FIITJEE JEE MAINS

MOCK TEST - 3

PHYSICS, CHEMISTRY & MATHEMATICS

JEE - MAINS 2014

Time Allotted: 3 Hours **Maximum Marks: 420**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*

2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.

3. The test is of **3 hours** duration.

4. The Test Booklet consists of **105** questions. The maximum marks are **420**.

5. There are ***three*** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 35 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.

6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*

7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.

8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***

9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.

10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***

11. **Do not fold or make any stray marks on the Answer Sheet.**

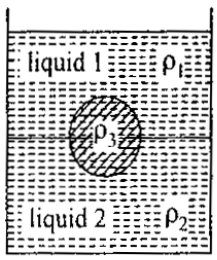
Name of the Candidate (in Capital Letters) :_____

Enrolment Number :_____

Batch :_____ **Date of Examination :** _____

PHYSICS AND CHEMISTRY

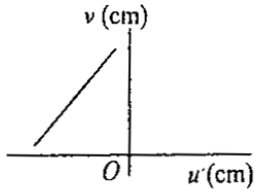
1. A jar is filled with two non-mixing liquids 1 and 2 having densities ρ_1 and ρ_2 respectively. A solid ball, made of a material of density ρ_3, is dropped in the jar. It comes to equilibrium in the position shown in the figure. Which of the following is true for ρ_1, ρ_2 and ρ_3?

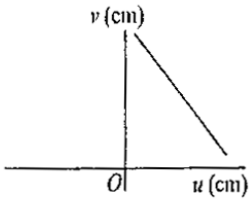


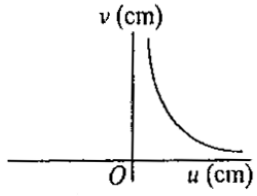
(a) $\rho_1 < \rho_3 < \rho_2$ (b) $\rho_3 < \rho_1 < \rho_2$
(c) $\rho_1 > \rho_3 > \rho_2$ (d) $\rho_1 < \rho_2 < \rho_3$

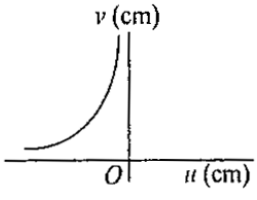
2. A working transistor with its three legs marked P, Q and R is tested using a multimeter. No conduction is found between P and Q. By connecting the common (negative) terminal of the multimeter to R and the other (positive) terminal to P or Q, some resistance is seen on the multimeter. Which of the following is true for the transistor?
(a) It is an *npn* transistor with R as collector.
(b) It is an *npn* transistor with R as base.
(c) It is a *pnp* transistor with R as collector.
(d) It is a *pnp* transistor with R as emitter.

3. A student measures the focal length of a convex lens by putting an object pin at a distance u from the lens and measuring the distance v of the image pin. The graph between u and v plotted by the student should look like

(a) 

(b) 

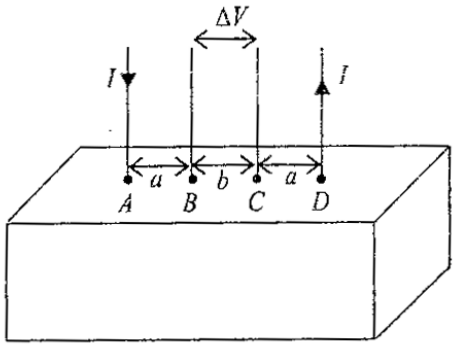
(c) 

(d) 

Directions : Questions 4 and 5 are based on the following paragraph.

Consider a block of conducting material of resistivity ρ shown in the figure. Current I enters at A and leaves from D. We apply superposition principle to find voltage ΔV developed between B and C. The calculation is done in the following steps:

(i) Take current I entering from A and assume it to spread over a hemispherical surface in the block.
(ii) Calculate field $E(r)$ at distance r from A by using Ohm's law $E = \rho j$, where j is the current per unit area at r.
(iii) From the r dependence of $E(r)$, obtain the potential $V(r)$ at r.
(iv) Repeat (i), (ii) and (iii) for current I leaving D and superpose results for A and D.



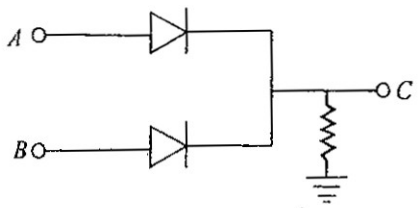
4. ΔV measured between B and C is

(a) $\dfrac{\rho I}{2\pi(a-b)}$ (b) $\dfrac{\rho I}{\pi a} - \dfrac{\rho I}{\pi(a+b)}$
(c) $\dfrac{\rho I}{a} - \dfrac{\rho I}{(a+b)}$ (d) $\dfrac{\rho I}{2\pi a} - \dfrac{\rho I}{2\pi(a+b)}$

5. For current entering at A, the electric field at a distance r from A is

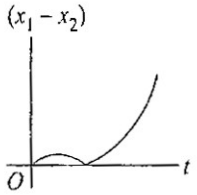
(a) $\dfrac{\rho I}{4\pi r^2}$ (b) $\dfrac{\rho I}{8\pi r^2}$
(c) $\dfrac{\rho I}{r^2}$ (d) $\dfrac{\rho I}{2\pi r^2}$

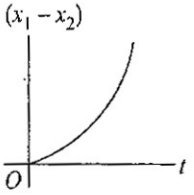
6. In the circuit below, A and B represent two inputs and C represents the output. The circuit represents

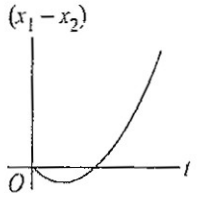


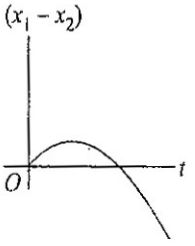
(a) OR gate (b) NOR gate
(c) AND gate (d) NAND gate.

7. A body is at rest at $x = 0$. At $t = 0$, it starts moving in the positive x-direction with a constant acceleration. At the same instant another body passes through $x = 0$ moving in the positive x-direction with a constant speed. The position of the first body is given by $x_1(t)$ after time t and that of the second body by $x_2(t)$ after the same time interval. Which of the following graphs correctly describes $(x_1 - x_2)$ as a function of time t?

(a) 

(b) 

(c) 

(d) 

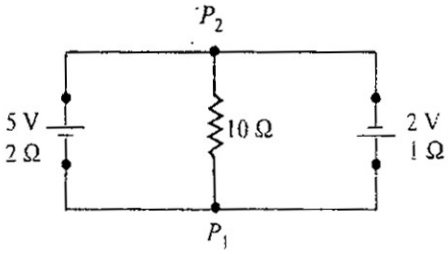
Directions : Questions 8 and 9 contains statement-1 and statement-2. Of the four choices given, choose the one that best describes the two statements.

(a) Statement-1 is true, statement-2 is false.
(b) Statement-1 is false, statement-2 is true.
(c) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for statement-1.
(d) Statement-1 is true, statement-2 is true; statement-2 is not a correct explanation for statement-1.

8. **Statement-1 :** Energy is released when heavy nuclei undergo fission or light nuclei undergo fusion.
Statement-2 : For heavy nuclei, binding energy per nucleon increases with increasing Z while for light nuclei it decreases with increasing Z.

9. **Statement-1 :** For a mass M kept at the centre of a cube of side a, the flux of gravitational field passing through its sides is $4\pi GM$.
Statement-2 : If the direction of a field due to a point source is radial and its dependence on the distance r from the source is given as $1/r^2$, its flux through a closed surface depends only on the strength of the source enclosed by the surface and not on the size or shape of the surface.

10. A 5 V battery with internal resistance 2 Ω and 2 V battery with internal resistance 1 Ω are connected to a 10 Ω resistor as shown in the figure. The current in the 10 Ω resistor is



(a) 0.27 A P_1 to P_2 (b) 0.27 A P_2 to P_1
(c) 0.03 A P_1 to P_2 (d) 0.03 A P_2 to P_1.

11. An experiment is performed to find the refractive index of glass using a travelling microscope. In this experiment distances are measured by
(a) a screw gauge provided on the microscope
(b) a vernier scale provided on the microscope
(c) a standard laboratory scale
(d) a meter scale provided on the microscope.

12. A horizontal overhead powerline is at a height of 4 m from the ground and carries a current of 100 A from east to west. The magnetic field directly below it on the ground is ($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})
(a) 2.5×10^{-7} T northward
(b) 2.5×10^{-7} T southward
(c) 5×10^{-6} T northward
(d) 5×10^{-6} T southward.

13. The speed of sound in oxygen (O_2) at a certain temperature is 460 ms^{-1}. The speed of sound in helium (He) at the same temperature will be (assume both gases to be ideal)
(a) 330 ms^{-1} (b) 460 ms^{-1}
(c) 500 ms^{-1} (d) 650 ms^{-1}

14. Consider a uniform square plate of side a and mass m. The moment of inertia of this plate about an axis perpendicular to its plane and passing through one of its corners is

(a) $\frac{2}{3}ma^2$ (b) $\frac{5}{6}ma^2$

(c) $\frac{1}{12}ma^2$ (d) $\frac{7}{12}ma^2$

15. A body of mass $m = 3.513$ kg is moving along the x-axis with a speed of 5.00 ms^{-1}. The magnitude of its momentum is recorded as

(a) 17.57 kg ms^{-1} (b) 17.6 kg ms^{-1}

(c) 17.565 kg ms^{-1} (d) 17.56 kg ms^{-1}

16. The dimension of magnetic field in M, L, T and C (coulomb) is given as

(a) $MT^{-2}C^{-1}$ (b) $MLT^{-1}C^{-1}$

(c) $MT^{2}C^{-2}$ (d) $MT^{-1}C^{-1}$

17. A parallel plate capacitor with air between the plates has a capacitance of 9 pF. The separation between its plates is d. The space between the plates is now filled with two dielectrics. One of the dielectrics has dielectric constant $k_1 = 3$ and thickness $d/3$ while the other one has dielectric constant $k_2 = 6$ and thickness $2d/3$. Capacitance of the capacitor is now

(a) 20.25 pF (b) 1.8 pF

(c) 45 pF (d) 40.5 pF.

18. An athlete in the olympic games covers a distance of 100 m in 10 s. His kinetic energy can be estimated to be in the range

(a) 2,000 J - 5,000 J

(b) 200 J - 500 J

(c) 2×10^5 J - 3×10^5 J

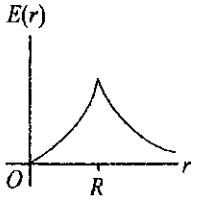
(d) 20,000 J - 50,000 J.

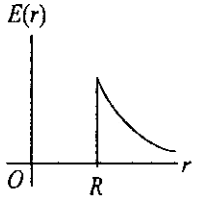
19. Relative permittivity and permeability of a material are ε_r and μ_r, respectively. Which of the following values of these quantities are allowed for a diamagnetic material?

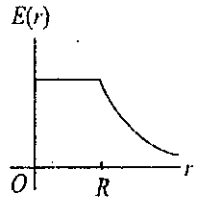
(a) $\varepsilon_r = 1.5, \mu_r = 1.5$ (b) $\varepsilon_r = 0.5, \mu_r = 1.5$

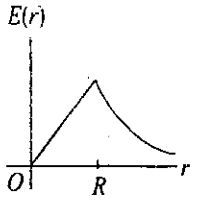
(c) $\varepsilon_r = 1.5, \mu_r = 0.5$ (d) $\varepsilon_r = 0.5, \mu_r = 0.5$

20. A thin spherical shell of radius R has charge Q spread uniformly over its surface. Which of the following graphs most closely represents the electric field $E(r)$ produced by the shell in the range $0 \le r < \infty$, where r is the distance from the centre of the shell?

(a) 

(b) 

(c) 

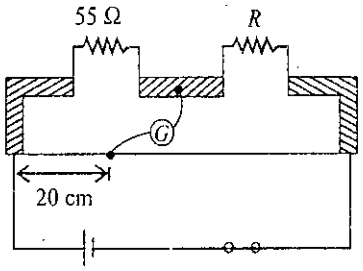
(d) 

21. A spherical solid ball of volume V is made of a material of density ρ_1. It is falling through a liquid of density ρ_2 ($\rho_2 < \rho_1$). Assume that the liquid applies a viscous force on the ball that is proportional to the square of its speed v, *i.e.*, $F_{viscous} = -kv^2$ ($k > 0$). The terminal speed of the ball is

(a) $\frac{Vg(\rho_1 - \rho_2)}{k}$ (b) $\sqrt{\frac{Vg(\rho_1 - \rho_2)}{k}}$

(c) $\frac{Vg\rho_1}{k}$ (d) $\sqrt{\frac{Vg\rho_1}{k}}$

22. Shown in the figure below is a meter-bridge set up with null deflection in the galvanometer. The value of the unknown resistance R is



(a) 55 Ω (b) 13.75 Ω

(c) 220 Ω (d) 110 Ω.

23. While measuring the speed of sound by performing a resonance column experiment, a student gets the first resonance condition at a column length of 18 cm during winter. Repeating the same experiment during summer, she measures the column length to be x cm for the second resonance. Then

(a) $36 > x > 18$ (b) $18 > x$

(c) $x > 54$ (d) $54 > x > 36$.

24. A wave travelling along the x-axis is described by the equation $y(x, t) = 0.005 \cos(\alpha x - \beta t)$. If the wavelength and the time period of the wave are 0.08 m and 2.0 s, respectively, then α and β in appropriate units are

(a) $\alpha = 12.50\pi$, $\beta = \frac{\pi}{2.0}$ (b) $\alpha = 25.00\pi$, $\beta = \pi$

(c) $\alpha = \frac{0.08}{\pi}$, $\beta = \frac{2.0}{\pi}$ (d) $\alpha = \frac{0.04}{\pi}$, $\beta = \frac{1.0}{\pi}$

25. A block of mass 0.50 kg is moving with a speed of 2.00 ms^{-1} on a smooth surface. It strikes another mass of 1.00 kg and then they move together as a single body. The energy loss during the collision is
(a) 0.34 J (b) 0.16 J
(c) 1.00 J (d) 0.67 J.

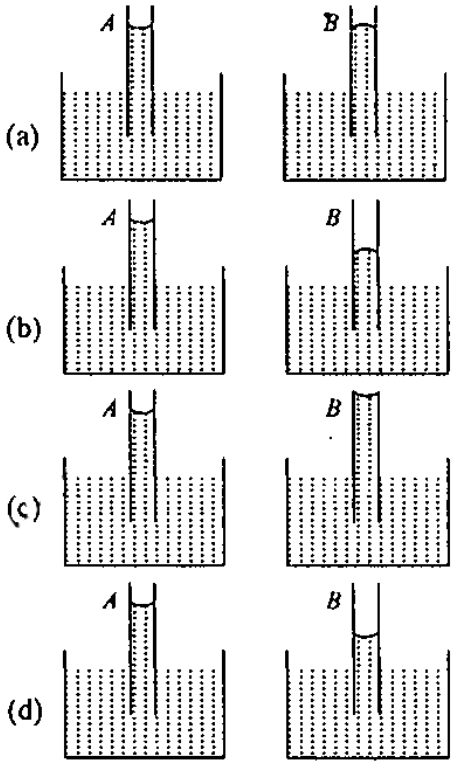
26. Suppose an electron is attracted towards the origin by a force k/r where k is a constant and r is the distance of the electron from the origin. By applying Bohr model to this system, the radius of the n^{th} orbital of the electron is found to be r_n and the kinetic energy of the electron to be T_n. Then which of the following is true?
(a) $T_n \propto \frac{1}{n}$, $r_n \propto n^2$ (b) $T_n \propto \frac{1}{n^2}$, $r_n \propto n^2$
(c) T_n independent of n, $r_n \propto n$
(d) $T_n \propto \frac{1}{n}$, $r_n \propto n$

27. Two full turns of the circular scale of a screw gauge cover a distance of 1 mm on its main scale. The total number of divisions on the circular scale is 50. Further, it is found that the screw gauge has a zero error of – 0.03 mm. While measuring the diameter of a thin wire, a student notes the main scale reading of 3 mm and the number of circular scale divisions in line with the main scale as 35. The diameter of the wire is
(a) 3.38 mm (b) 3.32 mm
(c) 3.73 mm (d) 3.67 mm.

28. An insulated container of gas has two chambers separated by an insulating partition. One of the chambers has volume V_1 and contains ideal gas at pressure P_1 and temperature T_1. The other chamber has volume V_2 and contains ideal gas at pressure P_2 and temperature T_2. If the partition is removed without doing any work on the gas, the final equilibrium temperature of the gas in the container will be
(a) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_1 + P_2V_2T_2}$ (b) $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$
(c) $\frac{P_1V_1T_1 + P_2V_2T_2}{P_1V_1 + P_2V_2}$ (d) $\frac{P_1V_1T_2 + P_2V_2T_1}{P_1V_1 + P_2V_2}$

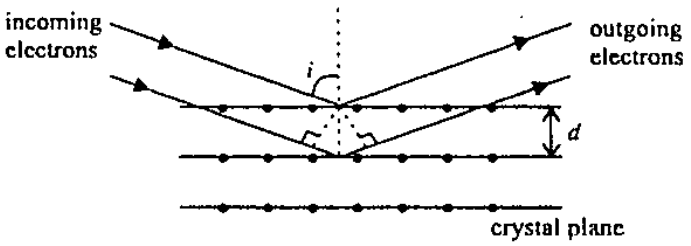
29. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area $A = 10\ cm^2$ and length = 20 cm. If one of the solenoids has 300 turns and the other 400 turns, their mutual inductance is ($\mu_0 = 4\pi \times 10^{-7}\ T\ mA^{-1}$)
(a) $2.4\pi \times 10^{-4}$ H (b) $2.4\pi \times 10^{-5}$ H
(c) $4.8\pi \times 10^{-4}$ H (d) $4.8\pi \times 10^{-5}$ H.

30. A capillary tube (A) is dipped in water. Another identical tube (B) is dipped in a soap-water solution. Which of the following shows the relative nature of the liquid columns in the two tubes?



Directions : Questions 31, 32 and 33 are based on the following paragraph.

Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see figure).



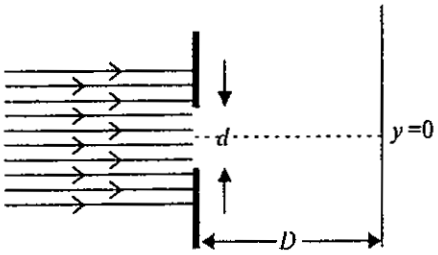
31. Electrons accelerated by potential V are diffracted from a crystal. If d = 1 Å and $i = 30°$, V should be about ($h = 6.6 \times 10^{-34}$ Js, $m_e = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C)

(a) 1000 V (b) 2000 V
(c) 50 V (d) 500 V.

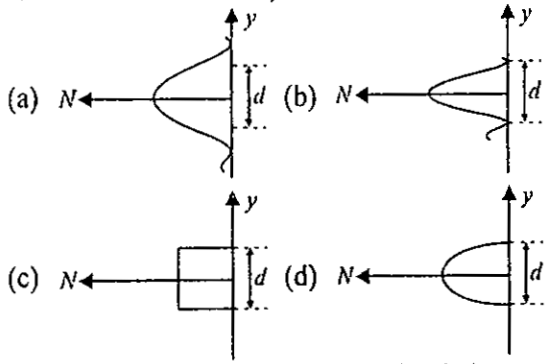
32. If a strong diffraction peak is observed when electrons are incident at an angle i from the normal to the crystal planes with distance d between them (see figure), de Broglie wavelength λ_{dB} of electrons can be calculated by the relationship (n is an integer)

(a) $d\cos i = n\lambda_{dB}$ (b) $d\sin i = n\lambda_{dB}$
(c) $2d\cos i = n\lambda_{dB}$ (d) $2d\sin i = n\lambda_{dB}$

33. In an experiment, electrons are made to pass through a narrow slit of width d comparable to their de Broglie wavelength. They are detected on a screen at a distance D from the slit.



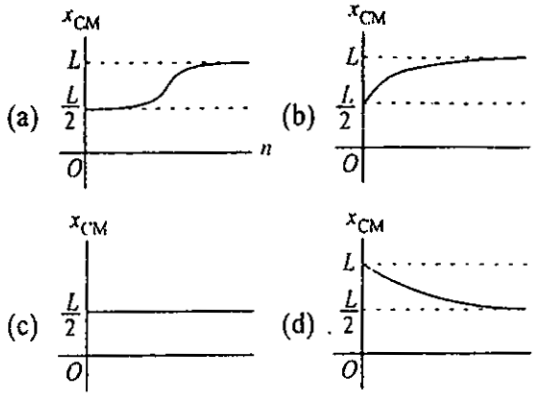
Which of the following graphs can be expected to represent the number of electrons N detected as a function of the detector position y ($y = 0$ corresponds to the middle of the slit)?



34. A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is 11 km s^{-1}, the escape velocity from the surface of the planet would be

(a) 0.11 km s^{-1} (b) 1.1 km s^{-1}
(c) 11 km s^{-1} (d) 110 km s^{-1}

35. A thin rod of length L is lying along the x-axis with its ends at $x = 0$ and $x = L$. Its linear density (mass/length) varies with x as $k(x/L)^n$ where n can be zero or any positive number. If the position x_{CM} of the centre of mass of the rod is plotted against n, which of the following graphs best approximates the dependence of x_{CM} on n?



36. At 80°C, the vapour pressure of pure liquid A is 520 mm of Hg and that of pure liquid B is 1000 mm of Hg. If a mixture solution of A and B boils at 80°C and 1 atm pressure, the amount of A in the mixture is (1 atm = 760 mm of Hg)

(a) 50 mol percent (b) 52 mol percent
(c) 34 mol percent (d) 48 mol percent

37. For a reaction $\frac{1}{2}A \rightarrow 2B$ rate of disappearance of A is related to the rate of appearance of B by the expression

(a) $-\frac{d[A]}{dt} = 4\frac{d[B]}{dt}$ (b) $-\frac{d[A]}{dt} = \frac{1}{2}\frac{d[B]}{dt}$
(c) $-\frac{d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$ (d) $-\frac{d[A]}{dt} = \frac{d[B]}{dt}$

38. The equilibrium constants k_{p_1} and k_{p_2} for the reactions $X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P + Q$, respectively are in the ratio of 1 : 9. If degree of dissociation of X and Z be equal then the ratio of total pressures at these equilibria is

(a) 1 : 9 (b) 1 : 36
(c) 1 : 1 (d) 1 : 3

39. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below:

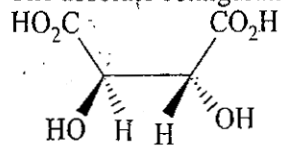
$$1/2\ Cl_{2(g)} \xrightarrow{1/2\,\Delta_{diss}\overset{\ominus}{H}} Cl_{(g)} \xrightarrow{\Delta_{eg}\overset{\ominus}{H}} Cl^-_{(g)} \xrightarrow{\Delta_{hyd}\overset{\ominus}{H}} Cl^-_{(aq)}$$

The energy involved in the conversion of $1/2\ Cl_{2(g)}$ to $Cl^-_{(aq)}$ (using data, $\Delta_{diss}\overset{\ominus}{H}_{Cl_2} = 240$ kJ mol^{-1} $\Delta_{eg}\overset{\ominus}{H}_{Cl} = -349$ kJ mol^{-1}, $\Delta_{hyd}\overset{\ominus}{H}_{Cl^-} = -381$ kJ mol^{-1}) will be

(a) −120 kJ mol^{-1} (b) +152 kJ mol^{-1}
(c) −610 kJ mol^{-1} (d) −850 kJ mol^{-1}

40. α-*D*-(+)-glucose and β-*D*-(+)-glucose are
(a) enantiomers (b) conformers
(c) epimers (d) anomers

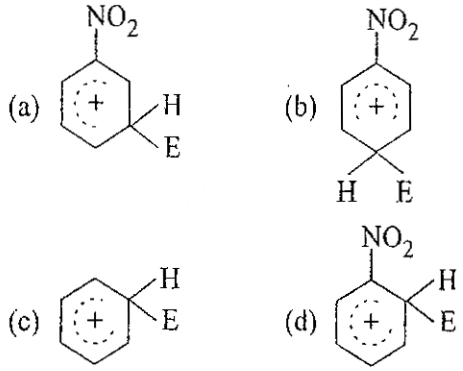
41. The absolute configuration of



is
(a) S, R (b) S, S
(c) R, R (d) R, S

42. Which of the following factors is of no significance for roasting sulphide ores to the oxides and not subjecting the sulphide ores to carbon reduction directly?
(a) CO_2 is more volatile than CS_2
(b) Metal sulphides are thermodynamically more stable than CS_2
(c) CO_2 is thermodynamically more stable than CS_2
(d) Metal sulphides are less stable than the corresponding oxides

43. The electrophile, $E^{\oplus}$ attacks the benzene ring to generate the intermediate σ-complex. Of the following, which σ-complex is of lowest energy?



44. Bakelite is obtained from phenol by reaction with
(a) HCHO (b) $(CH_2OH)_2$
(c) CH_3CHO (d) CH_3COCH_3

45. The organic chloro compound, which shows complete stereochemical inversion during a S_N2 reaction, is
(a) CH_3Cl (b) $(C_2H_5)_2CHCl$
(c) $(CH_3)_3CCl$ (d) $(CH_3)_2CHCl$

46. Toluene is nitrated and the resulting product is reduced with tin and hydrochloric acid. The product so obtained is diazotised and then heated with cuprous bromide. The reaction mixture so formed contains
(a) Mixture of *o*- and *m*-bromotoluenes
(b) Mixture of *o*- and *p*-bromotoluenes
(c) Mixture of *o*- and *p*-dibromobenzenes
(d) Mixture of *o*- and *p*-bromoanilines

47. In the following sequence of reactions, the alkene affords the compound *B*

$$CH_3CH=CHCH_3 \xrightarrow{O_3} A \xrightarrow[Zn]{H_2O} B.$$

The compound *B* is
(a) CH_3CHO (b) CH_3CH_2CHO
(c) CH_3COCH_3 (d) $CH_3CH_2COCH_3$

48. For the following three reactions (i), (ii) and (iii), equilibrium constants are given
(i) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$; K_1
(ii) $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$; K_2
(iii) $CH_{4(g)} + 2H_2O_{(g)} \rightleftharpoons CO_{2(g)} + 4H_{2(g)}$; K_3
Which of the following relation is correct ?
(a) $K_3 \cdot K_2^3 = K_1^2$ (b) $K_1\sqrt{K_2} = K_3$
(c) $K_2K_3 = K_1$ (d) $K_3 = K_1K_2$

49. Standard entropy of X_2, Y_2 and XY_3 are 60, 40 and 50 J K^{-1} mol^{-1}, respectively. For the reaction, $1/2\ X_2 + 3/2\ Y_2 \rightarrow XY_3$, $\Delta H = -30$ kJ, to be at equilibrium, the temperature will be
(a) 1000 K (b) 1250 K
(c) 500 K (d) 750 K

50. Phenol, when it first reacts with concentrated sulphuric acid and then with concentrated nitric acid, gives
(a) nitrobenzene (b) 2, 4, 6-trinitrobenzene
(c) *o*-nitrophenol (d) *p*-nitrophenol

51. The hydrocarbon which can react with sodium in liquid ammonia is
(a) $CH_3CH_2C \equiv CCH_2CH_3$
(b) $CH_3CH_2CH_2C \equiv CCH_2CH_2CH_3$
(c) $CH_3CH_2C \equiv CH$ (d) $CH_3CH = CHCH_3$

52. The treatment of CH_3MgX with $CH_3C \equiv C - H$ produces
(a) CH_4 (b) $CH_3 - CH = CH_2$
(c) $CH_3C \equiv C - CH_3$
(d) $CH_3 - \underset{|}{\overset{H}{C}} = \underset{|}{\overset{H}{C}} - CH_3$

53. The correct decreasing order of priority for the functional groups of organic compounds in the

IUPAC system of nomenclature is

(a) $-CONH_2, -CHO, -SO_3H, -COOH$

(b) $-COOH, -SO_3H, -CONH_2, -CHO$

(c) $-SO_3H, -COOH, -CONH_2, -CHO$

(d) $-CHO, -COOH, -SO_3H, -CONH_2$

54. The pK_a of a weak acid, HA, is 4.80. The pK_b of a weak base, BOH is 4.78. The pH of an aqueous solution of the corresponding salt, BA, will be

(a) 9.22 (b) 9.58

(c) 4.79 (d) 7.01

55. In context with the industrial preparation of hydrogen from water gas ($CO + H_2$), which of the following is the correct statement?

(a) CO is oxidised to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali

(b) CO and H_2 are fractionally separated using differences in their densities

(c) CO is removed by absorption in aqueous Cu_2Cl_2 solution

(d) H_2 is removed through occlusion with Pd

56. In a compound, atoms of element *Y* form *ccp* lattice and those of element *X* occupy $2/3^{rd}$ of tetrahedral voids. The formula of the compound will be

(a) X_3Y_4 (b) X_4Y_3

(c) X_2Y_3 (d) X_2Y

57. Which one of the following pairs of species have the same bond order?

(a) NO^+ and CN^+ (b) CN^- and NO^+

(c) CN^- and CN^+ (d) O_2^- and CN^-

58. The vapour pressure of water at 20°C is 17.5 mm Hg. If 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2 g of water at 20°C, the vapour pressure of the resulting solution will be

(a) 17.325 mm Hg (b) 17.675 mm Hg

(c) 15.750 mm Hg (d) 16.500 mm Hg

59. Four species are listed below :

(i) HCO_3^- (ii) H_3O^+

(iii) HSO_4^- (iv) HSO_3F

Which one of the following is the correct sequence of their acid strength?

(a) iii < i < iv < ii (b) iv < ii < iii < i

(c) ii < iii < i < iv (d) i < iii < ii < iv

60. The ionization enthalpy of hydrogen atom is 1.312×10^6 J mol^{-1}. The energy required to excite the electron in the atom from $n = 1$ to $n = 2$ is

(a) 9.84×10^5 J mol^{-1} (b) 8.51×10^5 J mol^{-1}

(c) 6.56×10^5 J mol^{-1} (d) 7.56×10^5 J mol^{-1}

61. Which one of the following constitutes a group of the isoelectronic species?

(a) N_2, O_2^-, NO^+, CO (b) C_2^{2-}, O_2^-, CO, NO

(c) $NO^+, C_2^{2-}, CN^-, N_2$ (d) $CN^-, N_2, O_2^{2-}, C_2^{2-}$

62. Gold numbers of protective colloids *A*, *B*, *C* and *D* are 0.50, 0.01, 0.10 and 0.005, respectively. The correct order of their protective powers is

(a) $B < D < A < C$ (b) $D < A < C < B$

(c) $C < B < D < A$ (d) $A < C < B < D$

63. Larger number of oxidation states are exhibited by the actinoids than those by the lanthanoids, the main reason being

(a) More reactive nature of the actinoids than the lanthanoids

(b) 4*f* orbitals more diffused than the 5*f* orbitals

(c) Lesser energy difference between 5*f* and 6*d* than between 4*f* and 5*d* orbitals

(d) More energy difference between 5*f* and 6*d* than between 4*f* and 5*d* orbitals

64. Given $E^\circ_{Cr^{3+}/Cr} = -0.72$ V, $E^\circ_{Fe^{2+}/Fe} = -0.42$ V.

The potential for the cell

Cr $Cr^{3+}(0.1\ M) \,||\, Fe^{2+}(0.01\ M) \,|$ Fe is

(a) –0.26 V (b) 0.26 V

(c) 0.339 V (d) –0.339 V

65. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of HCl, because HCl

(a) oxidises oxalic acid to carbon dioxide and water

(b) gets oxidised by oxalic acid to chlorine

(c) furnishes H^+ ions in addition to those from oxalic acid

(d) reduces permanganate to Mn^{2+}

66. Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is

(a) R_3SiCl (b) R_4Si

(c) $RSiCl_3$ (d) R_2SiCl_2

67. In which of the following octahedral complexes of Co (At. no. 27), will the magnitude of Δ_{oct} be the highest?
(a) $[Co(NH_3)_6]^{3+}$ (b) $[Co(CN)_6]^{3-}$
(c) $[Co(C_2O_4)_3]^{3-}$ (d) $[Co(H_2O)_6]^{3+}$

68. The coordination number and the oxidation state of the element E in the complex $[E(en)_2(C_2O_4)]NO_2$ (where (en) is ethylene diamine) are, respectively
(a) 6 and 3 (b) 6 and 2
(c) 4 and 2 (d) 4 and 3

69. Identify the wrong statement in the following.
(a) Acid rain is mostly because of oxides of nitrogen and sulphur
(b) Chlorofluorocarbons are responsible for ozone layer depletion
(c) Greenhouse effect is responsible for global warming
(d) Ozone layer does not permit infrared radiation from the sun to reach the earth

70. Which one of the following is the correct statement?
(a) $B_2H_6 \cdot 2NH_3$ is known as 'inorganic benzene'.
(b) Boric acid is a protonic acid.
(c) Beryllium exhibits coordination number of six.
(d) Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase.

MATHEMATICS

Directions : Questions 71 to 75 contain Statement-1 and Statement-2. Of the four choices given, choose the one that best describes the two statements.
(a) Statement-1 is true, Statement-2 is false
(b) Statemen-1 is false, Statement-2 is true
(c) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
(d) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

71. Let p be the statement "x is an irrational number", q be the statement "y is a transcendental number", and r be the statement "x is a rational number iff y is a transcendental number".
Statement-1 : r is equivalent to either q or p.
Statement-2 : r is equivalent to $\sim (p \leftrightarrow \sim q)$.

72. In a shop there are five types of ice-creams available. A child buys six ice-creams.
Statement-1 : The number of different ways the child can buy the six ice-creams is ${}^{10}C_5$.
Statement-2 : The number of different ways the child can buy the six ice-creams is equal to the number of different ways of arranging 6 A's and 4 B's in a row.

73. **Statement-1 :** $\sum_{r=0}^{n}(r+1)\,{}^nC_r = (n+2)2^{n-1}$
Statement-2 :
$$\sum_{r=0}^{n}(r+1)\,{}^nC_r\,x^r = (1+x)^n + nx(1+x)^{n-1}$$

74. **Statement-1 :** For every natural number $n \geq 2$,
$$\frac{1}{\sqrt{1}} + \frac{1}{\sqrt{2}} + \ldots + \frac{1}{\sqrt{n}} > \sqrt{n}.$$
Statement-2 : For every natural number $n \geq 2$,
$$\sqrt{n(n+1)} < n+1.$$

75. Let A be a 2×2 matrix with real entries. Let I be the 2×2 identity matrix. Denote by $tr(A)$, the sum of diagonal entries of A. Assume that $A^2 = I$.
Statement-1 : If $A \neq I$ and $A \neq -I$, then $\det A = -1$.
Statement-2 : If $A \neq I$ and $A \neq -I$, then $tr(A) \neq 0$.

76. The statement $p \rightarrow (q \rightarrow p)$ is equivalent to
(a) $p \rightarrow (p \leftrightarrow q)$ (b) $p \rightarrow (p \rightarrow q)$
(c) $p \rightarrow (p \vee q)$ (d) $p \rightarrow (p \wedge q)$

77. The value of $\cot\left(\operatorname{cosec}^{-1}\frac{5}{3} + \tan^{-1}\frac{2}{3}\right)$ is
(a) $\frac{5}{17}$ (b) $\frac{6}{17}$
(c) $\frac{3}{17}$ (d) $\frac{4}{17}$

78. The differential equation of the family of circles

with fixed radius 5 units and centre on the line $y = 2$ is

(a) $(x-2)^2 y'^2 = 25 - (y-2)^2$

(b) $(x-2) y'^2 = 25 - (y-2)^2$

(c) $(y-2) y'^2 = 25 - (y-2)^2$

(d) $(y-2)^2 y'^2 = 25 - (y-2)^2$

79. Let $I = \int_0^1 \frac{\sin x}{\sqrt{x}} dx$ and $J = \int_0^1 \frac{\cos x}{\sqrt{x}} dx$.

Then which one of the following is true?

(a) $I > \frac{2}{3}$ and $J < 2$ (b) $I > \frac{2}{3}$ and $J > 2$

(c) $I < \frac{2}{3}$ and $J < 2$ (d) $I < \frac{2}{3}$ and $J > 2$

80. The area of the plane region bounded by the curves $x + 2y^2 = 0$ and $x + 3y^2 = 1$ is equal to

(a) $\frac{4}{3}$ (b) $\frac{5}{3}$

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

81. The value of $\sqrt{2}\int \frac{\sin x\, dx}{\sin\left(x - \frac{\pi}{4}\right)}$ is

(a) $x - \log\left|\cos\left(x - \frac{\pi}{4}\right)\right| + c$

(b) $x + \log\left|\cos\left(x - \frac{\pi}{4}\right)\right| + c$

(c) $x - \log\left|\sin\left(x - \frac{\pi}{4}\right)\right| + c$

(d) $x + \log\left|\sin\left(x - \frac{\pi}{4}\right)\right| + c$

82. AB is a vertical pole with B at the ground level and A at the top. A man finds that the angle of elevation of the point A from a certain point C on the ground is 60°. He moves away from the pole along the line BC to a point D such that $CD = 7$ m. From D the angle of elevation of the point A is 45°. Then the height of the pole is

(a) $\frac{7\sqrt{3}}{2}\frac{1}{\sqrt{3}+1}$ m (b) $\frac{7\sqrt{3}}{2}\frac{1}{\sqrt{3}-1}$ m

(c) $\frac{7\sqrt{3}}{2}(\sqrt{3}+1)$ m (d) $\frac{7\sqrt{3}}{2}(\sqrt{3}-1)$ m

83. How many real solutions does the equation $x^7 + 14x^5 + 16x^3 + 30x - 560 = 0$ have?

(a) 5 (b) 7

(c) 1 (d) 3

84. Let $f(x) = \begin{cases} (x-1)\sin\frac{1}{x-1} & \text{if } x \neq 1 \\ 0 & \text{if } x = 1 \end{cases}$

Then which one of the following is true?

(a) f is differentiable at $x = 1$ but not at $x = 0$

(b) f is neither differentiable at $x = 0$ nor at $x = 1$

(c) f is differentiable at $x = 0$ and at $x = 1$

(d) f is differentiable at $x = 0$ but not at $x = 1$

85. The first two terms of a geometric progression add up to 12. The sum of the third and the fourth terms is 48. If the terms of the geometric progression are alternately positive and negative, then the first term is

(a) 4 (b) -4

(c) -12 (d) 12

86. It is given that the events A and B are such that $P(A) = \frac{1}{4}$, $P(A|B) = \frac{1}{2}$ and $P(B|A) = \frac{2}{3}$.

Then $P(B)$ is

(a) $\frac{1}{2}$ (b) $\frac{1}{6}$

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

87. A dice is thrown. Let A be the event that the number obtained is greater than 3. Let B be the event that the number obtained is less than 5. Then $P(A \cup B)$ is

(a) $\frac{2}{5}$ (b) $\frac{3}{5}$

(c) 0 (d) 1

88. Suppose the cubic $x^3 - px + q$ has three distinct real roots where $p > 0$ and $q > 0$. Then which one of the following holds?

(a) The cubic has maxima at both $\sqrt{\frac{p}{3}}$ and $-\sqrt{\frac{p}{3}}$

(b) The cubic has minima at $\sqrt{\frac{p}{3}}$ and maxima at $-\sqrt{\frac{p}{3}}$

(c) The cubic has minima at $-\sqrt{\frac{p}{3}}$ and maxima at $\sqrt{\frac{p}{3}}$

(d) The cubic has minima at both $\sqrt{\frac{p}{3}}$ and $-\sqrt{\frac{p}{3}}$

89. How many different words can be formed by jumbling the letters in the word MISSISSIPPI in which no two S are adjacent?

(a) $7 \cdot {}^6C_4 \cdot {}^8C_4$ (b) $8 \cdot {}^6C_4 \cdot {}^7C_4$

(c) $6 \cdot 7 \cdot {}^8C_4$ (d) $6 \cdot 8 \cdot {}^7C_4$

90. The perpendicular bisector of the line segment joining $P(1, 4)$ and $Q(k, 3)$ has y-intercept -4. Then a possible value of k is

(a) -4 (b) 1

(c) 2 (d) -2

91. A parabola has the origin as its focus and the line $x = 2$ as the directrix. Then the vertex of the parabola is at

(a) $(2, 0)$ (b) $(0, 2)$

(c) $(1, 0)$ (d) $(0, 1)$

92. The point diametrically opposite to the point $P(1, 0)$ on the circle $x^2 + y^2 + 2x + 4y - 3 = 0$ is

(a) $(3, 4)$ (b) $(3, -4)$

(c) $(-3, 4)$ (d) $(-3, -4)$

93. A focus of an ellipse is at the origin. The directrix is the line $x = 4$ and the eccentricity is $\frac{1}{2}$. Then the length of the semi-major axis is

(a) $\frac{5}{3}$ (b) $\frac{8}{3}$

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

94. The solution of the differential equation

$$\frac{dy}{dx} = \frac{x+y}{x}$$

satisfying the condition $y(1) = 1$ is

(a) $y = x \ln x + x$ (b) $y = \ln x + x$

(c) $y = x \ln x + x^2$ (d) $y = x e^{(x-1)}$

95. Let a, b, c be any real numbers. Suppose that there are real numbers x, y, z not all zero such that $x = cy + bz$, $y = az + cx$ and $z = bx + ay$. Then $a^2 + b^2 + c^2 + 2abc$ is equal to

(a) 1 (b) 2

(c) -1 (d) 0

96. Let A be a square matrix all of whose entries are integers. Then which one of the following is true?

(a) If $\det A = \pm 1$, then A^{-1} need not exist

(b) If $\det A = \pm 1$, then A^{-1} exists but all its entries are not necessarily integers

(c) If $\det A \neq \pm 1$, then A^{-1} exists and all its entries are non-integers

(d) If $\det A = \pm 1$, then A^{-1} exists and all its entries are integers

97. The quadratic equations

$x^2 - 6x + a = 0$ and $x^2 - cx + 6 = 0$

have one root in common. The other roots of the first and second equations are integers in the ratio 4 : 3. Then the common root is

(a) 2 (b) 1

(c) 4 (d) 3

98. The mean of the numbers a, b, 8, 5, 10 is 6 and the variance is 6.80. Then which one of the following gives possible values of a and b?

(a) $a = 3, b = 4$ (b) $a = 0, b = 7$

(c) $a = 5, b = 2$ (d) $a = 1, b = 6$

99. The vector $\vec{a} = \alpha\hat{i} + 2\hat{j} + \beta\hat{k}$ lies in the plane of the vectors $\vec{b} = \hat{i} + \hat{j}$ and $\vec{c} = \hat{j} + \hat{k}$ and bisects the angle between $\vec{b}$ and $\vec{c}$. Then which one of the following gives possible values of α and β?

(a) $\alpha = 1, \beta = 1$ (b) $\alpha = 2, \beta = 2$

(c) $\alpha = 1, \beta = 2$ (d) $\alpha = 2, \beta = 1$

100. The non-zero vectors $\vec{a}, \vec{b}$ and $\vec{c}$ are related by $\vec{a} = 8\vec{b}$ and $\vec{c} = -7\vec{b}$. Then the angle between $\vec{a}$ and $\vec{c}$ is

(a) π (b) 0

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

101. The line passing through the points $(5, 1, a)$ and $(3, b, 1)$ crosses the yz-plane at the point $\left(0, \frac{17}{2}, \frac{-13}{2}\right)$. Then

(a) $a = 8, b = 2$ (b) $a = 2, b = 8$

(c) $a = 4, b = 6$ (d) $a = 6, b = 4$

102. If the straight lines

$$\frac{x-1}{k} = \frac{y-2}{2} = \frac{z-3}{3} \text{ and } \frac{x-2}{3} = \frac{y-3}{k} = \frac{z-1}{2}$$

intersect at a point, then the integer k is equal to

(a) -2 (b) -5

(c) 5 (d) 2

103. The conjugate of a complex number is $\frac{1}{i-1}$. Then

that complex number is

(a) $\frac{1}{i-1}$ (b) $\frac{-1}{i-1}$

(c) $\frac{1}{i+1}$ (d) $\frac{-1}{i+1}$

104. Let R be the real line. Consider the following subsets of the plane $R \times R$:

$S = \{(x, y) : y = x + 1 \text{ and } 0 < x < 2\}$

$T = \{(x, y) : x - y \text{ is an integer}\}$.

Which one of the following is true?

(a) T is an equivalence relation on R but S is not

(b) Neither S nor T is an equivalence relation on R

(c) Both S and T are equivalence relations on R

(d) S is an equivalence relation on R but T is not

105. Let $f: N \to Y$ be a function defined as

$f(x) = 4x + 3$ where

$Y = \{y \in N : y = 4x + 3 \text{ for some } x \in N\}$.

Show that f is invertible and its inverse is

(a) $g(y) = \frac{y-3}{4}$ (b) $g(y) = \frac{3y+4}{3}$

(c) $g(y) = 4 + \frac{y+3}{4}$ (d) $g(y) = \frac{y+3}{4}$

Answer Key
MOCK TEST – 3

Physics

1.A	2.A	3.D	4.D	5.D	6.A	7.C	8.A	9.C	10.D	11.D	12.D	13.*	14.A	15.A
16.D	17.D	18.A	19.C	20.B	21.B	22.C	23.C	24.B	25.D	26.C	27.A	28.B	29.A	30.D
31.C	32.C	33.A	34.D	35.B										

Chemistry

36.A	37.C	38.B	39.C	40.D	41.C	42.A	43.C	44.A	45.A	46.B	47.A	48.D	49.D	50.*
51.C	52.A	53.C	54.D	55.A	56.B	57.B	58.A	59.D	60.A	61.C	62.D	63.C	64.B	65.D
66.C	67.B	68.A	69.D	70.D										

Mathematics

71.A	72.B	73.C	74.D	75.A	76.C	77.B	78.D	79.C	80.A	81.D	82.C	83.C	84.B	85.C
86.C	87.D	88.B	89.A	90.A	91.C	92.D	93.B	94.A	95.A	96.D	97.A	98.A	99.A	10.A
101.D	102.B	103.D	104.A	105.A										

Answer Key
MOCK TEST – 3

Physics

1.A	2.A	3.D	4.D	5.D	6.A	7.C	8.A	9.C	10.D	11.D	12.D	13.*	14.A	15.A
16.D	17.D	18.A	19.C	20.B	21.B	22.C	23.C	24.B	25.D	26.C	27.A	28.B	29.A	30.D
31.C	32.C	33.A	34.D	35.B										

Chemistry

36.A	37.C	38.B	39.C	40.D	41.C	42.A	43.C	44.A	45.A	46.B	47.A	48.D	49.D	50.*
51.C	52.A	53.C	54.D	55.A	56.B	57.B	58.A	59.D	60.A	61.C	62.D	63.C	64.B	65.D
66.C	67.B	68.A	69.D	70.D										

Mathematics

71.A	72.B	73.C	74.D	75.A	76.C	77.B	78.D	79.C	80.A	81.D	82.C	83.C	84.B	85.C
86.C	87.D	88.B	89.A	90.A	91.C	92.D	93.B	94.A	95.A	96.D	97.A	98.A	99.A	10.A
101.D	102.B	103.D	104.A	105.A										