Time : 3 Hr. **JEE ADVANCED TEST SERIES** **Exam Date: 18-09-2020**

Max. Marks : 180

PAPER - 1
PHYSICS
SECTION – I
MULTIPLE CORRECT CHOICE TYPE

This section contains 6 multiple choice questions. Each question has 4 choices A, B, C and D for its answer, out of which ONE OR MORE is/are correct. (+4, –2) 6 x 4 = 24 M

1. Velocity of a particle of mass 2 Kg changes from $\vec{v}_1 = -2\hat{i} - 2\hat{j}\ m/s$ *to* $\vec{v}_2 = \left(\hat{i} - \hat{j}\right)$ m/s after colliding with a smooth plane surface

   A. The angle made by the plane surface with the positive x-axis is $90^0 + \tan^{-1}\left(\frac{1}{3}\right)$

   B. The angle made by the plane surface with the positive x-axis is $\tan^{-1}\left(\frac{1}{3}\right)$

   C. The direction of change in momentum makes an angle $\tan^{-1}\left(\frac{1}{3}\right)$ with the positive x-axis

   D. The direction of change in momentum makes an angle $90^0 + \tan^{-1}\left(\frac{1}{3}\right)$ with the plane surface

2. A uniform solid sphere of radius R rolls without slipping between the rails such that the horizontal distance is $\sqrt{3}$ R between the two contact points of the rails of the ball. Figure (a) shows the front view of the ball and figure (b) shows the side view of the ball. V_{CM} is the velocity of centre of mass of the ball and ω is the angular velocity of the ball after rolling down a distance 2h along the incline then

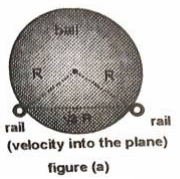


figure (a)

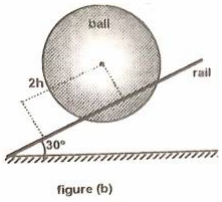
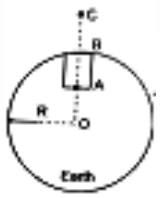


figure (b)

A. $V_{CM} = \omega R$ B. $V_{CM} = \omega \frac{R}{2}$ C. $V_{CM} = \sqrt{\frac{10gh}{13}}$ D. $V_{CM} = \sqrt{\frac{10gh}{7}}$

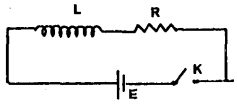
3. First an object is slowly lifted from the bottom (point –A) of a shaft of depth h_1 = R/2 to earth's surface (point – B) and then it is slowly lifted still higher to attain altitude h_2 = R/2, above the earth's surface (point C). W_1 and W_2 are the work performed in two cases respectively. Choose the correct option(s)



A. $W_1 > W_2$ B. $W_1 < W_2$ C. $\left|\frac{W_1 + W_2}{W_1 - W_2}\right| = 17$ D. $\left|\frac{W_1 + W_2}{W_1 - W_2}\right| = 9$

4. The electron in a hydrogen atom moves in circular orbit of radius 5×10^{-11} m with a speed of $0.6\pi \times 10^6$ m/s then
   A. The frequency of the electron is 6×10^{15} rev/s
   B. The electron carries -1.6×10^{-19} C around the loop
   C. The current in the orbit is 0.96 mA
   D. The current flow is in the opposite direction to the direction of the motion of electron

5. Shown in the figure is an R-L circuit. Just after the key (K) in closed



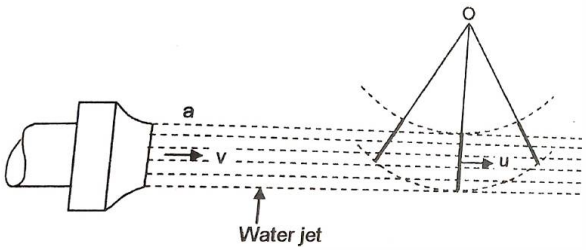
   A. The current in the circuit is zero
   B. Potential drop across the resistor is zero
   C. emf developed across the inductor equals the emf of the battery
   D. No heat is dissipated in the circuit

6. Mark out the correct statement(s)
   A. In alpha decay, the energy released is shared between alpha particle and daughter nucleus in the form of kinetic energy and share of alpha particle is more than that of the daughter nucleus
   B. In beta decay, the energy released is shared between electron and antineutrino
   C. A nuclide undergoes α decay then all the α particles emitted by that nuclide will have almost the same speed
   D. A nuclide undergoes β decay then all the β particles emitted by that nuclide may have widely different speeds

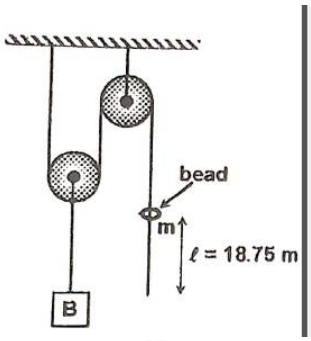
SECTION – II
INTEGER ANSWER TYPE

This section contains 8 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. (+3, 0) 8 x 3 = 24M

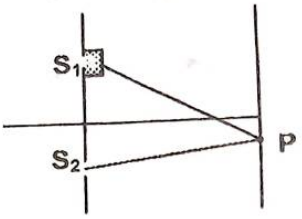
7. A particle having charge 'q' and mass 'm is projected with velocity $\left(4\hat{i}-6\hat{j}+3\hat{k}\right)$m/sec from the origin in a region occupied by electric field 'E' and magnetic field 'B' such that $\vec{B}=B_0\hat{j}$ *and* $\vec{E}=E_0\hat{j}\left(take\frac{qE_0}{m}=2\right)$. Find the time (in sec) when the magnitude of velocity of the charge particle becomes $5\sqrt{5}$ m/sec. (neglect the gravity)
8. A circuit has a self inductance of 1 henry and carries a current of 2A. To prevent sparking when the circuit is broken, a capacitor which can withstand 400 volts is used. Find the least capacitance of the capacitor connected across the switch. (in μF)
9. A ideal gas whose adiabatic exponent equals γ is expanded so that the amount of heat transferred to the gas is equal to twice of decrease of its internal energy. The equation of the process is $TV^{\frac{\gamma-1}{K}}$ = constant (where T and V are absolute temperature and volume respectively). Then find the value of 'K'
10. Two cars A and B are moving towards each other with same speed 25 m/s. Wind is blowing with speed 5 m/s in the direction of motion of car A. The car A blows horn of frequency 300 Hz and the sound is reflected from car B. The wavelength of the reflected sound received by the driver of car A is $\frac{31}{4n}m$. Find n. (velocity of sound in air = 330 m/s)
11. In an under shot water wheel, the cross-sectional area a = 0.1 m^2 of the stream is striking the series of radial flat vanes of the wheel. The velocity of stream is 6 m/s. The velocity of vanes is 3 m/s. if the power supplied by jet (in watts) is 2700 K, find K



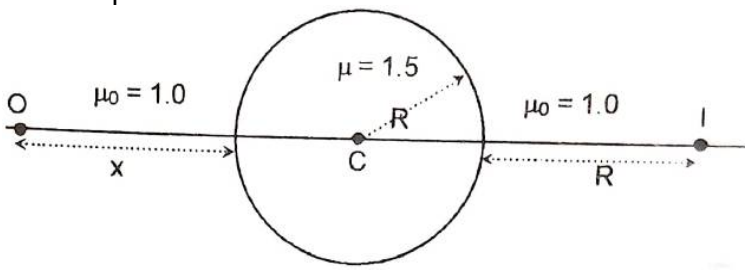
12. In the system shown in the figure, a bead of mass m can slide on the string. There is friction between the bead and the string. Block B has mass equal to twice that of the bead. The system is released from rest with length l = 18.75 m of the string hanging below the bead. Assuming the pulley and string to be massless. Find the distance (in meter) moved by the block B before the bead slips out of the thread.



13. In a young's double slit experiment one of the slit is covered by a thin film of thickness t = 0.04 mm, and refractive index $\mu = 1.2 + \frac{9\times10^{-14}m^2}{\lambda^2}$, where, λ is the wave length in meter. A beam of light consisting two wavelengths λ_1 = 400 nm and λ_2 = 600 nm falls normally on the plane of the slits. Find the distance between two central maxima in millimeter. Distance of screen from slits is 400 times the separation between the slits



14. A glass sphere of refractive index 1.5 forms the real image of object O at point I as shown in the figure when kept in air of refractive index 1. If the value of x is kr. Find k.



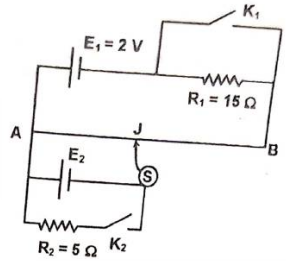
SECTION – III

COMPREHENSION TYPE

This section contains 2 group of questions. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct. (+3, –1) 4 x 3 = 12M

COMPREHENSION – 1

In the circuit shown AB is a 10 Ω uniform slide wire 50 cm long. E_1 is 2 V accumulator of negligible internal resistance R_1 and R_2 are 15Ω and 5 Ω respectively. When $k_1$and k_2 are both open, the galvanometer shows no deflection when AJ = 31.25. When k_1 and k_2 are both closed the balance length AJ = 5cm



15. The emf of the cell E_2

A. 0.5 V B. 1 V C. 1.5 V D. 2 V

16. The internal resistance of the cell E_2

A. 7.5 Ω B. 8Ω C. 10 Ω D. 2Ω

COMPREHENSION – 2

A photocell is operating in saturation mode with a photo current 4.8 mA. When a monochromatic radiation of wavelength 3000 A^0 and power 1W is incident. When another monochromatic radiation of wavelength 1650 A^0 and power 5mW is incident, it is observed that maximum velocity of photoelectron increases to two times assuming efficiency of photo-electron generation per incident photon to be same for both the cases, calculate

17. Threshold wavelength for the cell is

A. 4125 A^0 B. 6925 A^0 C. 5525 A^0 D. 4825 A^0

18. Saturation current in second case is

A. 9.2 μA B. 13.3 μA C. 15.1 μA D. 19.4 μA

CHEMISTRY

SECTION – I

MULTIPLE CORRECT CHOICE TYPE

This section contains 6 multiple choice questions. Each question has 4 choices A, B, C and D for its answer, out of which ONE OR MORE is/are correct. (+4, –2) 6 x 4 = 24 M

19. $CuSO_4\ 5H_2O(s) \Leftrightarrow CuSO_4(s) + 5H_2O(g)$

$K_P = 10^{-10}$ $(atm)^5$. 10^{-2} moles of $CuSO_4 5H_2O(s)$ is taken in a 2.5 L container at 27^0C then at equilibrium [Take : R = 1/12 litre atm mol^{-1} K^{-1}]

A. Moles of $CuSO_4.5H_2O$ left in the container is 9×10^{-3}

B. Moles of $CuSO_4.5H_2O$ left in the container is 9.8×10^{-3}

C. Moles of $CuSO_4$ in the container is 10^{-3}

D. Moles of $CuSO_4$ in the container is 2×10^{-4}

20. The wave function of 3s and $3p_z$ orbitals are given by

$$\psi_{3s} = \frac{1}{9\sqrt{3}}\left(\frac{1}{4\pi}\right)^{1/2}\left(\frac{z}{a_0}\right)^{3/2}\left(6-6\sigma+\sigma^2\right)e^{-\sigma/2}, \quad \psi_{3p_z} = \frac{1}{9\sqrt{6}}\left(\frac{3}{4\pi}\right)^{1/2}\left(\frac{z}{a_0}\right)^{3/2}(4-\sigma)\sigma e^{-\sigma/2}\cos\theta$$

where $\sigma = \frac{2zr}{na_0}$, a_0 = first Bohr radius, z = Charge number of nucleus, r = distance from nucleus

From these we can conclude

A. Number of nodal surface for $3p_z$ & 3s orbitals are equal

B. The angular nodal surface of $3p_z$ orbital occur at $\theta = \pi/2$

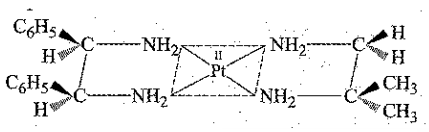
C. The radial nodal surfaces of 3s orbital and $3p_z$ oribitals are at equal distance from the nucleus

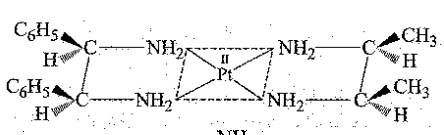
D. 3s electrons have greater penetrating power into the nucleus compared to 3p electrons

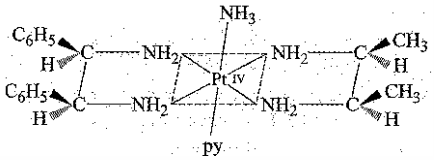
21. In which of the following compound(s) F atoms(s) can occupy any position around central atom?

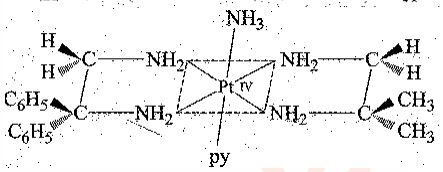
A. PCl_4F B. CH_3F C. BrF_3 D. PCl_5F^-

22. Select optically active complex(es)

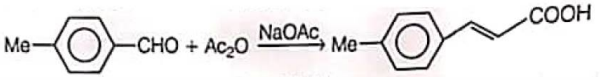
A. 

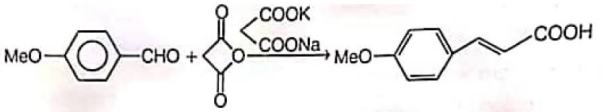
B. 

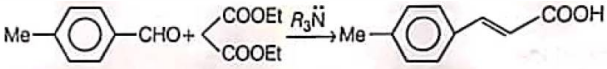
C. 

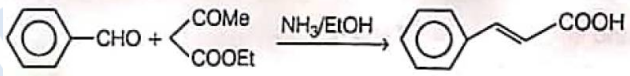
D. 

23. Which of the following reactions are Perkin reactions?

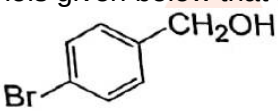
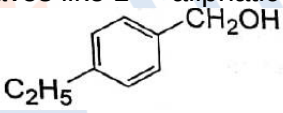
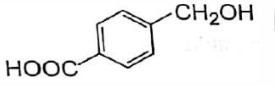
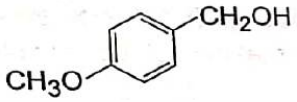
A. 

B. 

C. 

D. 

24. Alcohols given below that behaves like 1^0 – aliphatic alcohol in Lucas test is/are

A.  B.  C.  D. 

SECTION – II
INTEGER ANSWER TYPE

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25. 0.2 g of a non-volatile and non-electrolytic substance is present in 300 ml of a solution and the solution shows an osmotic pressure of 38 cm Hg at 27^0C.The molecular weight of the substance is (ab.cd) then 'b' is

26. 8g of a mixture of Na_2CO_3 and Na_2SO_4 is dissolved in water and the volume of the solution made upto 250 ml. 25ml of this solution required 20ml of $\frac{N}{10}$ H_2SO_4 solution for neutralization. The percentage of Na_2CO_3 in the mixture is (ab.cd), then (c+d) is

27. At 300 K temperature and 8 atm pressure the compressibility factor for a real gas is 0.8. The volume (in litre) of 10 mole of the gas at same temperature and pressure is (ab.cd), then 'c' is

28. Find the number of native ores out of given ores

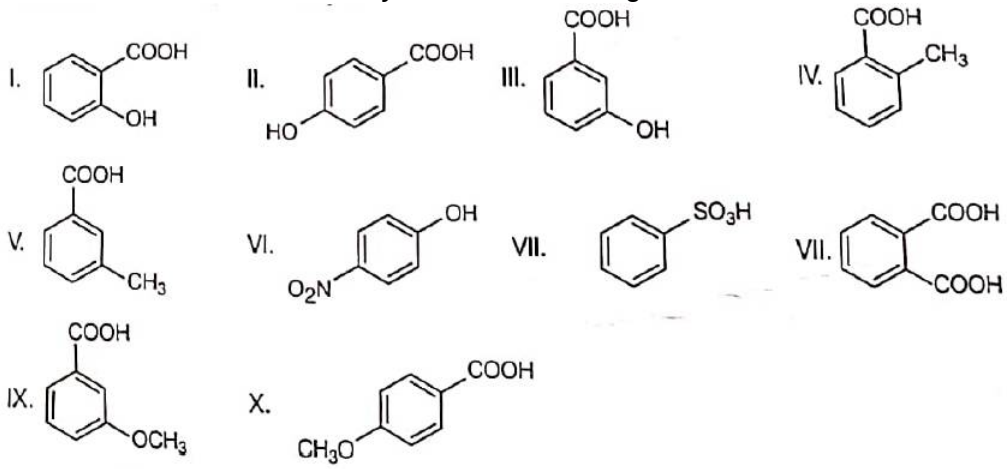
Pyrolusite, Chromite, Siderite, Cassiterite, Calamine, Argentite, Lime stone, Chalcopyrites

29. Total number of moles of P–H bond(s) in products when one mole of white phosphorus completely reacts with KOH solution

30. Find the maximum number of identical B–O–B linkages present in anionic part of borax

31. How many isomers exist for $C_5H_{11}ON$ that on treatment with $NaOH/Br_2$ give amines?

32. From the list below, how many of them are stronger acid than benzoic acid?



SECTION – III

COMPREHENSION TYPE

This section contains 2 group of questions. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct. (+3, –1) 4 x 3 = 12M

COMPREHENSION – 1

It is observed that when acids and bases react, some energy is released due to neutralization reaction. While in case of strong acids and bases, the energy released is greater, in case of weaker acids or bases, energy released will be lesser. The difference is attributed to energy required for ionization. From the above information and data below answer the questions that follow.

$\Delta H_{neutralization\ SA/SB}$ = –57.5 kJ/equivalent $\Delta H_{ionization}$ of $H_2C_2O_4$ = 20 kJ/mole.

$\Delta H_{ionization}$ of NH_4OH = 10 kJ/mole.

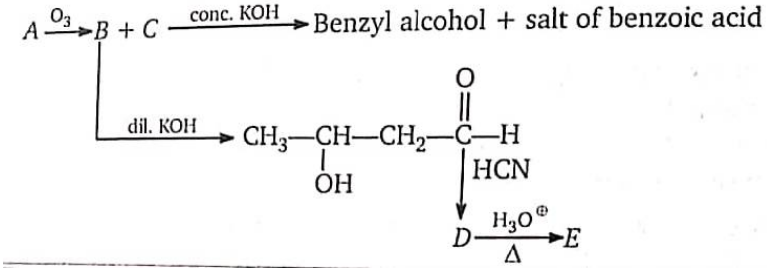
33. What will be the energy released when 500 ml of 0.1 M H_2SO_4 solution reacts with 1L of 0.1 M NH_4OH solution if the base is 30% ionized in the given solution?

A. 5.75 kJ B. 4.75 kJ C. 5.05 kJ D. 5.45 kJ

34. What will be the final temperature attained if all the heat released in neutralization of 1L of 0.2 M NH_4OH with 2L of 0.1 M HCl increases the temperature of the final solution having density 0.95 gm/ml and specific heat capacity = 1/3 J/gm^0 C if original temperature was 27^{0}C? Assume weak base to be completely unionized.

A. 312^{0}C B. 300 K C. 312 K D. 290 K

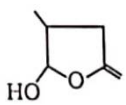
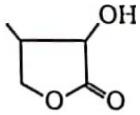
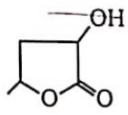
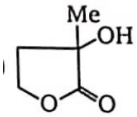
COMPREHENSION – 2



35. Structure of (B) and (C) differentiated by

A. Tollen's reagent B. Fehling solution C. 2,4-DNP D. $NaHSO_3$

36. Structure of E is

A.  B.  C.  D. 

MATHEMATICS

SECTION – I

MULTIPLE CORRECT CHOICE TYPE

This section contains 6 multiple choice questions. Each question has 4 choices A, B, C and D for its answer, out of which ONE OR MORE is/are correct. (+4, –2) 6 x 4 = 24 M

37. Let f(x) = $x^{13} + 2x^{12} + 3x^{11}+\ldots+13x + 14$ and $\alpha = \cos\frac{2\pi}{15} + i\sin\frac{2\pi}{15}, \left(i = \sqrt{-1}\right)$. If N = f(α). f($\alpha^2$). f($\alpha^3$)….f($\alpha^{14}$) then
   A. Number of divisors of N is 196
   B. Number of divisors of N is 256
   C. Number of divisors of N which are perfect square is 49
   D. Number of divisors of N which are perfect cubes is 25

38. The number $\left(\frac{2^{10}}{11}\right)^{11}$ is
   A. Strictly larger than $(^{10}C_1)^2(^{10}C_2)^2(^{10}C_3)^2(^{10}C_4)^2(^{10}C_5)$
   B. Strictly larger than $(^{10}C_1)^2(^{10}C_2)^2(^{10}C_3)^2(^{10}C_4)^2$ but strictly smaller than $(^{10}C_1)^2(^{10}C_2)^2(^{10}C_3)^2(^{10}C_4)^2(^{10}C_5)$
   C. Less than or equal to$(^{10}C_1)^2(^{10}C_2)^2(^{10}C_3)^2(^{10}C_4)^2$
   D. Equal to $(^{10}C_1)^2(^{10}C_2)^2(^{10}C_3)^2(^{10}C_4)^2(^{10}C_5)$

39. The equation $\frac{1}{(x+1)^5} - 7x + 2\sin x = 0$ has
   A. One positive root B. One negative root C. Three real roots D. No real rot in (–1, 0)

40. If $\left|\int_a^b f(x)dx\right| = \int_a^b \left|f(x)dx\right|, (a \neq b)$ also f(x) ≠ 0 fro any x∈ (a, b) and $g(x) = \int_0^x f(x)dx$, *then* $\int_a^b f(x).g(x)dx$ is, where a > 0, b > 0
   A. Can be positive B. Can be negative C. Can not be zero D. Cannot say any thing

41. Choose the correct statement
   A. Each focal chord subtends an obtuse angle at the vertex of the parabola
   B. An ellipse whose one of the focus being fixed at a point P, is sliding along two fixed straight lines L_1 and L_2 (P does not lie on any L_1 and L_2), then locus of its cnentre is a circle
   C. A triangle of 8 sq units area is inscribed in parabola $y^2 = 4x$. Then sum of absolute difference of ordinates of vertices, taken pair wise is always greater than 12
   D. A pair of tangents are drawn to $x^2 - \frac{y^2}{4} = 1$ from a point (2, 7/2), then both points of contact will lie in 1st quadrant

42. If M and N are orthogonal matrix of order 3 then which of the following is/are orthogonal matrix
   A. M^{2017} B. M^TN C. M^2N^2 D. MN

SECTION – II

INTEGER ANSWER TYPE

This section contains 8 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. (+3, 0) 8 x 3 = 24M

43. Number of ways of covering a 3 × 14 chess board with tiles of 3 × 1 size is K, then the value of [K/20] is where [.] is G.I.F_____

44. Let 'n' be the number of the form 9^x where 0 ≤ x≤ 4000, have left most digit 9, given that 9^{4000} has 3817 digits and that its left most digit is 9 then n is equal to

45. Let f(x) satisfies the requirements of LMVT in (0, 2). If f(0) = 0 and $\left|f'(x)\right| \le \frac{1}{2} \forall x \in (0,2)$, then the maximum value of |f(x)| is

46. Let f : R → R be a continuous function and $\int_{-\infty}^{\infty} f(x)dx = l$. If $\int_{-\infty}^{\infty} f\left(x - \frac{1}{x}\right)dx = kl$, then the value of 'K' is

47. Point 'O' is the centre of the ellipse with major axis AB and minor axis CD. Point F is one focus of ellipse. If OF = 6 and the diameter of the inscribed circle of ΔOCF is 2, if the product AB.CD is a two digited number then its unit digit is

48. Three circles of radii 11, 11 and 50 units are touching each other externally and a fourth circle of radius r is placed such that it touches all 3 circle externally then [r] is equal to

49. If x, y, z ∈R, x + y + z = 4, $x^2 + y^2 + z^2 = 6$. Then the maximum value of z is

50. OA, OB, OC are the sides of a rectangular parallelepiped whose diagonals are OO', AA', BB' and CC'. D is the centre of rectangle $AC'O'B'$ and D' is centre of rectangle $O'A'CB'$. If sides OA, OB, OC are in ratio 1 : 2 : 3 and $\angle DOD' = \alpha$ then $\frac{697\cos^2\alpha}{128}$ is (centre of rectangle is mid point of diagonal)

SECTION – III

COMPREHENSION TYPE

This section contains 2 group of questions. Each group has 2 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct. **(+3, –1) 4 x 3 = 12M**

COMPREHENSION – 1

Saina is to play with sharapova in a three set match. For a particular set, the probability of saina winning the set is 'y' and if she wins probability of her winning the next set becomes $\sqrt{y}$ else the probability that she wins the next one becomes 'y^2'. There is no possibility that a set is to be abandoned. R is probability that sains win the first set

51. If R = 1/2 then the probability that match will end in first two sets is nearly equal to
A. 0.73 B. 0.95 C. 0.51 D. 0.36

52. If R = 1/2 and saina wins the second set then probability that she has won first set as well is nearly equal to
A. 0.74 B. 0.46 C. 0.26 D. 0.54

COMPREHENSION – 2

Consider the areas S_0, S_1,S_2, bounded by the x-axis and half waves of the curve $y = e^{-x}\sin x$, $x \geq 0$.

Now answer the following

53. The value of S_0 is
A. $\frac{1}{2}\left(1+e^{\pi}\right)$ B. $\frac{1}{2}\left(1+e^{-\pi}\right)$ C. $\frac{1}{2}\left(1-e^{-\pi}\right)$ D. $\frac{1}{2}\left(e^{\pi}-1\right)$

54. If the sequence S_0, S_1, S_2… forms a G.P, then the common ratio is
A. $\frac{e^{\pi}}{2}$ B. e^{π} C. $\frac{e^{-\pi}}{2}$ D. $e^{-\pi}$

THE–END