



JEE Paper 1  
ENTRANCE EXAM - JEE MAIN

Time Allowed: 3 hours

Maximum Marks : 300

General Instructions:

- All questions are compulsory.
- There are three parts and each part carries 25 questions where the first 20 questions are MCQs and the next 5 questions are numerical.
- You will get 4 marks for each correct response and 1 mark will be deducted for an incorrect answer.

PHYSICS

- 1) The velocity of sound  $v$  in air depends on the pressure  $P$  and the density of air  $\rho$ . Which of the following relations is true? [4]

- a)  $v \propto (\rho P)^{1/2}$   
b)  $v \propto \sqrt{\frac{P}{\rho}}$   
c)  $v \propto P\rho$   
d)  $v \propto \frac{P}{\rho}$

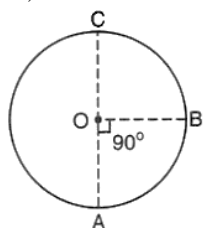
- 2) For motion on a curved path with constant acceleration (magnitude of displacement/distance covered): [4]

- a)  $< 1$                       b)  $\leq 1$   
c)  $> 1$                       d)  $\geq 1$

- 3) The magnitude of the sum of the two vectors is equal to the difference in their magnitudes. What is the angle between the vectors? [4]

- a)  $0^\circ$                       b)  $90^\circ$   
c)  $45^\circ$                       d)  $180^\circ$

- 4) A particle crosses the topmost point C of a vertical circle with critical speed; then the ratio of velocities at points A, B and C is:



[4]

- a)  $\sqrt{5} : \sqrt{3} : \sqrt{1}$   
b)  $3 : 2 : 1$   
c)  $5^2 : 3^2 : 1^2$   
d)  $5 : 3 : 1$

- 5) A ball of mass  $m$  moving with a constant velocity strikes against a ball of the same mass at rest. If  $e$  = coefficient of restitution, then what will be the ratio of the velocity of two balls after collision? [4]

- a)  $\frac{1-e}{1+e}$   
b)  $\frac{2+e}{e-1}$   
c)  $\frac{1+e}{1-e}$   
d)  $\frac{e-1}{e+1}$

- 6) Kinetic energies of open cylinder, circular disc, hollow sphere are  $E_1$ ,  $E_2$ , and  $E_3$  respectively when they slide with speed of 10 m/s without rotating. If the kinetic energies of open cylinder, circular disc, hollow sphere

are  $E_4$ ,  $E_5$  and  $E_6$  respectively when they roll with some speed without slipping, then, [4]

- a)  $E_4 > E_6 > E_5 > E_2 = E_1$   
b)  $E_6 > E_5 > E_4 > E_3$   
c)  $E_5 > E_6 > E_4 > E_3$   
d)  $E_4 < E_6 < E_5 < E_1 = E_3$

- 7) A hollow metallic sphere, the outer and inner diameters of which are  $d_1$  and  $d_2$ , floats on the surface of a liquid. The density of metal is  $\rho_1$  and the density of liquid is  $\rho_2$ . What weight must be added inside the sphere in order for it to float below the level of liquid? [4]

- a)  $\frac{\pi}{6} [d_1^3 (\rho_2 - \rho_1) + d_2^3 \rho_1] g$   
b)  $\pi [d_1^3 (\rho_2 - \rho_1) + d_2^3 \rho_1] g$   
c)  $\frac{4\pi}{3} d_1^3 (\rho_2 - \rho_1) g$   
d)  $\frac{4\pi}{3} [d_1^3 (\rho_2 - \rho_1) + d_2^3 \rho_1] g$

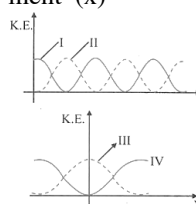
- 8) A steel ball of mass 0.1 kg falls freely from a height of 10 m and bounces to a height of 5.4 m from the ground. If the dissipated energy in this process is absorbed by the ball, the rise in its temperature is: (Specific heat of steel =  $460 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$ ,  $g = 10 \text{ ms}^{-2}$ ) [4]

- a)  $0.1^\circ\text{C}$                       b)  $0.01^\circ\text{C}$   
c)  $1.1^\circ\text{C}$                       d)  $1^\circ\text{C}$

- 9) If 150 J of heat is added to a system and the work done by the system is 110 kJ, then change in internal energy will be: [4]

- a) 110 J                      b) 260 J  
c) 150 J                      d) 40 J

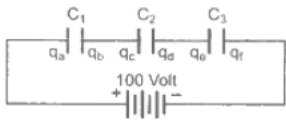
- 10) For a particle executing S.H.M., the displacement  $x$  is given by  $x = A \cos \omega t$ . Identify which represents the variation of (K.E.) as a function of time ( $t$ ) and displacement ( $x$ )



[4]

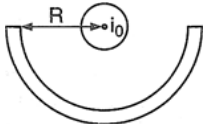
- a) II and III                      b) I and III  
c) II and IV                      d) I and IV

- 11) Three capacitors are connected to a DC source of 100 volts as shown in figure. If the charges accumulated on the plates of  $C_1$ ,  $C_2$  and  $C_3$  are  $q_a$ ,  $q_b$ ,  $q_c$ ,  $q_d$ ,  $q_e$  and  $q_f$  respectively, then:



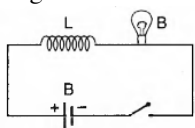
[4]

- a)  $Q_b + q_d + q_f = 0$  coulomb  
 b)  $Q_b = q_d = q_f$   
 c)  $Q_a + q_c + q_e = 50$  coulomb  
 d)  $Q_b + q_d + q_f = (100/9)$  coulomb
- 12) Adjoining figure shows a very long semi-cylindrical conducting shell of radius  $R$  and carrying a current  $i$ . An infinitely long straight current carrying conductor is lying along the axis of the semi-cylinder. If the current flowing through the straight wire be  $i_0$ , then the force per unit length on the conducting wire is:



[4]

- a)  $\frac{\mu_0 i^2 i_0}{\pi^2 R^2}$   
 b)  $\frac{\mu_0 i i_0}{\pi^2 R}$   
 c)  $\frac{\mu_0 i i_0}{\pi R^2}$   
 d)  $\frac{\mu_0 i_0^2 i}{\pi^2 R}$
- 13) The time period of a vibration magnetometer is  $T_0$ . Its magnet is replaced by another magnet whose moment of inertia is 3 times and magnetic moment is  $(1/3)$  of the initial magnet. The time period now will be: [4]
- a)  $T_0/3$                       b)  $T_0/\sqrt{3}$   
 c)  $3T_0$                         d)  $T_0$
- 14) An inductor is connected to a battery through a switch. Induced emf is  $e_1$  when the switch is pressed and  $e_2$  when the switch is opened. Then: [4]
- a)  $E_1 < e_2$                       b)  $E_1 = e_2$   
 c)  $E_1 > e_2$                       d)  $E_1 > /< e_2$
- 15) In the circuit of figure the bulb will become suddenly bright if:

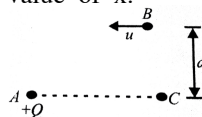


[4]

- a) Contact is made  
 b) Contact is made or broken  
 c) Would not become bright at all  
 d) Contact is broken
- 16) Radiation of energy  $E$  falls normally on a perfectly reflecting surface. The momentum transferred to the surface is: [4]
- a)  $\frac{E}{2}$                               b)  $\frac{E}{c}$   
 c)  $\frac{2E}{c}$                               d)  $Ec$
- 17) Photoelectric effect shows: [4]
- a) Both wave-like and particle-like behaviour of light  
 b) Particle-like behavior of light  
 c) Neither wave-like nor particle-like behaviour of light  
 d) Wave-like behaviour of light
- 18) What is the energy of the ionization energy of 10 times ionized sodium atom? [4]

- a) 13.6 eV  
 b)  $\frac{13.6}{11}$  eV  
 c)  $13.6 \times 11^2$  eV  
 d)  $13.6 \times 11$  eV

- 19) The nuclear radius of a nucleus with nucleon number 16 is  $3 \times 10^{-15}$  metre. Then, the nuclear radius of a nucleus with nucleon number 128 is: [4]
- a)  $1.5 \times 10^{-15}$  m                      b)  $6 \times 10^{-15}$  m  
 c)  $4.5 \times 10^{-15}$  m                      d)  $3 \times 10^{-15}$  m
- 20) The three axes of a crystal lattice are mutually perpendicular but all lattice parameters are unequal. The crystal is: [4]
- a) Hexagonal                              b) Cubic  
 c) Tetragonal                              d) Orthorhombic
- 21) A positive charge  $+Q$  is fixed at a point A. Another positively charged particle of mass  $m$  and charge  $+q$  is projected from a point B with velocity  $u$  as shown in the  $+Q$  figure. Point B is at a large distance from A and at distance  $d$  from the line AC. The initial velocity is parallel to the line AC. Point C is at a very large distance from A. If the minimum distance (in metre) of  $+q$  from  $+Q$  during motion. [Take  $Qq = 4\pi\epsilon_0 mu^2 d$ ] is  $d(1 + \sqrt{x})$ , then find the value of  $x$ .



[4]

- 22) With what velocity (in km/s) should a body be thrown up so as to reach a height four times the radius of earth from earth's surface? (Radius of earth =  $6.4 \times 10^6$  m and  $g = 9.8$  m/s<sup>2</sup>) [4]
- 23) A convex lens A of focal length 20 cm and a concave lens B of focal length 5 cm are kept along the same axis with a distance  $d$  between them. If a parallel beam of light falling on A leaves B as a parallel beam, then the distance  $d$  (in cm) will be \_\_\_\_\_. [4]
- 24) A wire of length 314 cm carrying current of 14 A is bent to form a circle. The magnetic moment of the coil is \_\_\_\_\_ A - m<sup>2</sup>. [Given  $\pi = 3.14$ ][4]
- 25) P - V diagram of a monoatomic gas is a straight line passing through the origin. The molar heat capacity of the gas in the process will be  $nR$  ( $R$  is a universal gas constant). Then find the value of  $n$ . [4]

## CHEMISTRY

- 26) Which one of the following sets of quantum numbers represents an impossible arrangement? [4]

	N	L	M	S
a)	3	2	- 3	$\frac{1}{2}$

	N	L	M	S
b)	4	0	0	$\frac{1}{2}$

	N	L	M	S
c)	5	3	0	-

	N	L	M	S
d)	3	2	- 2	$\frac{1}{2}$

27) Elements which occupied position in the Lothar Meyer curve, on the peaks, were: [4]

- All of these
- Elements having large atomic volume
- Alkali metals
- Highly electropositive elements

28) Which of the following species have same shape and hybridisation? [4]

- $\text{TeF}_5^-$ ,  $\text{XeO}_2\text{F}_4$
- $\text{BrF}_4^-$ ,  $\text{XeF}_5^-$
- $\text{XeF}_5^+$ ,  $\text{TeF}_5^-$
- $\text{XeF}_5^+$ ,  $\text{XeF}_3^+$

29) The heats of neutralization of four acids A, B, C and D are - 13.7, - 9.4, - 11.2 and - 12.4 kcal respectively, when they are neutralized by a common base. The acidic character obeys the order: [4]

- $D > B > C > A$
- $A > B > C > D$
- $D > C > B > A$
- $A > D > C > B$

30) The molar solubility (in  $\text{mol L}^{-1}$ ) of a sparingly soluble salt  $\text{MX}_4$  is  $s$ . The corresponding solubility product is  $K_{sp} \cdot s$  is given in terms of  $K_{sp}$  by the relation: [4]

- $S = \left[ \frac{K_{sp}}{128} \right]^{1/4}$
- $S = \left[ \frac{K_{sp}}{256} \right]^{1/5}$
- $S = [128 K_{sp}]^{1/4}$
- $S = [256 K_{sp}]^{1/5}$

31) Equivalent weight of  $\text{Fe}_3\text{O}_4$  and  $\text{Fe}_2\text{O}_3$  in the change  $\text{Fe}_3\text{O}_4 \rightarrow \text{Fe}_2\text{O}_3$  is respectively.  $M_1$  and  $M_2$  are mol. wt. of  $\text{Fe}_3\text{O}_4$  and  $\text{Fe}_2\text{O}_3$  respectively: [4]

- $M_1, \frac{3M_2}{2}$
- $\frac{M_1}{3}, \frac{M_2}{2}$
- $\frac{M_1}{2}, \frac{M_2}{3}$
- $M_1, \frac{3M_2}{1}$

32) The correct order of catenation is [4]

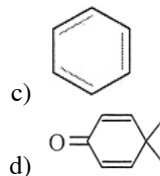
- $\text{Ge} > \text{Sn} > \text{Si} > \text{C}$
- $\text{Si} > \text{Sn} > \text{C} > \text{Ge}$
- $\text{C} > \text{Sn} > \text{Si} \approx \text{Ge}$
- $\text{C} > \text{Si} > \text{Ge} \approx \text{Sn}$

33) Find the incorrect direction with reference to the inductive effect. [4]

- 
- 
- 
- 

34) Which of the following molecules is the least resonance stabilized? [4]

- 
- 



35) The process of getting freshwater from sea water is known as: [4]

- Diffusion
- Filtration
- Reverse osmosis
- Osmosis

36) The volume strength of 1.5 N  $\text{H}_2\text{O}_2$  solution is: [4]

- 3.0
- 8.0
- 8.4
- 4.8

37) Consider the electrolysis of  $\text{aq. NaCl}$  using Pt electrodes. What is the volume of  $\text{H}_2$  at 27 °C and 1 atm pressure obtained by the above electrolytic process, if 852 g of  $\text{Cl}_2$  gas is collected at anode? [4]

- 325.56 litres
- 295.56 litres
- 246.96 litres
- 188.56 litres

38) The rate coefficient (k) for a particular reactions is  $1.3 \times 10^{-4} \text{M}^{-1} \text{s}^{-1}$  at 100 °C, and  $1.3 \times 10^{-3} \text{M}^{-1} \text{s}^{-1}$  at 150 °C. What is the energy of activation ( $E_a$  in kJ) for this reaction? ( $R = \text{molar gas constant} = 8.314 \text{JK}^{-1} \text{mol}^{-1}$ ) [4]

- 60
- 16
- 99
- 132

39) Ethylene diamine is an example of a \_\_\_\_ ligand. [4]

- Hexadentate
- Bidentate
- Monodentate
- Tridentate

40) Match the following:

Oxide	Nature
(a) CO	(i) Basic
(b) BaO	(ii) Neutral
(c) $\text{Al}_2\text{O}_3$	(iii) Acidic
(d) $\text{Cl}_2\text{O}_7$	(iv) Amphoteric

Which of the following is correct option? [4]

- (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)
- (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
- (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
- (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

41) Co-ordination number of platinum  $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]^{2+}$  ion is: [4]

- 4
- 8
- 2
- 6

42) In  $\text{S}_\text{N}1$  reaction, the first step involves the formation of: [4]

- Carbocation
- Carbanion
- Free radical
- Final product

43) 2 - Phenylbutan - 2 - ol can be prepared by which of the following combinations? [4]

- $\text{C}_6\text{H}_5\text{COCH}_3 + \text{C}_2\text{H}_5\text{COCH}_3$
- $\text{C}_2\text{H}_5\text{MgBr} + \text{C}_6\text{H}_5\text{MgBr}$
- $\text{C}_6\text{H}_5\text{COC}_2\text{H}_5 + \text{CH}_3\text{MgBr}$
- All of these

44) The product formed in Aldol condensation is: [4]

- A beta - hydroxy aldehyde or a beta - hydroxy

ketone.

- b) An alpha – hydroxy aldehyde or ketone.  
 c) A beta – hydroxy acid  
 d) An alpha, beta unsaturated ester

45) Nitrosoamines ( $R_2N - N=O$ ) are soluble in water. On heating them with concentrated  $H_2SO_4$ , they give secondary amines. This reaction is called [4]

- a) Fittig's reaction  
 b) Sandmeyer's reaction  
 c) Liebermann nitroso reaction  
 d) Perkin reaction

46) Consider an imaginary ion  ${}_{22}^{48}X^{3-}$ . The nucleus contains  $a\%$  more neutrons than the number of electrons in the ion. The value of  $a$  is \_\_\_\_\_. [nearest integer][4]

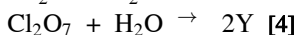
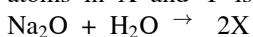
47) The value of  $\log K$  for the reaction  $A \rightleftharpoons B$  at 298 K is - (Nearest integer)

$$\text{Given: } \Delta H^\circ = - 54.07 \text{ kJ mol}^{-1}$$

$$\Delta S^\circ = 10 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$(\text{Take } 2.303 \times 8.314 \times 298 = 5705) \text{ [4]}$$

48) In the following reactions, the total number of oxygen atoms in X and Y is \_\_\_\_\_.



49) The minimum number of moles of  $O_2$  required for complete combustion of 1 mole of propane and 2 moles of butane is \_\_\_\_\_. [4]

50) Sum of  $\sigma$  - bonds and  $\pi$  - bonds in carbon suboxide is: [4]

### MATHEMATICS

51) If  $f(x) = 2017x + 5$ , then  $\frac{f(x+k)-f(x)}{k}$  is [4]

- a)  $(2016)(2017)$       b) 5  
 c)  $\frac{2017}{5}$                       d) 2017

52) If the four complex numbers  $z, \bar{z}, \bar{z} - 2 \operatorname{Re}(\bar{z})$  and  $z - 2 \operatorname{Re}(z)$  represent the vertices of a square of side 4 units in the Argand plane, then  $|z|$  is equal to: [4]

- a) 4                              b)  $4\sqrt{2}$   
 c)  $2\sqrt{2}$                         d) 2

53) Number of selections of 6 different letters can be made from the words **NISHIT** and **RAHUL** so that each selection consists of 3 letters from each word, is: [4]

- a) 100                            b) 64  
 c) 106                            d) 84

54) The term independent of  $x$  in the expansion of  $\left(\frac{1}{60} - \frac{x^8}{81}\right) \cdot (2x^2 - \frac{3}{x^2})^6$  is equal to [4]

- a) 36                              b) - 108  
 c) - 36                            d) - 72

55) The sum of the first three terms of a GP. is S and their product is 27. Then all such S lie in: [4]

- a)  $(-\infty, -9] \cup [3, \infty)$   
 b)  $(-\infty, 9]$   
 c)  $[-3, \infty)$   
 d)  $(-\infty, -3] \cup [9, \infty)$

56) Let  $p = \lim_{x \rightarrow 0^+} (1 + \tan^2 \sqrt{x})^{\frac{1}{2x}}$ , then  $\log p$  is equal to [4]

- a)  $\frac{1}{2}$                               b)  $\frac{1}{4}$   
 c) 2                                d) 1

57) Let  $f(x) = 2x^3 - 3(2+p)x^2 + 12px + \ln(16 - p^2)$ . If  $f(x)$  has exactly one local maxima and one local minima, then the number of integral value of  $p$  is: [4]

- a) 7                                b) 6  
 c) 4                                d) 5

58)  $\lim_{n \rightarrow \infty} \frac{1}{2^n} \left( \frac{1}{\sqrt{1-\frac{1}{2^n}}} + \frac{1}{\sqrt{1-\frac{1}{2^{2n}}}} + \frac{1}{\sqrt{1-\frac{1}{2^{3n}}}} + \dots + \frac{1}{\sqrt{1-\frac{1}{2^{2n-1}}}} \right)$  is equal to [4]

- a) 1                                b) 2  
 c)  $\frac{1}{2}$                                 d) - 2

59) If  $(\alpha, \beta)$  is the orthocentre of the triangle ABC with vertices A(3, - 7), B(- 1, 2) and C(4, 5), then  $9\alpha - 6\beta + 60$  is equal to: [4]

- a) 25                              b) 30  
 c) 40                              d) 35

60) The equation of the circle of radius 5 and touching the coordinate axes in third quadrant, is [4]

- a)  $(x + 4)^2 + (y + 4)^2 = 25$   
 b)  $(x + 6)^2 + (y + 6)^2 = 25$   
 c)  $(x + 5)^2 + (y + 5)^2 = 25$   
 d)  $(x - 5)^2 + (y + 5)^2 = 25$

61) If P is a point on the parabola  $y^2 = 8x$  and A is the point (1, 0), then the locus of the midpoint of the line segment AP is [4]

- a)  $Y^2 = 2(2x + 1)$   
 b)  $Y^2 = 4\left(x - \frac{1}{2}\right)$   
 c)  $Y^2 = x - \frac{1}{2}$   
 d)  $Y^2 = 2x + 1$

62) The value of  $\sum_{k=1}^{13} \frac{1}{\sin\left(\frac{\pi}{4} + \frac{(k-1)\pi}{6}\right) \sin\left(\frac{\pi}{4} + \frac{k\pi}{6}\right)}$  is equal to [4]

- a)  $2(\sqrt{3} - 1)$                       b)  $2(2 + \sqrt{3})$   
 c)  $3 - \sqrt{3}$                             d)  $2(3 - \sqrt{3})$

63) The distance of the point P (4, 6, - 2) from the line passing through the point (- 3, 2, 3) and parallel to a line with direction ratios 3, 3, - 1 is equal to: [4]

- a) 3                                b)  $\sqrt{6}$   
 c)  $\sqrt{14}$                             d)  $2\sqrt{3}$

64) Let  $\vec{a} = f(x)\hat{i} - f'(x)\hat{j}$  and  $\vec{b} = g(x)\hat{i} + g'(x)\hat{j}$  be any two non - zero vectors and  $h(x)$  be antiderivative of  $f(x)g(x)$ . If  $h(1) = 1$ ,  $h(2) = 3$ ,  $h(4) = 7$ , then vectors  $\vec{a}$  and  $\vec{b}$  are linearly dependent for: [4]

- a) Atleast one  $x \in (2, 4)$   
 b) Atleast one  $x \in (1, 2)$   
 c) Atleast one  $x \in (1, 4)$   
 d) Atleast two  $x \in (1, 4)$

65) If the mean deviation about the median of the numbers a, 2a, 3a, ..., 50a is 50, then  $|a|$  equals [4]

- a) 3                                b) 4  
 c) 2                                d) 5

66)  $2n$  distinguishable balls are kept in an urn,  $n$  balls are black and remaining  $n$  are white. A person draws balls one by one randomly and without replacement until all  $2n$  balls are withdrawn.  $P(n)$  is the probability that the sequence of balls withdrawn shows colours alternately, starting with any colour first. Then  $P(n)$  equals: [4]

- a)  $\frac{(n!)^2}{(2n)!}$   
 b)  $\frac{(n!)^2}{2^n(2n)!}$   
 c)  $\frac{2(n!)^2}{(2n)!}$   
 d)  $\frac{2(n!)^2}{(2n)!}$

67) The value of  $\tan 9^\circ + \tan 36^\circ + \tan 9^\circ - \tan 36^\circ$  is equal to: [4]

