CODE:112

QUANTUM POTENTIAL TEST - 2023

[Quality Nurturer & Mind Utilizer Test for Potential Enhancement]

(IPEC Scholarship-Cum-Admission Test)

For

CLASS - XI

(For XI to XII Moving Students)

PAPER - II

Time : 3 Hrs. **Maximum Marks : 255**

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS

1. The booklet is your Question Paper. Do not break the seal of this booklet before being instructed to do so by the invigilator.
2. Blank spaces and blank pages are provided in the question paper for your rough work. No additional sheets will be provided for rough work.
3. Blank papers, clipboards, log tables, slide rules, calculators, cameras, cellular phones, pagers and electronic gadgets are **NOT** allowed inside the examination hall.
4. The answer sheet, a machine-readable Optical Response Sheet **(ORS),** is provided separately.
5. On breaking the seal of the booklet check that it contains **15** pages and all the **75** questions.
6. A candidate has to write his / her answers in the ORS sheet by darkening the appropriate bubble with the help of **Black/Blue ball point pen** as the correct answer of the question attempted.
7. **Question Paper Format :**

   This question paper consists of **Three Parts**

   Part - I: Physics - 25 Questions

   Part - II: Chemistry - 25 Questions

   Part - III: Mathematics - 25 Questions

8. **Marking Scheme :**

   Please see the marking scheme as mentioned in all sections.

PART -I [Physics]

[SECTION - I]

[SINGLE CORRECT TYPE]

This section contains 15 Multiple Choice Questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
[**Marking Scheme : +3 marks** for correct answer and **-1** for wrong answer]

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1. The mean time period of second's pendulum is 2.00s and mean absolute error in the time period is 0.05s. To express maximum estimate of error, the time period should be written as

(A) $(2.00 \pm 0.01)s$ (B) $(2.00 \pm 0.025)s$ (C) $(2.00 \pm 0.05)s$ (D) $(2.00 \pm 0.10)s$

2. The resultant of two equal forces is double of either of the forces. The angle between them is

(A) 120^o (B) 90^o (C) 60^o (D) 0^o

3. In a clockwise system

(A) $\hat{j} \times \hat{k} = \hat{i}$ (B) $\hat{i} \cdot \hat{i} = 0$ (C) $\hat{j} \times \hat{j} = 1$ (D) $\hat{k} \cdot \hat{j} = 1$

4. KE of a body of mass m and momentum p, is given by

(A) mp (B) $\left(p^2 / 2m\right)$ (C) $p^2 m$ (D) $\left(m^2 / 2p\right)$

5. The period of oscillation of a simple pendulum in the experiment is recorded as 2.63 s, 2.56 s, 2.42 s, 2.71 s and 2.80 s respectively. The average absolute error is

(A) $0.1s$ (B) $0.11s$ (C) $0.01s$ (D) $1.0s$

6. An aeroplane files 400 m north and 300 m south and then files 1200 m upwards then net displacement is

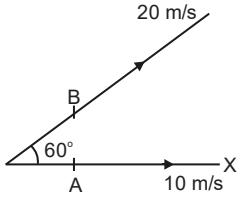
(A) $1200\,m$ (B) $1300\,m$ (C) $1400\,m$ (D) $1500\,m$

7. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in metres) of the particle from O is given by $x = 40 + 12t - t^3$
How long would the particle travel before coming to rest

(A) 24 m (B) 40 m (C) 56 m (D) 16 m

(Space for rough work)

8. Particle A moves along X-axis with a uniform velocity of magnitude 10 m/s. Particle B moves with uniform velocity 20 m/s along a direction making an angle of 60^o with the positive direction of X-axis as shown in figure. The relative velocity of B with respect to that of A is



(A) 10 m/s along X-axis

(B) $10\sqrt{3}\, m/s$ along Y-axis (perpendicular to X-axis)

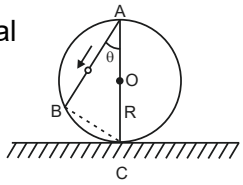
(C) $10\sqrt{5}$ along the bisection of the velocity of A and B

(D) 30 m/s along negative X-axis

9. A boat is moving with a velocity $3i + 4j$ with respect to ground. The water in the river is moving with a velocity $-3i - 4j$ with respect to ground. The relative velocity of the boat with respect to water is

(A) $8j$ (B) $-6i - 8j$ (C) $6i + 8j$ (D) $5\sqrt{2}$

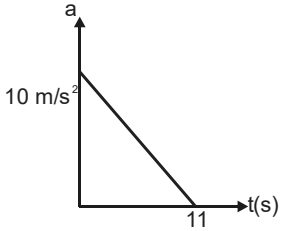
10. A frictionless wire AB is fixed on a sphere of radius R. A very small spherical ball slips on this wire. The time taken by this ball to slip from A to B is



(A) $\dfrac{2\sqrt{gR}}{g\cos\theta}$ (B) $2\sqrt{gR}.\dfrac{\cos\theta}{g}$

(C) $2\sqrt{\dfrac{R}{g}}$ (D) $\dfrac{gR}{\sqrt{g\cos\theta}}$

11. A particle starts from rest. Its acceleration (a) versus time (t) is as shown in the figure. The maximum speed of the particle will be



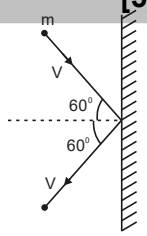
(A) 110 m/s (B) 55 m/s
(C) 550 m/s (D) 660 m/s

12. When a body is thrown with a velocity u making an angle θ with the horizontal plane, the maximum distance covered by it in horizontal direction is

(A) $\dfrac{u^2\sin\theta}{g}$ (B) $\dfrac{u^2 2\sin\theta}{2g}$ (C) $\dfrac{u^2\sin 2\theta}{g}$ (D) $\dfrac{u^2\cos 2\theta}{g}$

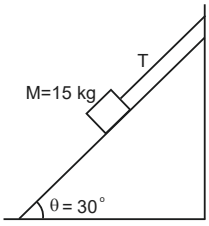
(Space for rough work)

13. A rigid ball of mass m strikes a rigid wall at 60^o and gets reflected without loss of speed as shown in the figure below. The value of impulse imparted by the wall to the ball will be



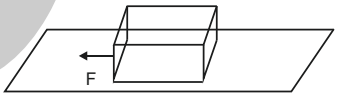
(A) $\frac{mV}{3}$ (B) mV (C) $2mV$ (D) $\frac{mV}{2}$

14. A block of mass 15 kg is held by a string on a inclined plane (angle 30^o). The tension T in the string is ($g = 10m/s^2$)



(A) 55 N (B) 60 N (C) 75 N (D) 90 N

15. A block of mass 2 kg is kept on the floor. the coefficient of static friction is 0.4. If a force F of 2.5 Newtons is applied on the block as shown in the figure, the frictional force between the block and the floor will be



(A) 2.5 N (B) 5 N (C) 7.84 N (D) 10 N

[SECTION - II]

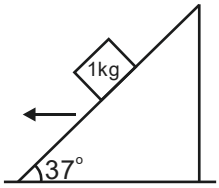
[COMPREHENSION TYPE]

This section contains 2 Comprehension (5 Multiple Choice Questions). Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

[**Marking Scheme : +4 marks** for correct answer and **-1** for wrong answer]

Passage # I

A block of 1 kg is kept on a wedge which is moving with constant acceleration $5m/s^2$ towards left. Given the surface between wedge and floor is smooth and coefficient of friction between block and wedge is $\mu = 0.2$. Take $g = 10m/s^2$



16. Find the work done by normal force during an interval of 2s on the block.

(A) 0 (B) 48 J (C) 66 J (D) 8 J

17. Find the work done by frictional force.

(A) $-17.6\,J$ (B) $-16\,J$ (C) $-48\,J$ (D) 0

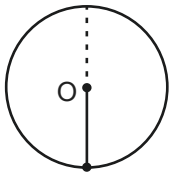
18. Find the work done by gravity

(A) $100\,J$ (B) $-40\,J$ (C) 0 (D) $32\,J$

(Space for rough work)

Passage # II

A small particle of mass m attached with a light inextensible thread of length L is moving in a vertical circle of radius L. Minimum velocity required for the particle to go around complete vertical circle at a highest point is $\sqrt{gL}$. In the given case particle is moving in complete vertical circle and ratio of its maximum to minimum velocity is 2 : 1.



19. Minimum velocity of the particle is

(A) $\sqrt{\frac{gL}{3}}$ (B) $2\sqrt{\frac{gL}{3}}$ (C) $4\sqrt{\frac{gL}{3}}$ (D) $8\sqrt{\frac{gL}{3}}$

20. Velocity of the particle when it is moving vertically downward is

(A) $2\sqrt{\frac{gL}{3}}$ (B) $\sqrt{\frac{8gL}{3}}$ (C) $\sqrt{\frac{10gL}{3}}$ (D) $\sqrt{\frac{13gL}{3}}$

(Space for rough work)

[SECTION - III]

[INTEGER TYPE]

This section contains 5 Subjective Questions. The answer to each of the questions is a single digits integer, ranging from 0 to 9 (both inclusive)

[Marking Scheme: +4 marks for correct answer and **0** for wrong answer**]**

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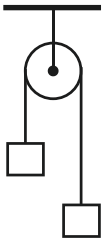
21. A light inextensible string that goes over a smooth fixed pulley as shown in the figure connects two blocks of masses 0.36 kg and 0.72 kg. Taking $g = 10 m/s^2$, find the work done (in joules) by the string on the block of mass 0.36 kg during the first second after the system is released from rest

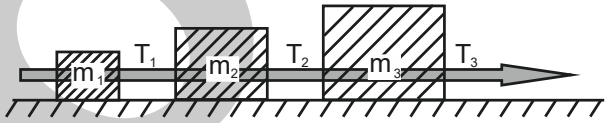


22. A force $\left(4\hat{i} + \hat{j} - 2\hat{k}\right) N$ acting on a body maintains its velocity at $\left(2\hat{i} + 2\hat{j} + 3\hat{k}\right) ms^{-1}$. The power exerted is (in Watt)

23. If a body looses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest

24. The height y and the distance x along the horizontal plane of a projectile on a certain planet (with no surrounding atmosphere) is given by $y = \left(4t - 5t^2\right) m$ and $x = 3t\, m,$ where t is in second. The velocity with which the projectile is projected is (in m/s)

25. Three blocks are connected as shown in the fig. on a horizontal frictionless table if $m_1 = 1kg,\ m_2 = 8kg, m_3 = 27kg$ and $T_3 = 36N,\ T_2$ will be



(Space for rough work)

PART - II [Chemistry]

[SECTION - I]

[SINGLE CORRECT TYPE]

This section contains 15 Multiple Choice Questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
[**Marking Scheme : +3 marks** for correct answer and **-1** for wrong answer]

26. 10gm of $CaCO_3$ was strongly heated and CO_2 liberated was absorbed in 1000 mL of 0.5 M NaOH. Assuming 90% purity of $CaCO_3$, how much solution of 0.5 M HCl would be required to react with the solution of the alkali to reach phenolphthalein end point? [Atomic mass C = 12, O = 16, Ca = 40]
(A) 730 mL (B) 800 mL (C) 410 mL (D) 820 mL

27. The IE_1, IE_2, IE_3, IE_4 and IE_5 of an element are 15.1, 24.3, 34.5, 46.8, 162.2 eV respectively. The element is likely to be: (I.E. = Ionisation energy)
(A) Na (B) Si (C) F (D) Ca

28. In which of the following $p\pi - d\pi$ bonding is observed?
(A) NO_3^- (B) SO_3^{2-} (C) BO_3^{3-} (D) CO_3^{2-}

29. The correct order of bond angles is:
(A) $H_2S < NH_3 < BF_3 < SiH_4$ (B) $NH_3 < H_2S < SiH_4 < BF_3$
(C) $H_2S < NH_3 < SiH_4 < BF_3$ (D) $H_2S < SiH_4 < NH_3 < BF_3$

30. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with highest boiling point is:
(A) H_2Se because of lower molecular weight
(B) H_2Te because of higher molecular weight
(C) H_2S because of hydrogen bonding
(D) H_2O because of hydrogen bonding

31. The value of Vander Waal's constant 'a' for gases O_2, N_2, NH_3 and CH_4 are 1.360, 1.390, 4.170 and 2.253 litre^2 atm mol^{-2} respectively. The gas which can most easily be liquefied is:
(A) O_2 (B) N_2 (C) NH_3 (D) CH_4

32. The equation for complete combustion of methanol is
$2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)$. If 64 g of CH_3OH is combined with 44.8 L of O_2, measured at STP, the number of moles of CO_2 which can be produced is: [Atomic mass H = 1, C = 12, O = 16]
(A) 2/3 (B) 11/3 (C) 11/2 (D) 4/3

(Space for rough work)

33. From the following reaction sequence,

$$CaC_2 + H_2O \longrightarrow CaO + C_2H_2$$

$$C_2H_2 + H_2 \longrightarrow C_2H_4$$

$$nC_2H_4 \longrightarrow (C_2H_4)_n$$

Calculate the mass of polythene which can be produced by 10kg of CaC_2. [Atomic mass C = 12, Ca = 40]

(A) 4.375 kg (B) 2.375 kg (C) 1.375 kg (D) 3.375 kg

34. The formal charge on the O-atoms in the ion $\left[:\ddot{O}=N=\ddot{O}:\right]^+$ is:

(A) -2 (B) -1 (C) 0 (D) +1

35. If a mole were defined to be 3×10^{24} instead of Avogadro's number (N_A), what would be the atomic mass of Argon? Atomic mass of Argon is 40 on conventional scale. ($N_A = 6 \times 10^{23}$)

(A) 18 (B) 90 (C) 200 (D) 8

36. An atomic orbital has 2 angular nodes and 1 radial node. The orbital is:

(A) 2p (B) 3p (C) 3d (D) 4d

37. What set of quantum numbers is NOT possible?

	n	l	m_l	m_s		n	l	m_l	m_s
(A)	2	1	1	$\frac{1}{2}$	(B)	2	1	-1	$\frac{1}{2}$
(C)	3	2	2	$\frac{1}{2}$	(D)	3	3	-3	$\frac{1}{2}$

38. Which electronic transition in He^+ emits light of wavelength equal to the longest wavelength emitted in the Paschen series of H atom?

(A) $9 \rightarrow 6$ (B) $8 \rightarrow 6$ (C) $8 \rightarrow 5$ (D) $7 \rightarrow 3$

39. Which of the following sets have correctly matched each molecule or ion and its gemetry?

	Tetrahedral	Trigonal pyramidal	T-shaped	Square Planar
(A)	CH_4	BCl_3	NO_3^-	SO_4^{2-}
(B)	SO_4^{2-}	NF_3	ICl_3	XeF_4
(C)	CH_4	NO_3^-	CO_3^{2-}	$SnCl_4$
(D)	CCl_4	PF_3	ICl_3	SF_4

(Space for rough work)

40. Density of a H_2SO_4 solution is 1.2 g/ml and it is 40% H_2SO_4 by weight. Determine molarity of this solution.
(A) 2.9 M (B) 3.9 M (C) 4.9 M (D) 5.9 M

[SECTION - II]
[COMPREHENSION TYPE]

This section contains 2 Comprehension (5 Multiple Choice Questions).
Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
[**Marking Scheme : +4 marks** for correct answer and **-1** for wrong answer]

Passage # I

20ml of the solution containg Na_2CO_3 and $NaHCO_3$ is titrated with 0.1 M HCl using Phenolphthalein indicator the end point was 10ml. 20ml of the same solution is titrated with 0.1M HCl, the end point was 25ml. with Methylorange indicator from the begining.
$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$
$Na2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$

41. What is molarity of Na2CO3 in solution
(A) 0.05 M (B) 1.05 g (C) 5M (D) can not be calculated

42. What is amount of NaHCO3 present in 1liter of solution
(A) 2.1 g (B) 1.05g (C) 8.1 g (D) 0.855 g

43. What amount of NaOH is required to convert $NaHCO_3$ to Na_2CO_3 in 1liter of solution.
(A) 2g (B) 20g (C) 1 g (D) 0.5 g

Passage # II

The energy required to pull the most loiosely bound electrons from an atom is known as ionization potential. It is expressed in electron volts. The value of ionization potential depends on three fators : (i) the charge on the nucleus (ii) the atomic radius and (iii) the screening effect of inner electron shells.

44. Ionization potential of Na would be numerically the same as
(A) electron affinity of Na+ (B) electronegativity of Na+
(C) electron affinity of Na (D) ionization potential of Mg

45. Which of the folowing elements has the least ionization potential?
(A) Lithium (B) Cesium (C) Mgnesium (D) Calcium

(Space for rough work)

[SECTION - III]

[INTEGER TYPE]

This section contains 5 Subjective Questions. The answer to each of the questions is a single digits integer, ranging from 0 to 9 (both inclusive)

[Marking Scheme: +4 marks for correct answer and **0** for wrong answer**]**

46. If root mean square speed of CH_4 (methane) at 48K is same as the most probable speed of H_2 at TK, then T is __

47. To prepare 100 gm of 92% by weight solution of NaOH. How many g of H_2O is needed.

48. Silver (atomic weight = 108 g/mol) has denisty of 10.5 g cm^{-3}. The number of silver atoms on a surface of area $10^{-22} m^2$ can be expressed in scientific notation $y \times 10^x$. The value of x is

49. The number of spherical node in 4s orbitals is

50. Maximum number of electrons in an atom that can have the quantum numbers n = 4, m_e = +1 is

(Space for rough work)

PART - III [Mathematics]

[SECTION - I]

[SINGLE CORRECT TYPE]

This section contains 15 Multiple Choice Questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
[**Marking Scheme : +3 marks** for correct answer and **-1** for wrong answer]

51. The minimum value of $9\tan^2\theta + 4\cot^2\theta$ is
(A) 13 (B) 9 (C) 6 (D) 12

52. If $y + \cos\theta = \sin\theta$ has a real solution, then
(A) $-\sqrt{2} \le y \le \sqrt{2}$ (B) $y > \sqrt{2}$ (C) $y \le -\sqrt{2}$ (D) None of these

53. The nth term of the series $1 + \frac{2}{3} + \frac{3}{3^2} + \frac{4}{3^3} + ...$ is
(A) $\frac{n}{3^{n-1}}$ (B) $\frac{n}{3^n - 1}$ (C) $\frac{3n}{n-1}$ (D) $\frac{1}{3^n - 1}$

54. The equation $ax^2 + bx + c = 0$, where a, b, c are the sides of a ΔABC, and the equation $x^2 + \sqrt{2}x + 1 = 0$ have a common root. The measure of $\angle C$ is
(A) 90^o (B) 45^o (C) 60^o (D) None of these

55. The value of $\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + ... + n$ terms is
(A) $\frac{n}{2n+1}$ (B) $\frac{2n}{2n+1}$ (C) $\frac{2n-1}{2n+1}$ (D) None of these

56. The value of $\lim_{x\to 0} \frac{\sin x - \tan x}{\tan^3 x}$ is
(A) 1 (B) -1 (C) 1/2 (D) $-1/2$

57. If $y = \sqrt{x + \sqrt{x + \sqrt{x + ...\infty}}}$, then the value of $(2y-1)\frac{dy}{dx}$ is
(A) 0 (B) 1 (C) -1 (D) 2

(Space for rough work)

58. If $\cos(x-y), \cos x$ and $\cos(x+y)$ are in H.P., then $\cos x \sec\frac{y}{2}$ is equal to

(A) $\sqrt{2}$ (B) $-\sqrt{2}$ (C) $\pm\sqrt{2}$ (D) None of these

59. If a, b, c, d, e are in A.P., then $(e-a)$ is equal to

(A) $2(b+d)$ (B) $2(b-d)$ (C) $2(d-b)$ (D) None of these

60. Equation of the bisector of angle B of the triangle ABC is y = x. If A is (2, 6) and B is (1, 1); equation of side BC is

(A) $2x+y-3=0$ (B) $x-5y+4=0$ (C) $x-6y+5=0$ (D) None of these

61. The value of $\log\cot 1^\circ + \log\cot 2^\circ + \log\cot 3^\circ + ... + \log\cot 89^\circ$ is:

(A) 0 (B) 1 (C) 1/2 (D) 3/4

62. The domain of the function $f(x)=\frac{\sqrt{x+2}}{x^2-9}$ is:

(A) $(-\infty,-3)\cup[2,\infty)$ (B) $[2,3)$ (C) $[-2,3)\cup(3,\infty)$ (D) $(-\infty,-3)\cup(3,\infty)$

63. If $y=\frac{1}{2x^2+3x+1}$, then $\frac{d^2y}{dx^2}$ at $x=-2$ is:

(A) $\frac{38}{27}$ (B) $-\frac{38}{27}$ (C) $\frac{27}{38}$ (D) None of these

64. If $\int \sin^3 x \sin 3x\,dx = A\sin 2x + B\sin 4x + C\sin 6x + Dx + K$,

(where K is integration constant), then (A + B + C + D) is equal to:

(A) $\frac{1}{96}$ (B) $-\frac{1}{96}$ (C) $\frac{11}{24}$ (D) $-\frac{11}{24}$

65. If the quadratic equation $ax^2+bx+c=0$ has two roots α & β, then

(A) $a(x-\alpha)(x-\beta)=0$ (B) $(x+\alpha)(x+\beta)=0$

(C) $b(x-\alpha)(x-\beta)=0$ (D) None of these

(Space for rough work)

[SECTION - II]

[COMPREHENSION TYPE]

This section contains 2 Comprehension (5 Multiple Choice Questions).
Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
[**Marking Scheme : +4 marks** for correct answer and **-1** for wrong answer]

Consider the quadratic polynomial $f(x) = x^2 - 4ax + 5a^2 - 6a$.

66. The value of a for which roots of $f(x) = 0$ are equal in magnitude and opposite in sign, is:

(A) 0 (B) 1 (C) 2 (D) None of these

67. Number of values of a for which the equation $f(x) = 0$ has exactly one root equals to zero, is:

(A) 0 (B) 1 (C) 2 (D) 3

68. The largest integral value of 'a' for which range of $f(x)$ is $[-5, \infty)$ for every real x, is

(A) 1 (B) 5 (C) 7 (D) 10

Passage # 2

Let ABCD is a square with sides of units length. Points E and F are taken on sides AB and AD respectively so that AE = AF. Let P any point inside the square ABCD.

69. The maximum possible area of quadrilateral CDFE is:

(A) $\frac{1}{8}$ (B) $\frac{1}{4}$ (C) $\frac{3}{8}$ (D) $\frac{5}{8}$

70. The value of $(PA)^2 - (PB)^2 + (PC)^2 - (PD)^2$ is equal to:

(A) 3 (B) 2 (C) 1 (D) 0

(Space for rough work)

[SECTION - III]

[INTEGER TYPE]

This section contains 5 Subjective Questions. The answer to each of the questions is a single digits integer, ranging from 0 to 9 (both inclusive)

[Marking Scheme: +4 marks for correct answer and **0** for wrong answer**]**

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71. Number of solution of the equation $e^x\left(e^x-2\right)=5\left|e^x-1\right|-7$ is

72. The value of $\cos 5^\circ+\cos 77^\circ+\cos 149^\circ+\cos 221^\circ+\cos 293^\circ$ is equal to

73. If the straight lines $ax+by+p=0$ and $x\cos\alpha+y\sin\alpha=p$ are inclined at an angle $\frac{\pi}{4}$ and concurrent with the straight line $x\sin\alpha-y\cos\alpha=0$, then a^2+b^2 is

74. Let S_1, S_2, ... be squares such that for each $n\geq 1$, the length of a side of S_n equals the length of the diagonal of S_{n+1}. If the length of a side of S_1 is 10cm and the area of S_n less than 1sqcm, then the least value of n is

75. The number of real soltuions of the equation $27^{1/x}+12^{1/x}=2\cdot 8^{1/x}$ is

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(Space for rough work)