

JEE Main 2023 April 13 Shift 1 Question Paper

Time Allowed :3 Hours

Maximum Marks :300

Total Questions :90

General Instructions

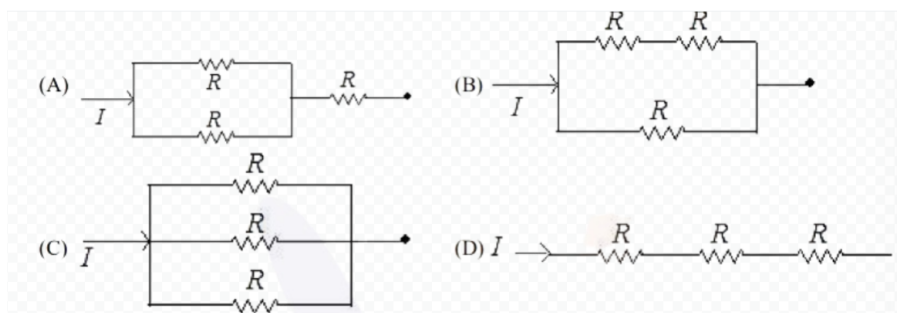
Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 90 questions, out of which 75 are to attempted.
The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage.
4. Each part (subject) has two sections.
 - (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and -1 mark for wrong answer.
 - (ii) Section-B: This section contains 10 questions. In Section-B, attempt any five questions out of 10. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and -1 mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer

Physics

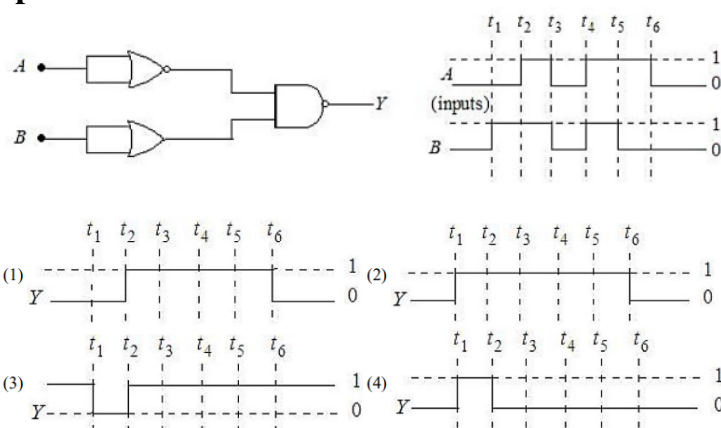
Section-A

31. Different combination of 3 resistors of equal resistance R are shown in the figures. The increasing order for power dissipation is:



- (1) $P_C < P_B < P_A < P_D$
- (2) $P_C < P_D < P_A < P_B$
- (3) $P_B < P_C < P_D < P_A$
- (4) $P_A < P_B < P_C < P_D$

32. For the following circuit and given inputs A and B, choose the correct option for output Y.



The given circuit is a NAND gate, which gives an output Y based on the inputs A and B. The truth table for a NAND gate is:

$$Y = \overline{A \cdot B}.$$

33. A bullet of 10 g leaves the barrel of the gun with a velocity of 600 m/s. If the barrel of the gun is 50 cm long and the mass of the gun is 3 kg, then the value of the impulse supplied to the gun will be:

- (1) 12 Ns
- (2) 6 Ns

- (3) 3 Ns
(4) 36 Ns

34. Which of the following Maxwell's equation is valid for time varying conditions but not valid for static conditions:

- (1) $\oint \vec{D} \cdot d\vec{A} = Q$
 (2) $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \Phi_E}{\partial t}$
 (3) $\oint \vec{E} \cdot d\vec{l} = 0$
 (4) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

35. Match List – I with List – II

List - I (Layer of atmosphere)	List - II (Approximate height over Earth's surface)
(A) F1 - Layer	(I) 10 km
(B) D - Layer	(II) 170 - 190 km
(C) Troposphere	(III) 100 km
(D) E - Layer	(IV) 65 - 75 km

Choose the correct answer from the options given below:

- (1) A – II, B – I, C – IV, D – III
 (2) A – II, B – IV, C – III, D – I
 (3) A – II, B – IV, C – I, D – III
 (4) A – III, B – IV, C – I, D – II

36. The rms speed of oxygen molecule in a vessel at particular temperature is

$\left(1 + \frac{5}{x}\right)^{\frac{1}{2}} \nu$, where ν is the average speed of the molecule. The value of x will be: (Take $\pi = \frac{22}{7}$)

- (1) 28
 (2) 27
 (3) 8
 (4) 4

37. The ratio of powers of two motors is

$$\frac{3\sqrt{x}}{\sqrt{x+1}},$$

that are capable of raising 300 kg of water in 5 minutes and 50 kg of water in 2 minutes respectively from a well 100 m deep. The value of x will be:

- (1) 16
 - (2) 2
 - (3) 4
 - (4) 2.4
-

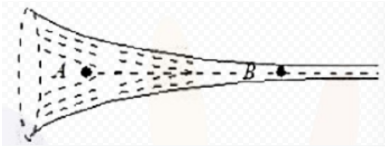
38. Two trains 'A' and 'B' of length l and l are travelling into a tunnel of length L in parallel tracks from opposite directions with velocities 108 km/h and 72 km/h, respectively. If train 'A' takes 35 s less time than train 'B' to cross the tunnel, then length L of the tunnel is: (Given $l = 60$ m)

- (1) 2700 m
 - (2) 1800 m
 - (3) 1200 m
 - (4) 900 m
-

39. Two bodies are having kinetic energies in the ratio 16 : 9. If they have the same linear momentum, the ratio of their masses respectively is:

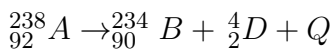
- (1) 16 : 9
 - (2) 4 : 3
 - (3) 9 : 16
 - (4) 3 : 4
-

40. The figure shows a liquid of given density flowing steadily in a horizontal tube of varying cross-section. Cross-sectional areas at A is 1.5 cm^2 , and at B is 25 mm^2 , if the speed of liquid at B is 60 cm/s then $(P_A - P_B)$ is: (Given P_A and P_B are liquid pressures at A and B points, and density $\rho = 1000 \text{ kg/m}^3$. A and B are on the axis of the tube.)



- (1) 175 Pa
- (2) 36 Pa
- (3) 27 Pa
- (4) 135 Pa

41.



In the given nuclear reaction, the approximate amount of energy released will be:

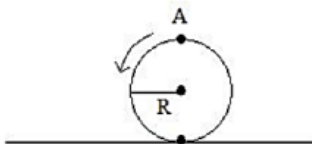
[Given, mass of ${}_{92}^{238}A = 238.05079 \times 931.5 \text{ MeV}/c^2$,

$$\text{mass of } {}_{90}^{234}B = 234.04363 \times 931.5 \text{ MeV}/c^2,$$

$$\text{mass of } {}_2^4D = 4.00260 \times 931.5 \text{ MeV}/c^2]$$

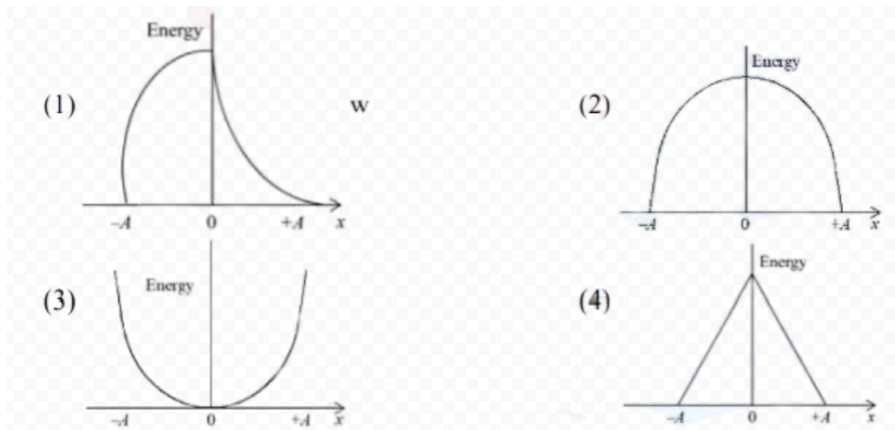
- (1) 4.25 MeV
- (2) 5.9 MeV
- (3) 3.82 MeV
- (4) 2.12 MeV

42. A disc is rolling without slipping on a surface. The radius of the disc is R . At $t = 0$, the top most point on the disc is A as shown in the figure. When the disc completes half of its rotation, the displacement of point A from its initial position is:



- (1) $2R\sqrt{1 + 4\pi^2}$
- (2) $R\sqrt{\pi^2 + 4}$
- (3) $2R$
- (4) $R\sqrt{\pi^2 + 1}$

43. Which graph represents the difference between total energy and potential energy of a particle executing SHM vs its distance from the mean position?



44. Two charges each of magnitude 0.01 C and separated by a distance of 0.4 mm constitute an electric dipole. If the dipole is placed in an uniform electric field $\vec{E}$ of 10 dyne/C making 30° angle with $\vec{E}$, the magnitude of torque acting on dipole is:

- (1) $1.5 \times 10^{-9}\text{ Nm}$
- (2) $2.0 \times 10^{-10}\text{ Nm}$
- (3) $1.0 \times 10^{-8}\text{ Nm}$
- (4) $4.0 \times 10^{-10}\text{ Nm}$

45. Under isothermal condition, the pressure of a gas is given by $P = aV^{-3}$, where a is a constant and V is the volume of the gas. The bulk modulus at constant temperature is equal to:

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

46. A planet having mass $9M_e$ and radius $4R_e$, where M_e and R_e are mass and radius of Earth respectively, has escape velocity in km/s given by: (Given escape velocity on earth $V_e = 11.2 \times 10^3\text{ m/s}$)

- (1) 11.2

- (2) 67.2
 - (3) 33.6
 - (4) 16.8
-

47. A body of mass (5 ± 0.5) kg is moving with a velocity of (20 ± 0.4) m/s. Its kinetic energy will be:

- (1) (1000 ± 140) J
 - (2) (500 ± 140) J
 - (3) (500 ± 0.14) J
 - (4) (1000 ± 0.14) J
-

48. The difference between threshold wavelengths for two metal surfaces A and B having work functions $\phi_A = 9$ eV and $\phi_B = 4.5$ eV in nm is:

Given, $hc = 1242$ eV nm

- (1) 276
 - (2) 264
 - (3) 540
 - (4) 138
-

49. The source of time varying magnetic field may be:

- (A) A permanent magnet
- (B) An electric field changing linearly with time
- (C) Direct current
- (D) A decelerating charge particle
- (E) An antenna fed with a digital signal

Choose the correct answer from the options given below:

- (1) (B) and (D) only
- (2) (C) and (E) only
- (3) (D) only
- (4) (A) only

50. A vessel of depth d is half filled with oil of refractive index n_1 and the other half is filled with water of refractive index n_2 . The apparent depth of this vessel when viewed from above will be:

- (1) $\frac{d(n_1+n_2)}{2n_1n_2}$
 - (2) $\frac{dn_1n_2}{(n_1+n_2)}$
 - (3) $\frac{dn_1n_2}{2(n_1+n_2)}$
 - (4) $\frac{2d(n_1+n_2)}{n_1n_2}$
-

Section-B

51. When a resistance of $5\ \Omega$ is shunted with a moving coil galvanometer, it shows a full scale deflection for a current of 250 mA, however, when $1050\ \Omega$ resistance is connected with it in series, it gives full scale deflection for 25 volt. The resistance of the galvanometer is $\text{---}\Omega$.

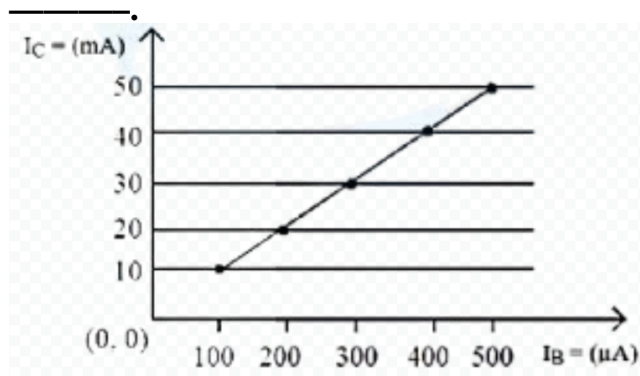
52. The radius of the 2nd orbit of He^+ of Bohr's model is r_1 and that of the fourth orbit of Be^{3+} is represented as r_2 . Now the ratio $\frac{r_2}{r_1}$ is $x : 1$. The value of x ---

53. A solid sphere is rolling on a horizontal plane without slipping. If the ratio of angular momentum about axis of rotation of the sphere to the total energy of the moving sphere is $\frac{\pi}{22}$, the value of its angular speed will be rad/s

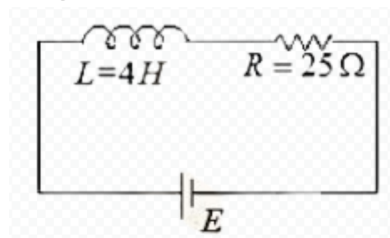
54. A fish rising vertically upward with a uniform velocity of 8 m/s observes that a bird is diving vertically downward towards the fish with the velocity of 12 m/s. If the refractive index of water is $\frac{4}{3}$, then the actual velocity of the diving bird to pick the fish will be ---m/s .

55. The elastic potential energy stored in a steel wire of length 20 m stretched through 2 cm is 80 J. The cross sectional area of the wire is --- mm^2 . (Given, $y = 2.0 \times 10^{11} \text{ Nm}^{-2}$)

56. From the given transfer characteristic of a transistor in CE configuration, the value of power gain of this configuration is 10^x , for $R_B = 10 \text{ k}\Omega$, $R_C = 1 \text{ k}\Omega$. The value of x is _____.



57. In the given figure, an inductor and a resistor are connected in series with a battery of emf E volt. $\frac{E^2}{2b}$ represents the maximum rate at which the energy is stored in the magnetic field (inductor). The numerical value of $\frac{b}{a}$ will be _____



58. A potential V_0 is applied across a uniform wire of resistance R . The power dissipation is P_1 . The wire is then cut into two equal halves and a potential V_0 is applied across the length of each half. The total power dissipation across two wires is P_2 . The ratio $P_2 : P_1$ is $\sqrt{x} : 1$. The value of x is _____

59. At a given point of time the value of displacement of a simple harmonic oscillator is given as $y = A \cos(30^\circ)$. If amplitude is 40 cm and kinetic energy at that time is 200 J, the value of force constant is $1.0 \times 10^x \text{ Nm}^{-1}$. The value of x is _____

60. A thin infinite sheet charge and an infinite line charge of respective charge densities $+\sigma$ and $+\lambda$ are placed parallel at a 5 m distance from each other. Points 'P' and 'Q' are at $\frac{3}{\pi} \text{ m}$ and $\frac{4}{\pi} \text{ m}$ perpendicular distances from the line charge towards the sheet charge, respectively. ' E_P ' and ' E_Q ' are the magnitudes of resultant electric field intensities at

point 'P' and 'Q' respectively. If $\frac{E_P}{E_Q} = \frac{4}{a}$ for $2|\sigma| = |\lambda|$, then the value of a is _____
