PHYSICS

1. An object of size 10 cm is kept at a distance of 10 cm from a convex lens. If the focal length of the lens is 5 cm, the size of the image is

   a) 10 cm
   b) 20 cm
   c) 5 cm
   d) 15 cm

2. A biconvex lens of focal length 10 cm is to be made from a glass material. If the refractive index of the material is 1.5, what must be the radius of curvature of the surface of the lens?

   a) 0.1 m
   b) 0.15 m
   c) 0.20 m
   d) 0.30 m

3. A diffraction grating with 10^6 lines / m is used to determine the wavelength of a monochromatic source. The angle of first order diffraction is 30°. The wavelength of the source is

   a) 1000 nm
   b) 500 nm
   c) 400 nm
   d) 600 nm

4. A glass plate of thickness 1.5 μm and refractive index 1.5 is introduced between one of the slits and screen in a Young's double slit experiment. If the wavelength of the monochromatic source used is λ = 0.75 μm, the phase difference between the interfering waves at the centre of the screen is equal to

   a) 6π
   b) 3π
   c) π
   d) 2π

5. What is the velocity of light in a medium with refractive index 1.5?

   a) 2×10^8 m/s
   b) 3×10^8 m/s
   c) 1.5×10^8 m/s
   d) 2.5×10^8 m/s

6. Which among the following electromagnetic radiations is the most energetic?

   a) Infra red light
   b) Visible light
   c) Ultraviolet light
   d) microwaves

7. Which of the following particles has the shortest de-Broglie wavelength, if all of them move with same speed?

   a) beta particle
   b) alpha particle
   c) proton
   d) neutron

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8. The mass of a photon of wavelength λ is given by

a) h λ/c
b) λ/hc
c) h/ λc
d) hc/ λ

9. The radius of a nucleus with A = 256 is 8 fermi (1 fermi = 1×10^{-15} m). The radius of a nucleus with A = 4 is

a) 1 fermi
b) 2 fermi
c) 3 fermi
d) 4 fermi

10. Photons of energy 6 eV fall on the surface of a metal with work function 4 eV. The stopping potential of the metal surface is

a) 2 V
b) 10 V
c) 3 V
d) 1 V

11. Addition of a minute quantity of phosphorus to a silicon crystal makes it

a) an n-type semiconductor
b) a bad conductor
c) a good conductor
d) a p-type semiconductor

12. The electric current in a circuit is given by $I = I_0 \sin(\omega t + \theta)$. What is the dimension of θ ?

a) second
b) 1/second
c) meter / second
d) dimensionless

13. The velocity varies with time according to the relation, v = 3t + 4. The distance travelled by the body in t = 2 s will be

a) 10 m
b) 12 m
c) 14 m
d) 16 m

14. When a projectile is at the highest point on its trajectory, the potential and kinetic energies are respectively

a) maximum and minimum
b) minimum and zero
c) zero and maximum
d) maximum and zero

15. A block of mass 2 kg starts moving when the angle of inclination of the inclined plane is 60°. If the coefficient of kinetic friction is 0.6, the frictional force is

a) 2 N
b) 1 N
c) 4 N
d) 0.5 N

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16. Two forces $F_1 = (7i + 2j)$ N and $F_2 = (-5i + 3j)$ N act on a particle. The third force F_3 that should act on the particle to make it move with constant velocity is

a) $(2i + 5j)$ N
b) $(-2i - 5j)$ N
c) $(-2i + 5j)$ N
d) $(2i - 5j)$ N

17. Two satellites of masses 3M and M orbit the earth in circular orbits of radii r and 3r respectively. The ratio of their speeds is

a) 1 : 1
b) $\sqrt{3}$: 1
c) 3 : 1
d) 9 : 1

18. In an adiabatic process, the pressure of a gas is proportional to the cube of its absolute temperature. The value of γ (which equals C_p/C_v) is

a) 5/4
b) 4/3
c) 5/3
d) 3/2

19. A mass is moving towards the origin along the x-axis with constant velocity. Its angular momentum with respect to the origin

a) remains constant
b) is zero
c) increases
d) decreases

20. The rate of cooling of a liquid is 4° C/s, when its temperature is 80° C and is 2° C/s when its temperature is 50° C. The temperature of the surroundings is

a) 30° C
b) 20° C
c) 10° C
d) 25° C

21. A Charged sphere of radius 1m carries a charge of 1×10^{-9} C. The electric fields at a point P, which is at a distance d = 3m from the centre of the sphere and at a point Q, at a distance d = 0.3m from the centre of the sphere are respectively

a) 1 N/C and 100 N/C
b) 1 N/C and zero
c) zero and 1 N/C
d) 1 N/C and 3 N/C

22. An electric dipole lying along X-axis with moment 5 Am^2 is subjected to an electric field of magnitude 10j N/C. The torque experienced is

a) 2 Nm
b) 10 Nm
c) 50 Nm
d) 25 Nm

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23. A parallel plate capacitor with air gap of 5 mm is 2 MFD. If a metallic plate of thickness 3 mm is inserted in between the plates, the new capacitance is

a) 5 MFD
b) 1 MFD
c) 2 MFD
d) 2.5 MFD

24. A galvanometer of resistance 50 ohm gives a full scale deflection when 3 mA current passes through it. The series resistance that is to be connected to convert it into a voltmeter of range 0 – 3 V is

a) 500 Ω
b) 950 Ω
c) 1000 Ω
d) 750 Ω

25. Two resistances 6Ω and 3Ω are connected in parallel and this combination is connected in series with a 4Ω resistance. This combination is powered by a voltage source of 12 V and zero internal resistance. The ratio of power dissipated between 6Ω resistance and 4Ω resistance is

a) 1:4
b) 4:1
c) 1:8
d) 3:2

26. Two charged particles of charge ratio 1:4 moving with same velocity enter a region of uniform magnetic field of strength B and get deflected and move along curves with equal radius R. The ratio of their masses is

a) 4:1
b) 2:1
c) 1:4
d) 1:2

27. When a charged particle moves in a region with electric field $\vec{E} = 3\hat{i}$ N/C and magnetic field $\vec{B} = 5\hat{j}$ T, the trajectory of the particle is

a) circle
b) parabola
c) straight line
d) helix

28. Two co-axial coils A and B of radius R_1 and R_2 carry equal amount of current but flowing in opposite direction. The net magnetic field produced at the centre of these coils is zero. The ratio of the current flowing in the coil A to current in coil B is

a) $R_1 : R_2$
b) $R_2 : R_1$
c) $(R_2 / R_1)^2$
d) $(R_1 / R_2)^2$

29. Which among the following is a desirable feature of a ferromagnet that can be used as core of a transformer?

a) high hysteresis loss and low retentivity
b) low hysteresis loss and high retentivity
c) high coercive field and high retentivity
d) low hysteresis loss and low retentivity

30. The phase difference between the current through the resistance and voltage across the resistance in a series LCR circuit is

a) 180°
b) 0°
c) 90°
d) 45°

31. S_N1 reaction is favored by
    a) non polar solvents
    b) more number of alkyl group on the carbon atom attached to the halogen atom
    c) small groups on the carbon attached to the halogen atom
    d) no groups on the carbon attached to the halogen atom

32. Phenol is less acidic than
    a) ethanol
    b) o-nitrophenol
    c) o-methylphenol
    d) o-methoxyphenol

33. Chloro ethane reacts with compound Z to form diethyl ether. Identify Z?
    a) NaOH
    b) H_2SO_4
    c) C_2H_5ONa
    d) $Na_2S_2O_3$

34. Which of the following reagents may be used to distinguish between phenol and benzoic acid?
    a) Tollens' reagent
    b) Molisch reagent
    c) Neutral $FeCl_3$
    d) Aqueous NaOH

35. In the following sequence of reactions, the alkene affords the compound 'B'.

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

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

36. How many chiral carbons are there in β-D-(+)-glucose?
    a) five
    b) six
    c) three
    d) four

37. Why are certain rubbers called as 'vulcanized rubber'?
    a) They are formed under volcanic eruption
    b) They are prepared by adding 5% of sulphur as cross-linking agent
    c) They do not use any co-monomer
    d) By the addition of excessive co-monomer

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38. One of the common components of photochemical smog is

a) formaldehyde
b) acetaldehyde
c) methane
d) CO_2

39. Sodium dodecylbenzenesulphonate refers to

a) anionic detergent
b) soap
c) cationic detergent
d) nonionic detergent

40. Which one of the following acts as antihistamine?

a) Equanil
b) Morphine
c) Serotonine
d) Bromophenylamine

41. The actual atomic weight of an element is represented in

a) number
b) "u"
c) "amu"
d) "mu"

42. The weight of nascent oxygen in milligrams obtained from 6.32 g of potassium permanganate (Molecular weight 158) in acid medium is

a) 16
b) 0.016
c) 0.16
d) 1.6

43. The value of Plank's constant in units of Js is

a) 6.626×10^{-34}
b) 6.626×10^{-23}
c) 6.626×10^{-27}
d) 1.38×10^{-23}

44. The mass of proton having a wavelength of 4.2A° is

a) 4.78×10^{-33} kg
b) 4.78×10^{-33} g
c) 7.17×10^{-33} kg
d) 2.39×10^{-33} g

45. The measurement of a thermodynamic property known as temperature is based on

a) zeroth law of thermodynamics
b) first law of thermodynamics
c) second law of thermodynamics
d) kirchoffs equation

46. The bond dissociation enthalpies of $H_2(g)$, $Cl_2(g)$ and HCl(g) are 435, 243 and 431 kJ/mol respectively. The enthalpy of formation of HCl(g) in kJ/mol will be

a) 121
b) -1211
c) -121
d) -242

47. Defective coating of zinc over mild steel leads to

a) enhanced corrosion of mild steel
b) increase of corrosion potential
c) corrosion of zinc coating
d) hydrogen evolution over mild steel

48. What will happen to the rate constant of a reaction when the temperature is raised by 10° C?

a) Increase by 10 times
b) Is halved
c) Is doubled
d) Not affected

49. The equivalent conductances at infinite dilution ($\lambda \infty$) of ammonium chloride, sodium hydroxide and sodium chloride are 120, 240 and 150 mhocm^{2}eq^{-1}. The $\lambda\infty$ of ammonium hydroxide in mhocm^{2}eq^{-1} is

a) 270
b) 210
c) 30
d) 510

50. 100 cm^3 of an aqueous solution of protein contains 0.63 g of protein. If the osmotic pressure of the solution at 300K is 2.57 x 10^{-3} bar, the molar mass of the protein will be

a) 60039
b) 61039
c) 62039
d) 63039

51. A compound formed by elements P and Q crystallizes in cubic structure in which atoms of P are at corners and atoms of Q are at the face center. The formula of the compound is

a) AB_3
b) AB
c) A_3B
d) A_2B

52. Syn gas is a mixture of

a) carbon dioxide and hydrogen
b) carbon monoxide and hydrogen
c) methane and hydrogen
d) methane and carbon monoxide

53. Which one of the following alkali metal hydrides is thermally stable?

a) Lithium hydride
b) Sodium hydride
c) Potassium hydride
d) Rubidium hydride

54. The correct order of acidic character of the following is

a) $SO_2 > CO_2 > CO > N_2O_5$
b) $SO_2 > N_2O_5 > CO > CO_2$
c) $N_2O_5 > SO_2 > CO > CO_2$
d) $N_2O_5 > SO_2 > CO_2 > CO$

55. Bell metal is an alloy of

a) copper and tin
b) silver and copper
c) copper and nickel
d) copper, zinc and tin

56. Ammonium dichromate is used in fireworks. The green coloured powder blown in the air is

a) CrO_3
b) Cr_2O_3
c) Cr
d) CrO (O_2)

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57. Which one of the following complexing agents is used for the estimation of hardness of water?

a) Cyanide
b) Pyrophosphate
c) EDTA
d) Ethylene diamine

58. How many σ and π bonds are present in nitromethane

a) 6 σ and 1 π
b) 5 σ and 2 π
c) 6 σ and 2 π
d) 5 σ and 1 π

59. Retardation factor is calculated as

a) ratio between 'distance travelled by the substance from the base line and distance moved by the solvent from the base line'
b) ratio between 'distance travelled by the solvent from the base line and distance moved by the substance from the base line'
c) sum of 'distance travelled by the substance from the base line and distance moved by the solvent from the base line'
d) difference of 'distance travelled by the substance from the base line and distance moved by the solvent from the base line'

60. In which one of the following, Mn exhibits its highest oxidation state?

a) MnO_2
b) MnO_4^{2-}
c) MnO_4^-
d) MnO

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61. The probability that the roots of the equation $x^2 + 2nx + \left(4n + \frac{5}{n}\right) = 0$ are not real numbers where n $\in$N such that n $\leq$ 5 is

a) 2/5 b) 4/5

c) 1/5 d) 3/5

62. If A is area lying between the curve y = cos x and x-axis between x = 0 and x = $\pi/2$, then the area of the region between the curve y = $\cos^2 x/2$ and the x-axis in the same interval is given by

a) $(\pi+A)/2$ b) $(\pi/4)+A$

c) $(\pi/2)+A$ d) $(\pi/4)+(A/2)$

63. $\int_{-1}^{1} \frac{x}{|x|} dx$ is equal to

a) 2 b) -2

c) 1 d) 0

64. If the area bounded by the curve y = f(x), x-axis and the ordinates x = 1 and x = b is (b - 1) sin(3b + 4), then f(x) is

a) [(x-1) cos (3x+4)] b) [sin(3x+4) + 3(x-1) cos(3x+4)]

c) sin (3x+4) d) None

65. The coefficient of x^{10} in the expansion of $(1 - x^3)^4 (1 + x)^5$ is

a) 15 b) 20

c) 10 d) 6

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66. Which one of the following is TRUE for any x

a) $\frac{1}{x+5} < \frac{1}{x+2} < \frac{1}{x+3}$

b) $\frac{1}{x+2} < \frac{1}{x+3} < \frac{1}{x+5}$

c) $\frac{1}{x+5} < \frac{1}{x+3} < \frac{1}{x+2}$

d) $\frac{1}{x+3} < \frac{1}{x+2} < \frac{1}{x+5}$

67. The order and degree of the differential equation $y - x\frac{dy}{dx} = \frac{a\frac{dy}{dx}}{\sqrt{1+\left(\frac{dy}{dx}\right)^3}}$ is

a) 1, 2

b) 1, 4

c) 1, $5\sqrt{2}$

d) 1, 3

68. The general solution of the differential equation $(1 + e^{(x/y)}) dx + e^{(x/y)} (1-(x/y)) dy = 0$ is

a) $y + xe^{(x/y)}=C$

b) $x + ye^{(x/y)}=C$

c) $x + C=ye^{(x/y)}$

d) $y + ye^{(x/y)}=C$

69. The triangle with vertices A = (2, 7), B = (4, y) and C = (-2, 6) is right angled at B if the value of y is

a) 10 or -3

b) -10 or -3

c) 10 or 3

d) 9 or 4

70. The point equidistant from the three lines x + y =1, y = 1 and x = 1 is

a) $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$

b) $\left(+\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$

c) $\left(+\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{2}}\right)$

d) $\left(+\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{3}}\right)$

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71. The equation of the line mid parallel to the two lines $5x - 2y - 9 = 0$ and $5x - 2y + 7 = 0$ is

a) $x + 5y - 8 = 0$ b) $5x - y - 1 = 0$

c) $2x - 5y - 6 = 0$ d) $5x - 2y - 1 = 0$

72. The straight line $3x + 4y + 4 = 0$ is moved parallelly so that its distance from the point $(3, -2)$ is increased by 4 units. Then its equation in the new position is

a) $3x + 4y - 30 = 0$ b) $3x + 4y - 24 = 0$

c) $3x + 4y - 21 = 0$ d) $3x + 4y + 24 = 0$

73. If a, b, c are AM, GM and HM respectively of two equal numbers, then

a) $2b = a + c$ b) $b = 2ac / (a+c)$

c) $b^2 = ac$ d) $ab^2 = c$

74. The harmonic mean of the roots of the equation is
$(7 + \sqrt{3})x^2 - (6 + \sqrt{7})x + (12 + 2\sqrt{7}) = 0$

a) 8 b) 6

c) 3 d) 4

75. The general solution of x satisfying the system of equations $5^{(\sin x + \sin y)} = 1$; $25^{(\sin 2x + \sin 2y)} = 5$ is

a) $n\pi \pm \pi/6$ b) $2n\pi + \pi/6$

c) $n\pi - (\pi/6)$ d) $n\pi + \pi/6$

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76. The angles of a triangle are in A.P and the least angle is 40°. The greatest angle in radians is

a) $\pi/2$ b) $4\pi/9$

c) $\pi/4$ d) $3\pi/2$

77. If $\sin\theta = 1/\sqrt{5}$ and $\tan\theta = 1/2$, then $\cos\theta$ is equal to

a) $2/\sqrt{5}$ b) $1/\sqrt{3}$

c) $1/\sqrt{5}$ d) $1/(2\sqrt{5})$

78. The value of $\lim_{x \to 0} (1 + x^3 + 5\sin x)^{4/\tan x}$ is equal to

a) 1 b) e^4

c) e d) $e^{1/4}$

79. Rolle's Theorem for $f(x) = x(x-3)e^{(-x/2)}$ is applicable in the interval

a) (0, 3) b) (0, -3)

c) (-3, 0) d) (3, 0)

80. Equation of the normal to the curve $y=(1+x)^y + \sin^{-1}(\sin^2 x)$ at $x = 0$ is

a) $y = x$ b) $y - x = 1$

c) $y + x = 1$ d) $y - 1 = 2x$

81. If A and B are two matrices such that $AB = A$ and $BA = B$, then $A^2 - B^2 =$

a) 2 AB b) A – B

c) A + B d) 2 BA

82. The system of linear equations $x + 3y + (\lambda+2)z = 0$, $2x + 4y + 8z = 0$, $3x + 5y + 10z = 0$ has non-trivial solution, when λ is

a) -2 b) 2

c) 4 d) -4

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83. If the roots of the equation $ax^2 + bx + c = 0$ are in the ratio 2 : 3, then

a) $6b^2 = 25\,ac$ b) $6b^2 = 25(a+c)$

c) $13b^2 = 6\,ac$ d) $13b^2 + 6\,ac = 0$

84. If $\vec{a}$ and $\vec{b}$ are adjacent sides of a parallelogram with $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, the adjacent sides of parallelogram are

a) perpendicular b) inclined at an angle of $\pi/3$

c) parallel d) inclined at an angle of $\pi/4$

85. The scalar $\vec{b} \cdot \{(\vec{c} + \vec{a}) \times (\vec{a} + \vec{b} + \vec{c})\}$ is equal to

a) $[\vec{a}, \vec{b}, \vec{c}\,]$ b) 0

c) $[\vec{a}, \vec{b}, \vec{c}] + [\vec{b}, \vec{c}, \vec{a}]$ d) $[\vec{a}, \vec{b}, \vec{c}] + [\vec{b}, \vec{c}, \vec{a}] + [\vec{c}, \vec{a}, \vec{b}]$

86. The equation of the line passing through the point of intersection of the lines and which $\frac{x-1}{1} = \frac{y-1}{0} = \frac{z-2}{1}$ and $\frac{x}{0} = \frac{y}{1} = \frac{z}{1}$ is perpendicular to the plane $5x-y+9z=10$ is

a) $\frac{x}{5} = \frac{y-1}{1} = \frac{z-1}{9}$ b) $\frac{x}{5} = \frac{y+1}{-1} = \frac{z-1}{9}$

c) $\frac{x}{5} = \frac{y+1}{-1} = \frac{z+1}{9}$ d) $\frac{x}{5} = \frac{y-1}{-1} = \frac{z-1}{9}$

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87. The equation of the plane through the intersection of the planes $2x - y + z = 6$ an $x + y + 2z = 7$ and passing through the point (1, 1, 1) is

a) $2x - 7y - 5z + 10 = 0$

b) $2x - 7y + 5z + 10 = 0$

c) $2x - 7y - 5z - 10 = 0$

d) $2x + 7y - 5z - 10 = 0$

88. The equation of the line passing through the point (1, 1, 0) and parallel to the plan $3x + 2y + z = 5$ is

a) $\frac{x-1}{-3} = \frac{y-1}{-2} = \frac{z}{1}$

b) $\frac{x+1}{3} = \frac{y+1}{2} = \frac{z}{1}$

c) $\frac{x-1}{3} = \frac{y-1}{2} = \frac{z}{1}$

d) $\frac{x-3}{1} = \frac{y-2}{1} = \frac{z-1}{0}$

89. The angle between the complex numbers $2 + 2i$ and -7 is

a) $\pi/2$

b) $\pi/4$

c) $3\pi/2$

d) $3\pi/4$

90. What is the value of $4 + 5\left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)^{334} + 3\left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)^{365}$?

a) i

b) $\frac{\sqrt{3}}{2}$

c) $\frac{\sqrt{3}}{2}i$

d) $\sqrt{3}i$

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91. The ratio between the number of ways we can arrange n persons in a circular manner to the number of ways we can arrange them in a line is

a) 1:n

b) n:1

c) 1:1

d) 1:2

92. A team of 8 students goes on an excursion, in two cars, of which one can seat 5 and the other only 4. In how many ways can they travel?

a) 274

b) 26

c) 126

d) 96

93. The number of common tangents to the circles $x^2 + y^2 - 4y = 0$ and $x^2 + y^2 - 2y = 0$ is

a) 4

b) 2

c) 3

d) 1

94. Centre of the circle passing through (4, 5), (3, 4), (5, 2) is

a) (9/2, 7/2)

b) (7/2, 9/2)

c) (7/2, 7/2)

d) (9/2, 9/2)

95. If e_1 and e_2 are the eccentricities of a hyperbola and its conjugate then $e_1^2 + e_2^2$ will be

a) 1

b) $e_1^2 e_2^2$

c) 0

d) $\frac{1}{e_1^2} + \frac{1}{e_2^2}$

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96. The equation $4x^2 + 7y^2 + 32x - 56y + 148 = 0$ represents

a) an ellipse with center (4, -4)

b) an ellipse with center (-4, 4)

c) an ellipse with center (2, -2)

d) an ellipse with center (-2, 2)

97. The equation for the circle obtained by shifting the circle $x^2 + y^2 = 49$ to 3 units down and 2 units left is:

a) $(x+3)^2 + (y+2)^2 = 49$

b) $(x-3)^2 + (y-2)^2 = 49$

c) $(x-2)^2 + (y-3)^2 = 49$

d) $(x+2)^2 + (y+3)^2 = 49$

98. The variance of a data set is k, then the variance of the data set obtained by shifting th original data to 3 units is

a) $k - 3$

b) $k + 3$

c) k

d) $3k$

99. Suppose that $P(A/B) = 0.7$, $P(A) = 0.5$ and $P(B) = 0.2$ then $P(B/A)$ is,

a) 0.14

b) 0.4

c) 0.3

d) 0.28

100. A medical test is capable of identifying someone with the illness as positive is 99% and someone without illness as negative 95%. If the illness is present in the general population with probability 0.0001, the probability for anyone to have illness when the medical test results positive is

a) 0.00009

b) 0.002

c) 0.0001

d) 0.9980

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