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CODE

Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005, Phone : 011-47623456

Time : 3 hrs **MM : 264**

MOCK TEST - 1

for JEE (Advanced) - 2022

Paper - 1

Mock Test on Complete Syllabus

General Instructions:

1. Read each question carefully.
2. It is mandatory to use blue/black ballpoint pen to darken the appropriate circle in the answer sheet.
3. Mark should be dark and should completely fill the circle.
4. Rough work must not be done on the answer sheet.
5. Do not use white-fluid or any other rubbing material on answer sheet.
6. Student cannot use log table and calculator or any other material in the examination hall.
7. Before attempting the question paper, student should ensure that the test paper contains all pages and no page is missing.
8. Before handing over the answer sheet to the invigilator, candidate should check that Roll No., Centre Code and Date of Birth have been filled and marked correctly.
9. Immediately after the prescribed examination time is over, the answer sheet is to be returned to the invigilator.
10. **Pattern of the questions are as under:**

    The question paper consists of 3 parts (Physics, Chemistry and Mathematics). Each part has **3 sections.**

    (i) **Section-1:** This section contains **8** questions. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. Each question carries **+4 marks** for correct answer. There is no negative mark for wrong answer.

    (ii) **Section-2:** This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.** Each question carries **+4 marks** for correct answer, **0 mark** if not attempted and **–2 marks** for wrong answer.

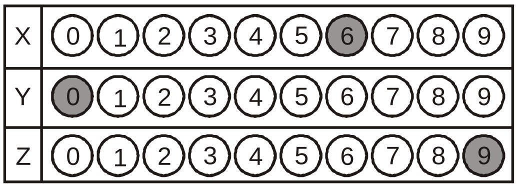
    (iii) **Section-3:** This section contains **2** questions. Each question contains two Columns (Column I and Column II). Column I has four entries (A), (B), (C) and (D), Column II has five entries (P), (Q), (R), (S) and (T). Match the entries in Column I with the entries in Column II. Each entry in Column I may match with one or more entries in Column II. Each entry in Column I carries **+2 marks** for correct answer, **0 mark** if not attempted and **–1 mark** for wrong answer.

PART – I : PHYSICS

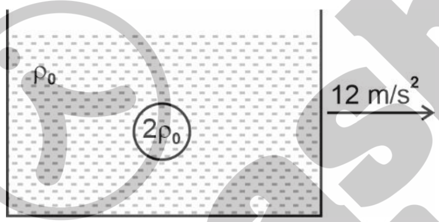
SECTION - 1

Integer Value Type

This section contains 8 questions. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively.



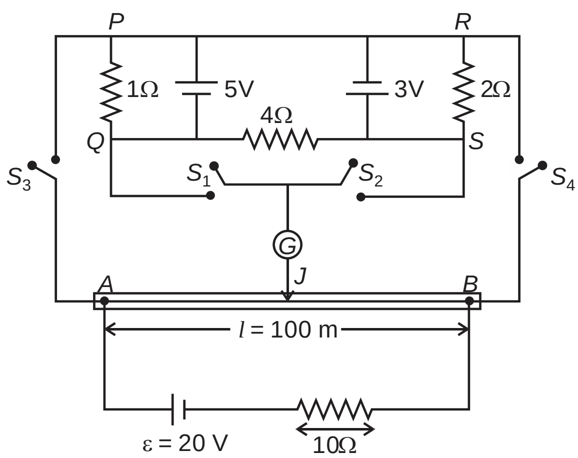
1. A vessel containing liquid of density ρ_0 is accelerated horizontally with constant acceleration 12 m/s^2 in gravity free space. A small sphere of density $2\rho_0$ is released from rest with respect to the vessel. Magnitude of initial horizontal acceleration of sphere with respect to vessel is _____ m/s^2



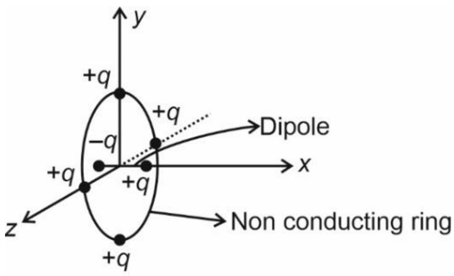
2. Two objects are placed on the principal axis of a thin converging lens. One is 10 cm from the lens and the other is on the other side of the lens at a distance of 40 cm from the lens. The images of both the objects are at the same point on the axis. If focal length of the lens (in cm) is 4 × *k*, than find *k.*

3. A body of mass 4 kg starts moving with velocity v_0 in a straight line in such a way that on the body work is being done at the rate which is proportional to the square of velocity and the constant of proportionality is $\ln(\sqrt{2})$. Find the time elapsed (in seconds) before velocity of body is doubled.

4. Figure shows a potentiometer connected to an external circuit. At an instant either switch S_1 and S_3 is closed or S_2 and S_4 is closed. When switch S_1 and S_3 is closed null point is attained at J_1($AJ_1 = l_1$) and when S_2 and S_4 is closed it is attained at J_2($BJ_2 = l_2$). If sum of l_1 and l_2 in cm is k × 10, then find k (Resistance of wire AB = 10 Ω)

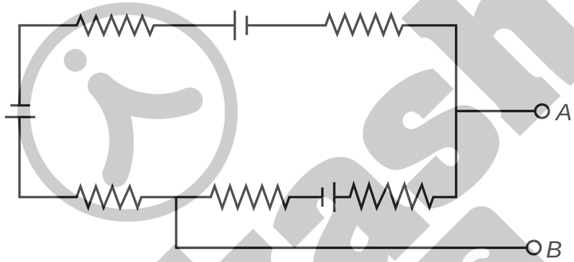


5. An electric dipole placed along x-axis with its dipole moment vector pointing along positive x-axis is placed at the centre of wire frame as shown in figure. A fixed circular wire frame lies in y-z plane with four identical charges each of charge $+q$ is fixed to wire frame. What is work done (in Joule) by an external agent in slowly turning the dipole through 180° from initial orientation of dipole moment vector?

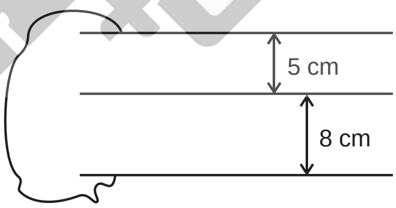


Radius of ring : R = 1 cm
Length of dipole : r = 1 mm
Charge : q = 1 μC

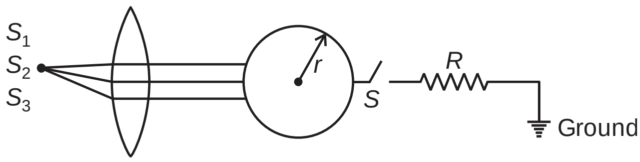
6. In the shown circuit, all five resistors have the same value 100 ohms and each cell has an electromotive force of 15 volts. Find the potential difference (in volts) between points B and A.



7. Three conducting plates are placed parallel to one another as shown in the figure. The outer plates are neutral and connected by a conducting wire. The inner plate is isolated and carries a total charge amounting to 10 μC. The charge densities on upper and lower face of middle plate are σ_1 and σ_2. Find $\frac{5\sigma_1}{\sigma_2}$



8. Three monochromatic sources having wavelengths 12.42 nm, 6.21 nm and 24.84 nm are placed close to each other in front of a converging lens such that equal powers from the three equal to 1 mW each fall on a converging lens and then on a small spherical conductor of radius r = 1 cm and work function 62.1 eV. (Assume 50% efficiency of emission and no change in effective value of work function due to photoelectric emission and potential rise, use hc = 1242 eV-nm, all electrons emitted by the sphere are immediately removed by some non-electrical mechanism). At t = 8 second switch S is closed so that the sphere gets connected to the earth via resistor of value 6.75 MΩ. Find the current (in A) flowing just after the switch is closed.



SECTION - 2

One or More Options Correct Type

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.**

9. A hypothetical pulse is travelling along positive x direction on a taught string. The speed of pulse is 10 cm/s and shape of pulse at t = 0 is given as

$$y = \frac{x}{6} + 1 \qquad \text{for } -6 \le x \le 0$$

$$= -x + 1 \qquad \text{for } 0 \le x < 1$$

$$= 0 \qquad \text{for all other value of } x$$

If x and y are in cm, then

(A) Vertical displacement of the particle at x = 1 cm at t = 0.2 s is $\frac{5}{6}$ cm

(B) Vertical displacement of the particle at x = 1 cm at t = 0.2 s is $\frac{4}{3}$ cm

(C) Transverse velocity of the particle at x = 1 cm at t = 0.2 s is $-\frac{5}{3}$ cm/s

(D) Transverse velocity of the particle at x = 1 cm at t = 0.2 s is $\frac{4}{3}$ cm/s

10. Two skaters, initially at rest, are 5 m apart. They each have one end of a single rope and each pull on the rope with a force of 50 N for a period of 1 s. One skater weighs 80 kg and the other weighs 45 kg. (Assume no friction between the skates and the ice)

(A) The two skaters meet at a distance of 1.8 m from the initial position of the heavy skater

(B) The two skaters meet at a distance of 3.2 m from the initial position of the heavy skater

(C) The relative velocity of the skaters when they meet is 125/72 m/s

(D) The relative velocity of the skaters when they meet is 25/72 m/s

11. An ideal gas in enclosed in a vertical conducting cylinder with a massless piston. The piston is raised slowly and isothermally by a person. Choose the correct option(s)

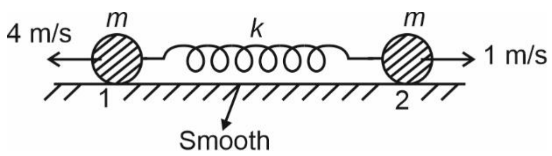
(A) Heat is dissipated in the process by the gas

(B) Heat is absorbed in the process by the gas

(C) A variable force has to be applied by the person lifting the piston

(D) A constant force has to be applied by the person lifting the piston

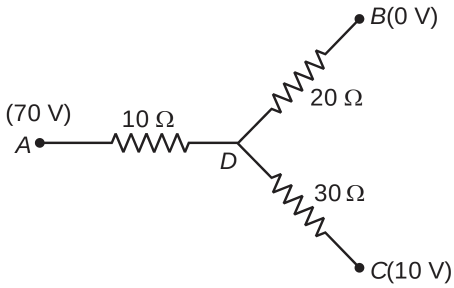
12. Velocities of two identical point masses connected at the ends of ideal spring is shown in figure. Spring was in its natural length at this moment. If v_1 and v_2 are respectively maximum and minimum velocity of mass 1 during its motion, then



(A) v_1 = 4 m/s (B) v_2 = 0

(C) v_1 = 2 m/s (D) v_2 = 1 m/s

13. In the network shown, points A, B and C are at potentials of 70 V, zero and 10 V respectively



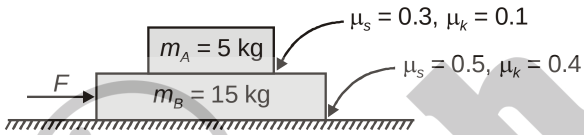
(A) Point D is at a potential of 40 V

(B) The currents in the sections AD, DB, DC are in the ratio 3 : 2 : 1

(C) The currents in the sections AD, DB, DC are in the ratio 1 : 2 : 3

(D) The network draws a total power of 200 W

14. A horizontal force F is applied on block B as shown in the figure. Now



(A) Magnitude of limiting frictional force on A = 15 N

(B) Magnitude of limiting frictional force on B = 100 N through the ground

(C) If F = 50 N then frictional force between A and B is zero

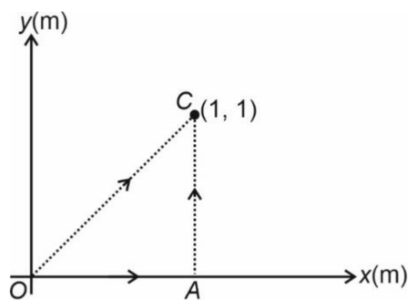
(D) If F = 110 N then frictional force between A and B is 2.5 N

15. White light is used to illuminate the two slits in a Young's double slit experiment. The separation between the slits is d and the screen is at a distance $D(>>d)$ from the slits. At a point on the screen directly in front of one of the slit, certain wavelengths are missing. Some of these missing wavelengths are

(A) $\lambda = \dfrac{d^2}{D}$ (B) $\lambda = \dfrac{2d^2}{D}$

(C) $\lambda = \dfrac{d^2}{3D}$ (D) $\lambda = \dfrac{2d^2}{3D}$

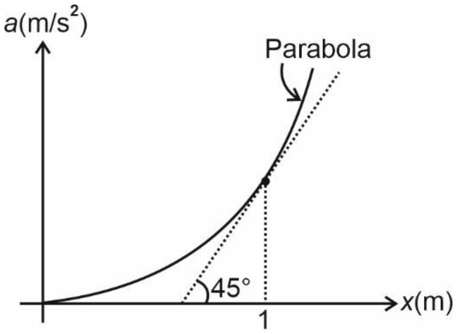
16. A particle of mass 1 kg is taken from point O to point C, under the action of force $\vec{F} = x^2y^2(\hat{i} + \hat{j})$ N. If W_1 and W_2 denote the work done by the force in path $O \to A \to C$ and $O \to C$ respectively then (x, y are in metre)



(A) $W_1 = \dfrac{1}{3}$ J (B) $W_1 = \dfrac{2}{5}$ J

(C) $W_2 = \dfrac{2}{5}$ J (D) $W_2 = \dfrac{1}{3}$ J

17. Variation of acceleration of a particle moving along x-axis is shown in figure where x-axis behaves as tangent to the parabola at origin. If particle starts its motion form $x = 0$ from rest, then



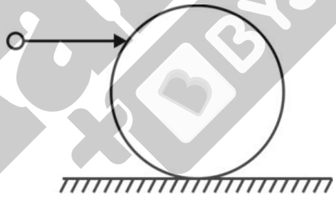
(A) x-coordinate of the particle upon its velocity become 1 m/s is $(3)^{1/3}$ m

(B) At $x = 2$ m, velocity of the particle will be $\left(\frac{8}{3}\right)^{1/2}$ m/s

(C) At $x = 2$ m, velocity of the particle will be $\left(\frac{4}{3}\right)^{1/2}$ m/s

(D) At $x = 2$ m, acceleration of the particle will be 2 m/s^2

18. A hollow sphere of radius R rests on a horizontal surface of finite coefficient of friction. A point object of mass m moved horizontally and hits the sphere at a height of $\frac{R}{2}$ above its centre. The collision is instantaneous and point object sticks to sphere after collision. Which of the following is/are correct if object and hollow sphere is taken as a system?



(A) Total linear momentum of the system is not conserved

(B) Total angular momentum about center of mass of the system remains conserved

(C) The sphere gets finite angular velocity immediately after collision

(D) The sphere moves with finite speed immediately after collision

SECTION - 3
Matching Column Type

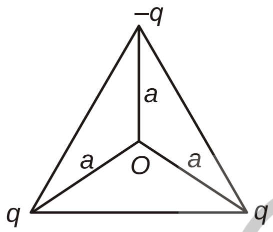
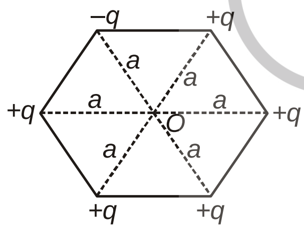
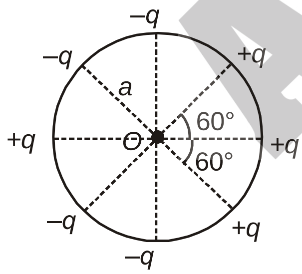
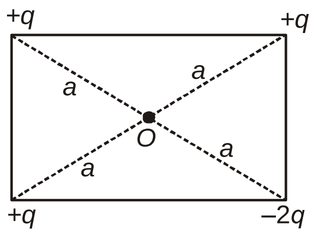
This section contains 2 questions. Each question contains two Columns (Column I and Column II). Column I has four entries (A), (B), (C) and (D), Column II has five entries (P), (Q), (R), (S) and (T). Match the entries in Column I with the entries in Column II. Each entry in Column I may match with one or more entries in Column II. The OMR contains a 4 × 5 matrix whose layout will be similar to the one shown below :

For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in Column I matches with entries (Q), (R) and (T), then darken these three bubbles in the OMR. Similarly, for entries (B), (C) and (D).

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

19. Consider the arrangements of point charges in Column-I and in Column-II magnitude of possible electric field (E) and electric potential (V) at point O are given. (Assume potential at infinity to be zero) $\left(k = \dfrac{1}{4\pi\varepsilon_0}\right)$

Match the entries in Column-I with Column-II.

	Column-I		Column-II
(A)		(P)	$V_0 = \dfrac{kq}{a}$
(B)		(Q)	$V_0 = \dfrac{2kq}{a}$
(C)		(R)	V_0 = Zero
(D)		(S)	$E_0 = \dfrac{2kq}{a^2}$
		(T)	$E_0 = \dfrac{3kq}{a^2}$

20. Match the following

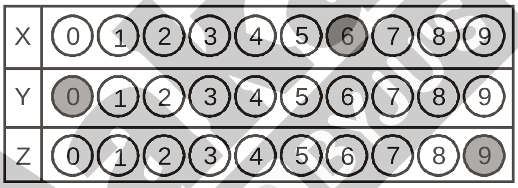
	Column-I		Column-II
(A)	The voltage applied to the X-ray tube is increased	(P)	The average kinetic energy of the electrons decreases.
(B)	In photoelectric effect work function of the target is increased	(Q)	The average kinetic energy of the electron increases.
(C)	The de-Broglie wavelength of β-rays is increased	(R)	The intensity increases
(D)	The de-Broglie wavelength of β-rays is decreases	(S)	The cut-off wavelength decreases
		(T)	The cut-off wavelength remains unchanged

PART – II : CHEMISTRY

SECTION - 1

Integer Value Type

This section contains 8 questions. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively.



21. Two gases in adjoining vessels were brought into contact by opening a stopcock between them. The one vessel measured 0.250 L and contained NO at 1200 torr and 220 K; the other measured 0.150 L and contained O_2 at 900 torr and 220 K. The reaction to form N_2O_4(s) exhausts the limiting reactant completely. Neglecting the vapour pressure of N_2O_4, the pressure of the gas remaining (in torr) at 220 K after completion of the reaction is P. What is the value of $\frac{P}{15}$?

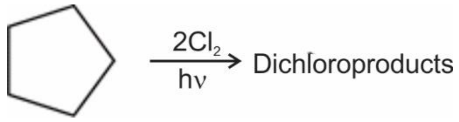
22. A solution is prepared by dissolving 10 g of non-volatile solute in 180 g of H_2O. If the relative lowering of vapour pressure is 0.005, the mol. wt. of the solute is x × 10^2 g/mol. What is the value of x?

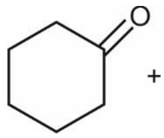
23. $KMnO_4$ oxidizes X^{n+} ion to XO_3^-, itself changing to Mn^{2+} in acid solution. 2.68 × 10^{-3} mole of X^{n+} requires 1.61 × 10^{-3} mole of MnO_4^-. Find the value of n. If the weight of 1g equivalent of XCl_n is 84, the atomic mass of X is (a × 10 + b). What is the value of $\frac{a+b}{n}$? (e.g. if atomic mass of X = 68; it is written as 6 × 10 + 8)

24. The internal energy change in the conversion of 1.0 mole of the calcite form of $CaCO_3$ to the aragonite form is +0.21 kJ. Calculate the enthalpy change when the pressure is 1.0 bar, given that the densities of the solids are 2.71 g cm^{-3} and 2.93 g cm^{-3} respectively. Express your answer as (ΔH/35) in J mol^{-1}.

25. A drop of solution (0.05 mL) contains 6.0 ×10^{-7} mole of H^+. If the rate constant of disappearance of H^+ is 6.0 × 10^5 mol L^{-1} s^{-1}, it takes x × 10^{-8} second for H^+ in the drop to disappear. What is the value of x?

26. How many dichloroproducts are formed in the following reaction (including stereoisomers)?



27.  + $CH_3NO_2 \xrightarrow[\Delta]{NaOH}$ (A) (major product)

If M is the molecular mass of A then find the sum of digits of M.

28. Let x be the co-ordination number of a lattice point of a 3D solid having ABAB.... packing, y be the co-ordination number of a lattice point of a 3D solid having ABC ABC packing, z be the co-ordination number of 2 dimensional H.C.P. arrangement and w be the effective number of atoms per unit cell for three dimensional H.C.P. arrangement then find the value of $\frac{xy}{zw}$.

SECTION - 2

One or More Options Correct Type

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.**

29. Colloidal solution can be purified by

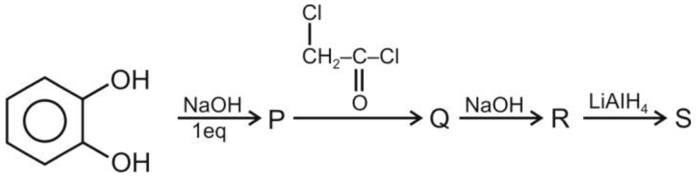
(A) Dialysis
(B) Electrodialysis
(C) Electrophoresis
(D) Ultrafiltration

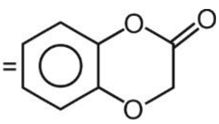
30. A two litre vessel contains 4 moles of N_2O_5. On heating to 100°C, N_2O_5 undergoes complete dissociation to NO_2 and O_2. Mark out the correct inference(s) if rate constant for decomposition of N_2O_5 is 6.2×10^{-4} sec^{-1}.

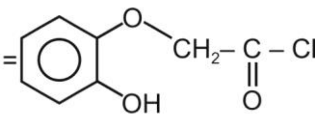
(A) Half life of N_2O_5 is 117 sec and is independent of temperature
(B) The mole ratio of reaction mixture before and after 40% dissociation of N_2O_5 is 5 : 7
(C) The time required to dissociate 40% of N_2O_5 is 824.6 sec [use log 6 = 0.778]
(D) If volume of container is doubled, the rate of decomposition becomes half of the initial rate

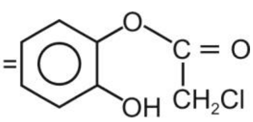
31. Aqueous solution of potassium propanoate is electrolysed. Possible organic products are

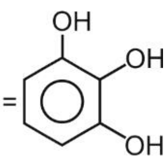
(A) n-Butane
(B) $C_2H_5COOC_2H_5$
(C) $H_3C–CH_3$
(D) $H_2C = CH_2$

32. 

(A) R = 

(B) Q = 

(C) Q = 

(D) S = 

33. Which of the following statement(s) is/are correct?

(A) In many α- and β– decay processes γ-radiation is emitted

(B) The nuclear isomers produced by γ-ray bombardment have the same atomic and mass numbers but differ in their life-times

(C) γ – radiation is very penetrating, relative to α and β particles

(D) A nucleus in an excited state may lose its excitation energy and return to the ground state by the emission of electromagnetic γ-radiation.

34. Which of the following statement(s) is/are incorrect about given aqueous solutions?

(A) 0.1 M KCl solution will have the same osmotic pressure as 0.1 M glucose solution

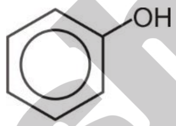
(B) 0.1 M KCl solution will have the same boiling point as 0.1 M urea solution

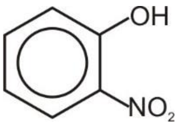
(C) 0.1 m glucose and 0.1 m urea are isotonic

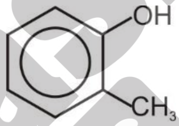
(D) 0.1 m $MgCl_2$ solution will have less relative lowering of vapour pressure than 0.1 m NaCl

35. Which of the following compound(s) is/are the more acidic than ethanol?

(A) $Cl—CH_2—CH_2—OH$

(B) 

(C) 

(D) 

36. Which of the following represents correct order w.r.t. property indicated?

(A) $NH_2—NH_2 < NH_2OH < N_2O < N_2O_3$ Oxidation state of N

(B) $I_2 < Br_2 < Cl_2 < F_2$ Oxidising nature

(C) $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$ Boiling point

(D) Cs < Na < K < Rb Reducing nature

37. Which of the following statements is/are correct?

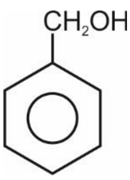
(A) LiH > NaH > KH > RbH > CsH (Thermal stability)

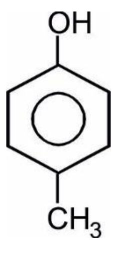
(B) KO_2 is paramagnetic in nature

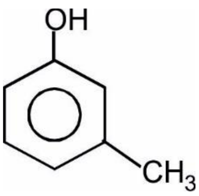
(C) Milk of magnesia is used as antabase

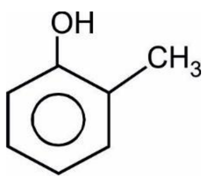
(D) $BeCl_2$ has polymeric structure in solid state

38 What could be the structure of compound (A) if it neither dissolves in aq. $NaHCO_3$ nor gives a characteristic colour with $FeCl_3$?

(A) 

(B) 

(C) 

(D) 

SECTION - 3

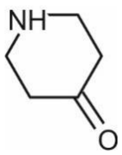
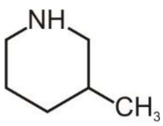
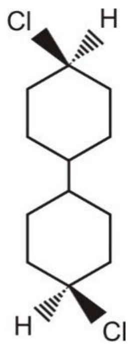
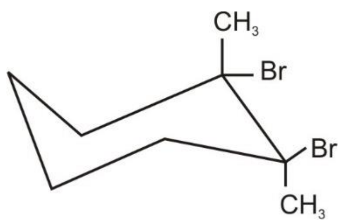
Matching Column Type

This section contains 2 questions. Each question contains two Columns (Column I and Column II). Column I has four entries (A), (B), (C) and (D), Column II has five entries (P), (Q), (R), (S) and (T). Match the entries in Column I with the entries in Column II. Each entry in Column I may match with one or more entries in Column II. The OMR contains a 4 × 5 matrix whose layout will be similar to the one shown below :

For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in Column I matches with entries (Q), (R) and (T), then darken these three bubbles in the OMR. Similarly, for entries (B), (C) and (D).

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

39. Match Column I with Column II.

	Column-I (Organic Compounds)		**Column-II (Properties)**
(A)		(P)	Plane of symmetry is present
(B)		(Q)	Optically active
(C)		(R)	Plane of symmetry is absent
(D)		(S)	Optically inactive
		(T)	Two chiral centres

40. Match Column I with Column II.

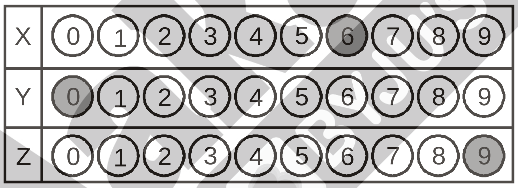
	Column-I (Complex/Ligand)		**Column-II (Formula/Magnetic behaviour/Denticity of ligand)**
(A)	Double salt	(P)	$K[PtCl_3(C_2H_4)]$
(B)	Zeise's salt	(Q)	Hexadentate
(C)	$[Pt(gly)_2]$	(R)	Bidentate
(D)	EDTA	(S)	Diamagnetic
		(T)	$FeSO_4.(NH_4)_2SO_4.6H_2O$

PART – III : MATHEMATICS

SECTION - 1

Integer Value Type

This section contains 8 questions. The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively.



41. A particle starts to travel from a point P on the curve C_1 : $|z - 3 - 4i| = 5$, where $|z|$ is maximum. From P, the particle moves through an angle $\tan^{-1}\dfrac{3}{4}$ in anticlockwise direction on $|z - 3 - 4i| = 5$ and reaches at point Q. From Q, it comes down parallel to imaginary axis by 2 units and reaches at point R. Complex number corresponding to point R in the Argand plane is $a + ib$. The value of $|a - b|$ is equal to

42. Let $t_{100} = \sum_{r=0}^{100} \dfrac{1}{\left({}^{100}C_r\right)^5}$ and $S_{100} = \sum_{r=0}^{100} \dfrac{r}{\left({}^{100}C_r\right)^5}$, then the value of $\sec\left(\cos^{-1}\left(\dfrac{S_{100}}{100t_{100}}\right)\right)$ equals

43. Let $\lim_{x\to\infty} x \ln\left(e\left(1+\dfrac{1}{x}\right)^{1-x}\right)$ equals $\dfrac{m}{n}$ where m and n are relatively prime positive integer. Find $(m + n)$.

44. If the expression $\cos^2\dfrac{\pi}{11}+\cos^2\dfrac{2\pi}{11}+\cos^2\dfrac{3\pi}{11}+\cos^2\dfrac{4\pi}{11}+\cos^2\dfrac{5\pi}{11}$ has the value equal to $\dfrac{p}{q}$ in their lowest form, then find $|p-q|$.

45. Let A, B, C be three square matrices of same order with real entries $BA + BC + AC = I$ and $\det(A + B) = 0$ then $\det(A + B + C - ABC)$ equals

46. A cubical die with faces marked 1, 2, 3, …, 6 is loaded such that the probability of throwing the number t is proportional to t^2. If the probability that the number 5 has appeared given that when the die is rolled the number turned up is not even, is $\frac{m}{n}$, where m and n are relatively prime positive integers, then value of $(n - m)$ is

47. Find the value of m ($m > 0$) for which the area bounded by the line $y = mx + 2$ and $x = 2y - y^2$ is 9/2 square units.

48. Let n be the number of values of x satisfying $\left[\frac{3x^2 - 2x + 1}{2}\right] = \frac{x+1}{2}$.

Find the value of $\frac{1}{\pi}\left(\sin^{-1}\frac{1}{n} + \tan^{-1}\frac{1}{n} + \sec^{-1}\left(\frac{-1}{n}\right) + \frac{1}{2}\sin^{-1}\left(\frac{2n}{1+n^2}\right)\right)$

[[y] denotes the largest integer less than or equal to y]

SECTION - 2

One or More Options Correct Type

This section contains 10 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.**

49. Let $\frac{dy}{dx} + y = f(x)$ where y is a continuous function of x with $y(0) = 1$

and $f(x) = \begin{cases} e^{-x}, & \text{if } 0 \le x \le 2 \\ e^{-2}, & \text{if } x > 2 \end{cases}$. Which of the following hold(s) good?

(A) $y(1) = 2e^{-1}$

(B) $y'(1) = -e^{-1}$

(C) $y(3) = -2e^{-3}$

(D) $y'(3) = -2e^{-3}$

50. The two lines pairs $y^2 - 4y + 3 = 0$ and $x^2 + 4xy + 4y^2 - 5x - 10y + 4 = 0$ enclose a 4 sided convex polygon, then the correct statement among the following is/are

(A) Area of polygon is 6

(B) Length of its diagonals are $\sqrt{5}$ & $\sqrt{53}$

(C) Point of intersection of diagonals is (– 2, 2)

(D) Polygon is parallelogram.

51. Consider the lines $L_1 : x - 3y = 0$, $L_2 : 4x + 3y = 5$ and $L_3 : 3x + y = 0$ which are representing the sides of ΔABC. Which of the following statement(s) is/are CORRECT?

(A) Radical centre of the circles described on the sides of ΔABC as diameter is (0, 0).

(B) Coordinates of circumcentre of ΔABC is $\left(0, \frac{10}{3}\right)$.

(C) The equation of the line joining centroid and orthocentre of ΔABC is $y = 0$.

(D) Radius of the circle circumscribing ΔABC is $\frac{5}{3}$.

52. An even polynomial function $f(x)$ satisfies a relation

$$f(2x)\left(1-f\left(\frac{1}{2x}\right)\right)+f\left(16x^2y\right)=f(-2)-f(4xy)\ \forall\ x, y \in R-\{0\} \text{ and } f(4)=-255,\ f(0)=1.$$

Which of the following hold(s) good?

(A) $f(x)$ has local maximum at $x = 1$

(B) $f(x)f\left(\frac{1}{x}\right)\le 0$

(C) Range of values of k for which $|f(x)| = k - 2$ has exactly four distinct solutions is (2, 3).

(D) $\int_0^1 f(x)dx=\frac{3}{4}$

53. Let $J=\int_{-1}^{2}\left(\cot^{-1}\frac{1}{x}+\cot^{-1}x\right)dx$ and $K=\int_{-2\pi}^{7\pi}\frac{\sin x}{|\sin x|}dx$.

Then which of the following alternative(s) is/are correct ?

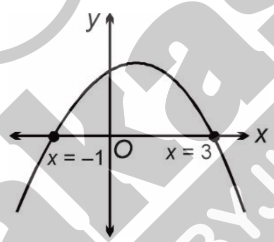
(A) $2J + 3K = 8\pi$

(B) $4J^2 + K^2 = 26\pi^2$

(C) $2J - K = 3\pi$

(D) $\frac{J}{K}=\frac{2}{5}$

54. Consider the graph of quadratic polynomial $y = ax^2 + bx + c$ as shown below. Which of the following is(are) correct?



(A) $\frac{a-b+c}{abc}=0$

(B) $abc(9a + 3b + c) < 0$

(C) $\frac{a+3b+9c}{abc}<0$

(D) $ab(a - 3b + 9c) > 0$

55. In ΔABC, D is a point on BC such that $DB = 14$, $DA = 13$ and $DC = 4$. If the circumcircle of the ΔADB is congruent to the circumcircle of the ΔADC then which of the following is/are correct?

(A) Angle $B > 45°$ but angle $C < 45°$

(B) Both the angles B and C are greater than 45°

(C) Area of the triangle is 108 sq. units

(D) Measure of angle A equal to $\tan^{-1}\left(\frac{24}{7}\right)$

56. Let $(a-1)(x^2+\sqrt{3}\,x+1)^2-(a+1)(x^4-x^2+1)\le 0\ \forall\ x \in R$, then which of the following is/are correct?

(A) $a\in\left[-\frac{1}{\sqrt{3}},\frac{4}{\sqrt{3}}\right]$

(B) Largest possible value of a is $\sqrt{3}$

(C) Number of possible integral values of a is 3

(D) Sum of all possible integral values of a is '0'

57. If the π-plane $7x + (\alpha + 4)y + 4z - r = 0$ passing through the points of intersection of the planes $2x + 3y - z + 1 = 0$ and $x + y - 2z + 3 = 0$ and is perpendicular to the plane $3x - y - 2z = 4$ and $\left(\frac{12}{\beta}, \frac{-78}{\beta}, \frac{57}{\beta}\right)$ is image of point (1, 1, 1) in π-plane, then

(A) $\alpha = 9$
(B) $\beta = -117$
(C) $\alpha = -9$
(D) $\beta = 117$

58. Let $2\sin x + 3\cos y = 3$ and $3\sin y + 2\cos x = 4$ then

(A) $x + y = (4n + 1)\pi/2,\ n \in I$
(B) $x + y = (2n + 1)\pi/2,\ n \in I$
(C) x and y can be the two non right angles of a 3-4-5 triangle with $x > y$.
(D) x and y can be the two non right angles of a 3-4-5 triangle with $y > x$.

SECTION - 3
Matching Column Type

This section contains 2 questions. Each question contains two Columns (Column I and Column II). Column I has four entries (A), (B), (C) and (D), Column II has five entries (P), (Q), (R), (S) and (T). Match the entries in Column I with the entries in Column II. Each entry in Column I may match with one or more entries in Column II. The OMR contains a 4 × 5 matrix whose layout will be similar to the one shown below :

For each entry in Column I, darken the bubbles of all the matching entries. For example, if entry (A) in Column I matches with entries (Q), (R) and (T), then darken these three bubbles in the OMR. Similarly, for entries (B), (C) and (D).

(A)	(P)	(Q)	(R)	(S)	(T)
(B)	(P)	(Q)	(R)	(S)	(T)
(C)	(P)	(Q)	(R)	(S)	(T)
(D)	(P)	(Q)	(R)	(S)	(T)

59. Match column-I with column-II.

	Column-I		**Column-II**
(A)	The value of $\dfrac{\int_0^\infty x^9 \cdot e^{-x^2}\,dx}{\int_0^\infty x^7 \cdot e^{-x^2}\,dx}$ is equal to	(P)	4
(B)	The maximum value of function $f(x) = x^3 - 3x$ subject to the condition $x^4 + 36 \le 13x^2$, is	(Q)	6
(C)	A circle passes through the points (2, 2) and (9, 9) and touches the x-axis. The absolute value of the difference of x-coordinates of the possible points of contact is	(R)	8
(D)	Let $f(x) = \cos^{-1}(3x - 4x^3)$ then $f'\left(\frac{\sqrt{3}}{2}\right)$ has the value equal to	(S)	12
		(T)	18

60. Match column-I with column-II.

	Column-I		**Column-II**
(A)	Number of integral values of k such that all solutions (x, y) to the system of equations $x + 4y = 2k^2$ $x + y = k$ are such that $x, y > 0$, is	(P)	0
(B)	Number of integers in the domain of function $g(x) = \ln(\cos^{-1}x)$ is	(Q)	1
(C)	If $x > 0$, then the value of expression $\frac{(1+\sin^{-1}x)^{2020}(1+\cos^{-1}x)^{2021}(1+\tan^{-1}x)^{2022}}{(1+\operatorname{cosec}^{-1}x)^{2020}(1+\sec^{-1}x)^{2021}(1+\cot^{-1}x)^{2022}}$ is	(R)	2
(D)	If the function $f: R - \{-b\} \to R - \{1\}$ defined by $f(x) = \frac{x+a}{x+b}$ $(a \neq b)$ is self inverse, then $(a + b)$ can be	(S)	3
		(T)	4

❐ ❐ ❐

CODE B

Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005, Phone : 011-47623456

Time : 3 hrs

MOCK TEST - 1

MM : 264

for JEE (Advanced) - 2022

Paper - 2

Mock Test on Complete Syllabus

General Instructions:

1. Read each question carefully.
2. It is mandatory to use blue/black ballpoint pen to darken the appropriate circle in the answer sheet.
3. Mark should be dark and should completely fill the circle.
4. Rough work must not be done on the answer sheet.
5. Do not use white-fluid or any other rubbing material on answer sheet.
6. Student cannot use log table and calculator or any other material in the examination hall.
7. Before attempting the question paper, student should ensure that the test paper contains all pages and no page is missing.
8. Before handing over the answer sheet to the invigilator, candidate should check that Roll No., Centre Code and Date of Birth have been filled and marked correctly.
9. Immediately after the prescribed examination time is over, the answer sheet is to be returned to the invigilator.
10. **Pattern of the questions are as under:**

    The question paper consists of 3 parts (Physics, Chemistry and Mathematics). Each part has **3 sections.**

    (i) **Section-1:** This section contains 8 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. Each question carries +4 marks for correct answer. There is no negative mark for wrong answer.

    (ii) **Section-2:** This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct.** Each question carries **+4 marks** for correct answer, 0 mark if not attempted and **–2 marks** for wrong answer.

    (iii) **Section-3:** This section contains 2 paragraphs. Based upon each paragraph, 2 multiple choice questions have to be answered. Each question has **one or more than one correct answer** and carries **+4 marks** for correct answer, 0 mark if not attempted and **–2 marks** for wrong answer.

PART – I : PHYSICS

SECTION - 1

Integer Value Correct Type

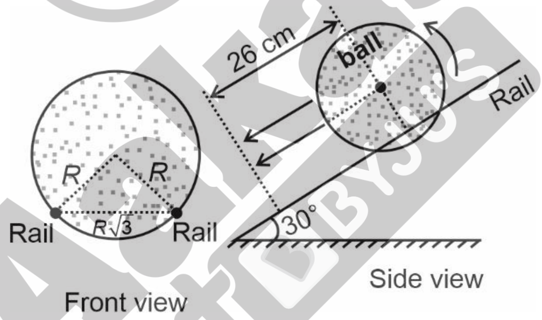
This section contains 8 questions. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. Examples- If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively.

X	0	1	2	3	4	5	6	7	8	9
Y	0	1	2	3	4	5	6	7	8	9
Z	0	1	2	3	4	5	6	7	8	9

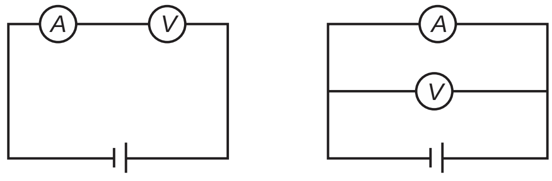
1. A long straight wire carries a current of 1.5 A. An electron travels with a speed of 5×10^6 cm/s parallel to the wire, 10 cm from it, and in the same direction as the current. The force that the magnetic field of the current exert on the moving electron is $3n \times 10^{-21}$ N. Find the value of n.

2. There is a circular raft of radius 6 m on the surface of a liquid reservoir of depth 3 m. The surface is illuminated by light incident from all directions. Determine the radius (in m) of the full shadow of the raft at the bottom of the reservoir. The refractive index of the liquid is 1.25.

3. A uniform ball of radius R rolls down without slipping between the parallel inclined rails separated by a horizontal distance $\sqrt{3}\,R$ as shown in the figure. Find maximum possible speed of a point on the sphere after rolling down a distance of 26 cm along the rails (g = 10 m/s^2) in m/s.

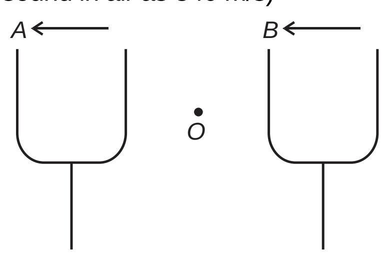


4. In circuit (a) the instruments read V_1 = 100 V, I_1 = 5 μA. In circuit (b) we have V_2 = 25 mV, I_2 = 2.5 A. If internal resistance of the cell (in Ohm). Round off to nearest integer is $8 \times r$, then find the value of r. (Consider both instruments to be regular laboratory instruments)



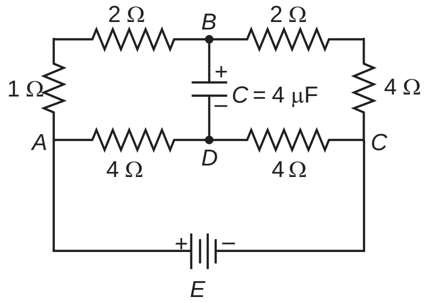
(a) (b)

5. Two tuning forks A and B each of natural frequency 85 Hz move with velocity 10 m/s relative to stationary observer 'O'. Fork A moves away from the observer while the fork B moves towards him as shown in the figure. A wind with a speed 10 m/s is blowing in the direction of motion of fork A. Find the beat frequency measured by the observer in Hz. (Take speed of sound in air as 340 m/s)

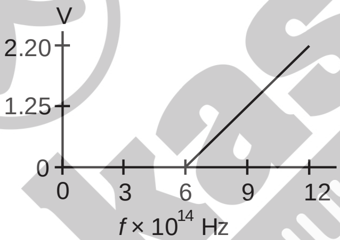


6. A small rigid object carries positive and negative charges +4 C and –4 C. It is oriented so that the positive charge has coordinates (–1.2 mm, 1.1 mm) and negative charge has coordinates (1.4 mm, –1.3 mm). The object is kept in an electric field of $\left(2500\hat{i} - 5000\hat{j}\right)$N/C. If magnitude of torque (in N-m) acting on the dipole is $k \times 7$, then find the value of k.

7. For the given circuit in the steady state condition charge on the capacitor is $q_0 = 16\ \mu$C. If now the battery is removed and the nodes A and C are shorted. The time during which charge on the capacitor becomes 4 μC is X (μs) and emf of battery was Y (volt). Write value of $\frac{XY}{128 \ln 2}$.



8. Figure shows the stopping potential versus the light frequency for a metal cathode used in a photoelectric-effect experiment. Suppose this cathode is now illuminated with 6.63 mW of 300 nm light and that the efficiency of converting photons to photoelectrons is 10%. Take $h = 6.63 \times 10^{-34}$ Js, $c = 3 \times 10^{8}$ ms^{-1}.



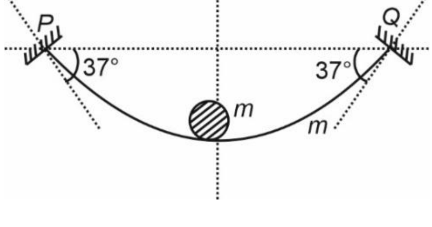
What is the power (in watt) of emitted photoelectron beam assuming that on an average, each photoelectron emitted has energy $\frac{5K_{max}}{6}$? Assume that anode potential is sufficiently positive. Express your answer in form of 'X' $\times 10^{-5}$ W. Find the value of $\frac{X}{11}$ in OMR sheet after rounding off to nearest integer.

SECTION - 2

One or More Options Correct Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct**.

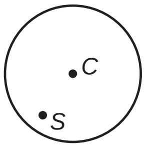
9. A uniform string of mass m fixed at point P and Q is having a point mass m at its lowest point as shown. If T_1 and T_2 are tensions in the string at point P and mid point of string, then

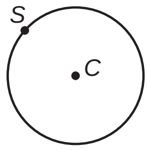


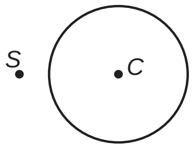
(A) $T_1 = \frac{5mg}{3}$ (B) $T_2 = \frac{4mg}{3}$

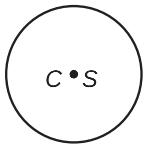
(C) $T_1 = \frac{4mg}{3}$ (D) $T_2 = \frac{5mg}{3}$

10. A body is continuously moving in circular path, its acceleration is always pointing towards a fixed point S. Which of the following positions of the fixed point S are possible? (C is the centre of circle)

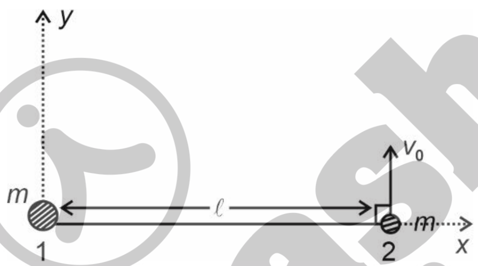
(A) 

(B) 

(C) 

(D) 

11. In the shown arrangement of two point masses each of mass m connected by an ideal string and placed on smooth horizontal surface. If point mass 2 is given velocity v_0, then displacement of mass $1\left(\vec{S}_1\right)$ and $2\left(\vec{S}_2\right)$ in time interval $\Delta t = \dfrac{\pi\ell}{2v_0}$ is



(A) $\vec{S}_1 = \dfrac{\ell}{2}\hat{i} + \left(\dfrac{\pi\ell}{4} - \dfrac{\ell}{2}\right)\hat{j}$

(B) $\vec{S}_2 = -\dfrac{\ell}{2}\hat{i} + \left(\dfrac{\pi\ell}{4} + \dfrac{\ell}{2}\right)\hat{j}$

(C) $\vec{S}_1 = \left(\dfrac{\ell}{2} - \dfrac{\pi\ell}{4}\right)\hat{j} - \dfrac{\ell}{2}\hat{i}$

(D) $\vec{S}_2 = -\dfrac{\ell}{2}\hat{i} + \left(\dfrac{\pi\ell}{4} - \dfrac{\ell}{2}\right)\hat{j}$

12. Which of the following actions would make a pulse travel faster along a stretched string?

(A) Move your hand up and down more quickly as you generate the pulse

(B) Use a heavier string of the same length, under the same tension

(C) Use a lighter string of the same length, under the same tension

(D) Stretch the string tighter to increase the tension

13. A particle of mass 1 kg moving with velocity $\vec{v}_1 = \left(-2\hat{i} - 3\hat{j}\right)$ m/s collides with a smooth plane and after collision its velocity becomes $\bar{v}_2 = (\hat{i} - \hat{j})$ m/s, then

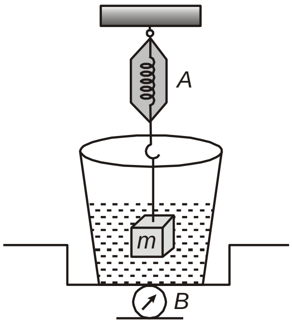
(A) Direction of impulses on the particle makes an angle $\tan^{-1}\left(\dfrac{2}{3}\right)$ with $+x$-axis

(B) Direction of impulses on the particle makes an angle $\dfrac{\pi}{2} + \tan^{-1}\dfrac{2}{3}$ with $+x$-axis

(C) Angle made by plane with $+x$-axis is $\dfrac{\pi}{2} + \tan^{-1}\left(\dfrac{2}{3}\right)$

(D) Angle made by plane with $+x$-axis is $\tan^{-1}\left(\dfrac{2}{3}\right)$

14. The spring balance A reads 2 kg with a block m suspended from it. A balance B reads 5 kg when a beaker filled with liquid is put on the pan of the balance. The two balances are now so arranged that the hanging mass is inside the liquid as shown in the figure. In this situation



(A) The balance A will read more than 2 kg

(B) Sum of the reading of spring balance 'A' and balance B is 7 kg

(C) The balance A will read less than 2 kg and B will read more than 5 kg

(D) The balances A and B will read 2 kg and 5 kg respectively

15. A set of n identical cubical blocks lies at rest parallel to each other along a line on a smooth horizontal surface. The separation between the near surfaces of any two adjacent blocks is L. The block at one end is given a speed v towards the next one at time $t = 0$. All collisions are completely inelastic, then

(A) The last block starts moving at $t = \frac{n(n-1)L}{v}$

(B) The last block starts moving at $t = \frac{n(n-1)L}{2v}$

(C) The centre of mass of the system will have a final speed v

(D) The centre of mass of the system will have a final speed $\frac{v}{n}$

16. The Earth circles the Sun once a year. Work that would have to be done on the Earth to bring it to rest relative to the Sun is, $W = \frac{-54}{x} \times 10^{32}$ J (Ignore the rotation of the Earth and the Sun about their own axis). Given that mass of Earth = 6×10^{24} kg, the distance between Sun and Earth is 1.5×10^{8} km (1 year = 3.14×10^{7} s). Find x (in nearest integer value).

(A) 2 (B) 4

(C) 5 (D) 7

SECTION - 3

Paragraph Type

This section contains 2 paragraphs, each describing theory, experiment, data etc. Four questions relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should have one or more than one correct answers among the four given choices (A), (B), (C) and (D).

Paragraph for Q. Nos. 17 and 18

Monochromatic radiation of wavelength λ_1 = 3000 Å falls on a photocell operating in saturation mode. The corresponding spectral sensitivity of photocell is J = 4.8 mA/W (Spectral sensitivity means the total charge emitted per Joule). When another monochromatic radiation of wavelength λ_2 = 1650 Å and power P = 5 mW is incident, it is found that maximum kinetic energy of photoelectrons increases to n = 4 times. Assume that efficiency of photo-electron generation per incident photon to be same for both the cases.

17. Choose the correct option(s).

(A) The work function of the cell is 1 eV

(B) Maximum KE of electrons in 1st case is 1.33 eV

(C) The work function of the cell is 3 eV

(D) Maximum KE of electrons in 1st case is 2.78 eV

18. Efficiency of photo-electron generation is

(A) 0.0198

(B) 0.0278

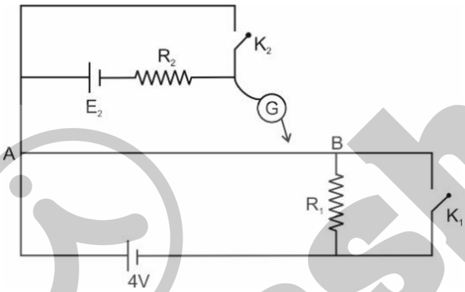
(C) 0.0369

(D) 0.0458

Paragraph For Q. Nos. 19 and 20

Figure shows the circuit of a potentiometer. The length of the potentiometer wire *AB* is 50 cm. The emf of the battery is 4 volt, having negligible internal resistance. Values of resistances R_1 and R_2 are 15 ohm and 5 ohm respectively. When both the keys are open, the null point is obtained at a distance of 31.25 cm from end *A.*

Given $R_{AB} = 10\ \Omega$.



19. Choose the correct option(s)

(A) The emf of the cell E_2 is 1 volt

(B) Potential gradient of wire *AB* at null point when K_2 is closed and K_1 is open is $\frac{4}{125}$ V/cm

(C) The emf of the cell E_2 is 3 volt

(D) Potential gradient of wire *AB* at null point when K_2 is closed and K_1 is open is $\frac{10}{17}$ V/cm

20. The balance length when key K_2 is open and K_1 is closed is given by

(A) 10.5 cm

(B) 11.5 cm

(C) 12.5 cm

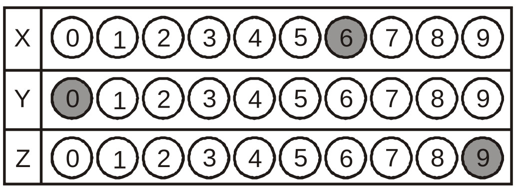
(D) 13.5 cm

PART – II : CHEMISTRY

SECTION - 1

Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. Examples- If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively.



21. For the first order reaction, the rate constant is 7.67×10^{-2} sec^{-1}. Calculate the time (in second) required for the initial concentration 1.20 mole/L of the reactant to be reduced to 0.75 mole/L. [Use log2 = 0.3]

22. How many lone pair of electrons on N-atoms in melamine are involved in resonance?

23. A hydrocarbon (X) has molecular weight of 80 g/mol. 12.0 mg sample of (X) reacts with 10.08 ml of H_2 at 0°C and 1 atm pressure. Ozonolysis of (X) gives HCHO and CHO–CHO only. What are the total moles of HCHO and CHO–CHO produced by 1 mole of (X) ?

24. How many of the following compounds give positive Fehling solution test?

    Ph–NH–OH, 1–hydroxy propanone, Fructose, Salicylaldehyde, 3–Butenal, Pentan-2-one, Formic acid, Methanal

25. When 0.742 g of a mixture of aluminium and its oxide were reacted with a solution of sodium hydroxide, 840 ml of a gas was evolved (measured in standard conditions). The percentage of aluminium oxide in the initial mixture is

26. How many of the following carbohydrates on treatment with excess of phenylhydrazine give the same osazone?

    Glucose, Allose, Xylose, Ribose, Mannose, Fructose and Galactose

27. A radioactive element A has an atomic number of 100. It decays directly into an element B along with a negatively charged sub-atomic particle which is the lightest of all charged particles. B decays directly into C along with a positively charged particle which is roughly four times heavier than proton. If Z_1 and Z_2 are atomic numbers of B and C respectively, then what is the value of $\frac{Z_1 + Z_2}{25}$?

28. Reaction $A(g) \longrightarrow B(g)$ is carried out at 300 K in a closed container in which concentration of (A) varies as $[A]_t = a - bt$. Rate of reaction in terms of pressure at 300 K is X. Find the value of $\frac{X}{2}$. [Given b = 0.4 atm s^{-1}, R = $\frac{1}{12}$ L atm mol^{-1} K^{-1} where R is universal gas constant]

SECTION - 2

One or More Options Correct Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct**.

29. Which of the following is/are true?

    (A) $\frac{V_1}{V_2} = \left(\frac{T_2}{T_1}\right)^{\frac{3}{2}}$ for reversible adiabatic expansion of an ideal monoatomic gas

    (B) At low pressure $Z = 1 - \frac{a}{V_m RT}$ for real gas

    (C) A gas can be liquified below critical temperature at high pressure

    (D) Higher the value of 'a' weaker is intermolecular forces of attraction

30. Salt of which of the following radicals will give brown fumes when treated with conc. H_2SO_4?

    (A) NO_3^- (B) Br^-

    (C) I^- (D) Cl^-

31. The coagulation of a sol may be brought about by

    (A) Heating (B) Adding sol of opposite charge

    (C) Adding electrolyte (D) Persistent dialysis

32. Which of the following elimination reactions will give but–1–ene as the major product ?

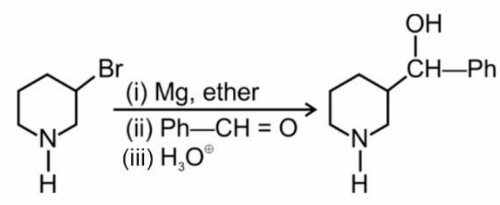
(A) $CH_3—CHCl — CH_2 — CH_3 + KOH \xrightarrow{EtOH} ?$

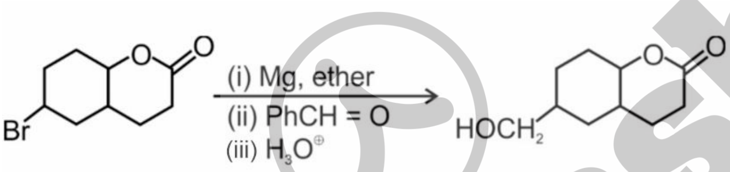
(B) $\underset{\underset{+NMe_3}{|}}{CH_3—CH}—CH_2 — CH_3 + NaOEt \xrightarrow{EtOH} ?$

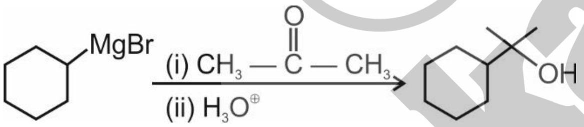
(C) $CH_3—CH_2—CHCl—CH_3 + Me_3COK \longrightarrow ?$

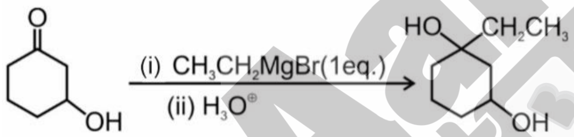
(D) $CH_3—CH_2—CH(OH)—CH_3 + \text{conc. } H_2SO_4 \longrightarrow ?$

33. Point out the incorrect products.

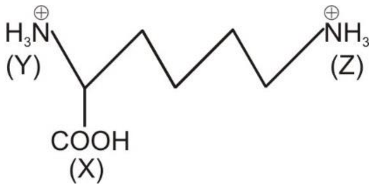
(A) 

(B) 

(C) 

(D) 

34. The compound given below is more acidic than



(A) CH_3COOH

(B) CH_3CH_2OH

(C) $CH \equiv CH$

(D) $CH_3CH_2SO_3H$

35. The correct statement(s) regarding a colloidal solution is/are

(A) ‘Hardy Schulze Rule’ deals with the coagulating power of an electrolyte

(B) ‘Brownian movement and Tyndall effect’ are the properties of colloidal state

(C) Gel is a liquid dispersed in another liquid

(D) Gold number deals with the protective power of a lyophilic sol

36. Lactose on hydrolysis gives

(A) Glucose

(B) Fructose

(C) Galactose

(D) Mannose

SECTION - 3

Paragraph Type

This section contains 2 paragraphs, each describing theory, experiment, data etc. Four questions relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should have one or more than one correct answers among the four given choices (A), (B), (C) and (D).

Paragraph for Q. Nos. 37 and 38

On July 1, 2000, the combined tunnel and bridge connecting Denmark and Sweden was officially opened. It consists of a tunnel from Copenhagen to an artificial island and a bridge from the Island to Malmo in Sweden. The major construction materials employed are concrete and steel. This problem deals with chemical reactions relating to production and degradation of such materials.

Concrete is produced from a mixture of cement, water, sand and small stones. Cement consists primarily of calcium silicates and calcium aluminates formed by heating and grinding of clay and limestone. In the later steps of cement production, a small amount of gypsum, $CaSO_4.2H_2O$, is added to improve subsequent hardening of the concrete. The use of elevated temperatures during the final production may lead to formation of unwanted semihydrate, $CaSO_4, \frac{1}{2}H_2O$.

Consider the following reaction :

$$CaSO_4 \cdot 2H_2O(s) \rightarrow CaSO_4 \cdot \frac{1}{2}H_2O(s) + \frac{3}{2}H_2O(g)$$

Compound	ΔH_f (kJ mol^{-1})	ΔS_f (J K^{-1} mol^{-1})
$CaSO_4 \cdot 2H_2O(s)$	– 2021.0	194.0
$CaSO_4 \cdot \frac{1}{2}H_2O(s)$	– 1575.0	130.5
$H_2O(g)$	– 241.8	188.6

37. ΔH (in kJ) for transformation of 1 kg of $CaSO_4 \cdot 2H_2O(s)$ to $CaSO_4 \cdot \frac{1}{2}H_2O(s)$ is equal to (Approximately)

(A) 484 kJ
(B) 450 kJ
(C) –484 kJ
(D) –450 kJ

38. ΔS (in J K^{-1}) for the transformation of 1 mole of gypsum to 1 mole of Plaster of Paris in above process is

(A) 219.4
(B) 319.4
(C) 0.219
(D) 3.19

Paragraph for Q. Nos. 39 and 40

A light green coloured crystalline solid (A) is soluble in water. The solution reacts with Nessler's reagent to give a brown ppt. Addition of $BaCl_2$ solution to (A) gives a white ppt (C) which is insoluble in conc. HNO_3. Aqueous solution of $K_3[Fe(CN)_6]$ to give a deep blue coloured ppt. An acidic solution of (A) absorbs nitric oxide to give a brown coloured compound (D). In acidic solution (A) decolourises the purple colour of $KMnO_4$ solution to give (E). (A) also converts orange colour of $K_2Cr_2O_7$ to green in acidic solution due to formation of a green compound (F). (A) is used in volumetric titrations.

39. Compound 'A' is

(A) $Cr_2(SO_4)_3$
(B) $(NH_4)_2SO_4$
(C) $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$
(D) $ZnSO_4$

40. The brown coloured compound (D) is detected in the confirmation test of

(A) $C_2O_4^{2-}$ (B) NO_3^-

(C) NH_4^+ (D) SO_4^{2-}

PART – III : MATHEMATICS

SECTION - 1

Integer Value Correct Type

This section contains 8 questions. The answer to each of the questions is a **single-digit integer**, ranging from 0 to 9. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. Examples- If the correct answer to question numbers X, Y and Z (say) are 6, 0 and 9 respectively, then mark 6, 0 and 9 in OMR respectively.

X	0	1	2	3	4	5	6	7	8	9
Y	0	1	2	3	4	5	6	7	8	9
Z	0	1	2	3	4	5	6	7	8	9

41. If $S = \sum_{r=1}^{50} \tan^{-1}\left(\frac{2r}{r^4 + r^2 + 2}\right)$ and value of cot $S = \frac{2552}{425k}$, then the value of k is

42. The largest number of elements in a subset of {1, 2, …, 9} such that the sum of every pair of distinct elements in the subset is different, is

43. If $x^2 + y^2 - 4x - 6y + c = 0$ is the circumcircle of the triangle formed by three tangents to the parabola $y^2 = 4x - 4$, then radius of the circle is

44. Let $f(x^3 + y^3) = xf(x^2) + yf(y^2)$ and $f(x)$ is differentiable. If $f'(0) = 5$, then $f'(5)$ is equal to

45. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three unit vectors such that $|\vec{a} + \vec{b} + \vec{c}| = \sqrt{3}$.

If $(\vec{a} \times \vec{b}) \cdot (\vec{b} \times \vec{c}) + (\vec{b} \times \vec{c}) \cdot (\vec{c} \times \vec{a}) + (\vec{c} \times \vec{a}) \cdot (\vec{a} \times \vec{b}) = \lambda$, then the least integer greater than or equal to the maximum value of λ, is

46. Let $f(x) = \begin{cases} \cot^{-1} x, & |x| \ge 1 \\ \frac{1}{2}|x| + \frac{\pi}{4} - \frac{1}{2}, & |x| < 1 \end{cases}$, then number of points which domain of $f'(x)$ does not contains is

47. The number of solution of equation $\sin \sin^{-1}([x]) + \cos^{-1} \cos x = 1$ is (where [·] denotes the greatest integer function)

48. If all chords of the parabola $y^2 = 4x + 4$ which subtends a right angle at point $(1, 2\sqrt{2})$ passes through a fixed point (α, β), then the value of $|\alpha + \beta + 2\sqrt{2} + 3|$ is equal to

SECTION - 2

One or More Options Correct Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more than one is/are correct**.

49. If positive quantities a, b, c are in H.P. then

(A) $b > \frac{a+c}{2}$ (B) $\frac{1}{a-b} - \frac{1}{b-c} < 0$

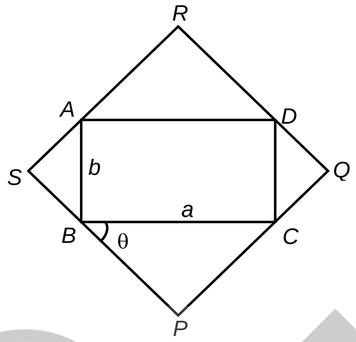
(C) $ac > b^2$ (D) $bc(1 - a)$, $ac(1 - b)$, $ab(1 - c)$ are in A.P.

50. A fair dice is rolled four times. Find the probability that each number is no smaller than the preceding number.

(A) $\frac{7}{72}$ (B) $< \frac{1}{3}$

(C) $> \frac{1}{3}$ (D) $\frac{11}{72}$

51. Let *ABCD* is a rectangle whose sides given are *a* and *b*. A rectangle *PQRS* whose area is *A* is shown in figure, then



(A) Area *A* is maximum when $\theta = \frac{\pi}{3}$ (B) Area *A* is maximum when $\theta = \frac{\pi}{4}$

(C) Maximum value of area $A = \frac{1}{4}(a+b)^2$ (D) Maximum value of area $A = \frac{1}{2}(a+b)^2$

52. On a right angle triangle *ABC*, right angled at *B*, $\angle BAC = 60°$, external triangle *ABR*, *BCP* and *CAQ* are constructed on the sides of ΔABC such that $\angle PBC = 45°$, $\angle PCB = 30°$, $\angle QAC = 45°$, $\angle QCA = 30°$, $\angle RAB = \angle RBA = 15°$, then

(A) $RP = RQ$ (B) $RP < AC$

(C) $RP > AC$ (D) $PQ = RC$

53. If $\lim_{x\to\infty} 4x\left(\frac{\pi}{4} - \tan^{-1}\frac{x+1}{x+2}\right) = y^2 + 4y + 5$, then *y* can be equal to

(A) 1 (B) – 1

(C) – 4 (D) – 3

54. Let $f(x) = \begin{cases} \int_0^x (5 + |1-t|)dt, & x > 2 \\ 5x+1, & x \le 2 \end{cases}$, then

(A) $f(x)$ is differentiable at $x = 2$

(B) $f(x)$ is continuous but not differentiable at $x = 2$

(C) $f(x)$ is differentiable everywhere

(D) $f(4) = 25$

55. If z_1, z_2 be two complex numbers ($z_1 \ne z_2$) satisfying $\left|z_1^2 - z_2^2\right| = \left|\bar{z}_1^2 + \bar{z}_2^2 - 2\bar{z}_1\bar{z}_2\right|$, then

(A) $|\arg z_1 - \arg z_2| = \pi$ (B) $|\arg z_1 - \arg z_2| = \frac{\pi}{2}$

(C) $\frac{z_1}{z_2}$ is purely imaginary (D) $\frac{z_1}{z_2}$ is purely real

56. Let $f(x)=\dfrac{e^x}{1+x^2}$ and $g(x)=f'(x)$ then

(A) $g(x)$ has two local maxima and two local minima points

(B) $g(x)$ has exactly one local maxima and one local minima point

(C) $x = 1$ is a point of local maxima for $g(x)$

(D) There is a point of local maxima for $g(x)$ in the interval (–1, 0)

SECTION - 3

Paragraph Type

This section contains 2 paragraphs, each describing theory, experiment, data etc. Four questions relate to two paragraphs with two questions on each paragraph. Each question pertaining to a particular passage should have one or more than one correct answers among the four given choices (A), (B), (C) and (D).

Paragraph for Q. Nos. 57 and 58

Consider the ellipse E: $\dfrac{x^2}{4}+\dfrac{y^2}{1}=1$, S, S' are foci and P is any point on E such that $SP\,.\,S'P$ be maximum, among the two values of P with lesser ordinate be name it as A and other as B.

57. Possible coordinates of P are

(A) $(0, \pm 1)$

(B) $(\pm 2, 0)$

(C) $(\pm\sqrt{2}, 0)$

(D) $\left(\pm\sqrt{2}, \pm\dfrac{1}{\sqrt{2}}\right)$

58. Ray of light is passing through point, A it gets reflected from curve X $\left(\dfrac{-x^2}{a^2}+\dfrac{y^2}{b^2}=1\right)$ such that reflected ray appear to pass through B, curve X is passing through the point $D(2, 1)$, then curve X is

(A) $\dfrac{-x^2}{2(\sqrt{2}-1)}+\dfrac{y^2}{(\sqrt{2}-1)^2}=1$

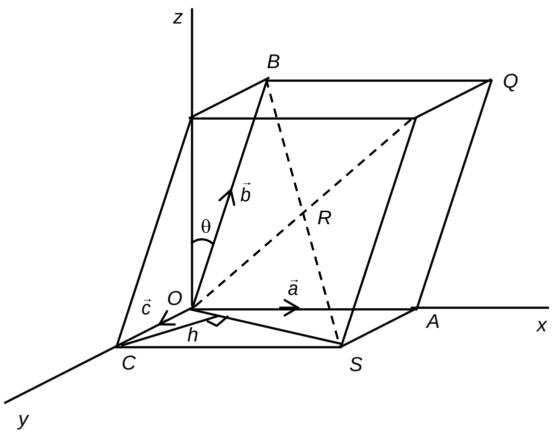
(B) $\dfrac{x^2}{(\sqrt{2}-1)^2}-\dfrac{y^2}{2(\sqrt{2}-1)}=1$

(C) $\dfrac{x^2}{2}-\dfrac{y^2}{3}=1$

(D) $\dfrac{x^2}{(\sqrt{2}+1)^2}+\dfrac{y^2}{2(\sqrt{2}+1)}=1$

Paragraph for Q. Nos. 59 and 60

$\vec{a}$, $\vec{b}$, $\vec{c}$ represent side of parallelepiped as in given figure. Here diagonal OP and BS intersect at R. A represents area of ΔORS.



59. Area of ΔORS

(A) $\frac{1}{4}\sqrt{|\vec{a}|^2+|\vec{c}|^2}\,|\vec{b}|\sqrt{1-\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}\right)^2}$

(B) $\frac{1}{4}\sqrt{|\vec{a}|^2+|\vec{c}|^2}\,|\vec{b}|\sqrt{1+\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}\right)^2}$

(C) $\frac{1}{2}\sqrt{|\vec{a}|^2+|\vec{c}|^2}\,|\vec{b}|\sqrt{1-\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}\right)^2}$

(D) $\frac{1}{2}\sqrt{|\vec{a}|^2+|\vec{c}|^2}\cdot|\vec{b}|\cdot\sqrt{1+\left(\frac{\vec{a}\cdot\vec{b}}{|\vec{a}|\cdot|\vec{b}|}\right)^2}$

60. h is height of perpendicular drawn from point C to base OS then h is

(A) $h = \frac{2|\vec{a}\times\vec{c}|}{\sqrt{|\vec{a}|^2+|\vec{c}|^2}}$

(B) $h = \frac{|\vec{a}\times\vec{c}|}{\sqrt{|\vec{a}|^2+|\vec{c}|^2}}$

(C) $h = \frac{4|\vec{a}\times\vec{c}|}{\sqrt{|\vec{a}|^2+|\vec{c}|^2}}$

(D) $h = \frac{3|\vec{a}\times\vec{c}|}{\sqrt{|\vec{a}|^2+|\vec{c}|^2}}$

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