : Xe = 54, Ce = 58, Eu = 63)

- (A) $[\text{Xe}] 4f^7 6s^2$ and $[\text{Xe}] 4f^2 6s^2$ (B) $[\text{Xe}] 4f^2$ and $[\text{Xe}] 4f^7$
(C) $[\text{Xe}] 4f^4$ and $[\text{Xe}] 4f^9$ (D) $[\text{Xe}] 4f^7$ and $[\text{Xe}] 4f^1$

66. The increasing order of basicity for the following intermediates is (from weak to strong)



66. (continued)



(iv)



(v)

- (A) (iii) < (i) < (ii) < (iv) < (v) (B) (iii) < (iv) < (ii) < (i) < (v)
 (C) (v) < (i) < (iv) < (ii) < (iii) (D) (v) < (iii) < (ii) < (iv) < (i)

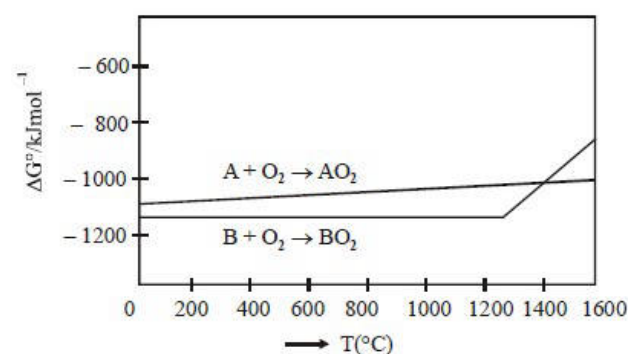
67. $[\text{Pd}(\text{F})(\text{Cl})(\text{Br})(\text{I})]^{2-}$ has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of $[\text{Fe}(\text{CN})_6]^{n-6}$, respectively, are:
 [Note : Ignore the pairing energy]

- (A) 1.73 BM and $-2.0 \Delta_0$ (B) 5.92 BM and 0
 (C) 2.84 BM and $-1.6 \Delta_0$ (D) 0 BM and $-2.4 \Delta_0$

68. 'X' melts at low temperature and is a bad conductor of electricity in both liquid and solid state. X is :

- (A) Mercury (B) Carbon tetrachloride
 (C) Zinc sulphide (D) Silicon carbide

69. According to the following diagram, A reduces BO_2 when the temperature is :



- (A) > 1400 °C (B) > 1200 °C but < 1400 °C
 (C) < 1400 °C (D) < 1200 °C

70. A chemist has 4 samples of artificial sweetener A, B, C and D. To identify these samples, he performed certain experiments and noted the following observations :

- (i) A and D both form blue-violet colour with ninhydrin.
 (ii) Lassaigine extract of C gives positive AgNO_3 test and negative $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ test.
 (iii) Lassaigine extract of B and D gives positive sodium nitroprusside test
 Based on these observations which option is correct ?

- (A) A : Aspartame ; B : Alitame ; C : Saccharin ; D : Sucralose
 (B) A : Alitame ; B : Saccharin ; C : Aspartame ; D : Sucralose
 (C) A : Aspartame ; B : Saccharin ; C : Sucralose ; D : Alitame
 (D) A : Saccharin ; B : Alitame ; C : Sucralose ; D : Aspartame

Chemistry - Section B · Numerical Value Questions

71. How much amount of NaCl should be added to 600 g of water ($\rho = 1.00 \text{ g/mL}$) to decrease the freezing point of water to -0.2°C ? _____.

(The freezing point depression constant for water = 2K kg mol^{-1})

72. 108 g of silver (molar mass 108 g mol^{-1}) is deposited at cathode from $\text{AgNO}_3(\text{aq})$ solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273 K and 1 bar pressure from water by the same quantity of electricity is _____.

73. The molarity of HNO_3 in a sample which has density 1.4 g/mL and mass percentage of 63% is _____.

(Molecular Weight of $\text{HNO}_3 = 63$)

74. The mass percentage of nitrogen in histamine is _____.

75. The hardness of a water sample containing 10^{-3} M MgSO_4 expressed as CaCO_3 equivalents (in ppm) is _____.

(molar mass of MgSO_4 is 120.37 g/mol)

- End of Question Paper -