CODE
3

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PRACTICE PAPER# 3

CLASS-XII

Time : 3 Hr. **Max. Marks : 100**

1. The Question paper consists of two parts (both contain only multiple choice question) for 100 marks. There will be four sections in **Part-I** (each containing 20 questions) four sections in **Part-II** (each containing 10 questions). Answer any **THREE** of the four sections in Part-I and any **TWO** of the four sections in Part-II.

2. The question paper **CODE** is printed on the right hand top corner on this sheet of this booklet.

3. The composition of the question paper is given in the table below :

S No.	Subject	Part-I	Part-II
1	Mathematics	20 questions - 1 mark each	10 questions - 2 mark each
2	Physics	20 questions - 1 mark each	10 questions - 2 mark each
3	Chemistry	20 questions - 1 mark each	10 questions - 2 mark each
4	Biology	20 questions - 1 mark each	10 questions - 2 mark each

4. The answer paper is machine readable. Do not forget to mention your paper code and **Roll Number** neatly and clearly in the blank space provided in the **Objective Response Sheet (ORS)/Answer Sheet.**

5. For each question, indicate your answer by filling the corresponding oval with a HB pencil only.

6. For each question there will be four choices given and only one of them is the correct answer. Fill only **one oval** per question. If you mark **more than one oval**, it will be considered as an **incorrect answer.**

7. There is **negative marking** for wrong answers. Unanswered questions will not be evaluated and will not be penalized as a wrong answer.

8. In Part-I each correct answer gets 1 mark and for each incorrect answer **0.25 mark will be deducted.** In Part-II each correct answer gets 2 marks and for each incorrect answer **0.5 mark will be deducted.**

9. You are permitted to use a non programable calculator.

10. Candidates are permitted to carry their question paper after the examination.

PRACTICE PAPER-3

MATHEMATICS

1. Suppose the sequence a_1, a_2, a_3 ..... is an arithmetic progression of distinct numbers such that the sequence a_1, a_2, a_4, a_8..... is a geometric progression. The common ratio of the geometric progression is :
(A) 2 (B) 4 (C) a_1 (D) not determinable

2. The positve integer k for which $(101)^{k/2}/k!$ is a maximum is :
(A) 9 (B) 10 (C) 11 (D) 101

3. Let $p(x) = a_0 + a_1x + ...+ a_nx^n$ be a zero polynomial with integer coefficients. If $p(\sqrt{2}+\sqrt{3}+\sqrt{6}) = 0$, the smallest possible value of n is :
(A) 8 (B) 6 (C) 4 (D) 2

4. Three players play a total of 9 games. In each game, one person wins and the other two lose ; the winner gets 2 points and the losers get 1 each. The number of ways in which they can play all the 9 games and finish each with a zero score is :
(A) 84 (B) 1680 (C) 7056 (D) 0

5. In a triangle, two vertices are (2, 3) and (4, 0), and its circumcentre is (2, z) for some real number z. The circumradius is :
(A) $\frac{6}{2+\sqrt{13}}$ (B) $\sqrt{5}$ (C) 2 (D) $\frac{13}{6}$

6. Consider an ellipse with foci at (5, 15) and (21, 15). If the x-axis is a tangent to the ellipse, then the length of its major axis equals :
(A) 17 (B) 34 (C) 13 (D) $\sqrt{416}$

7. Let the line 2x + 3y = 18 intersect the y-axis at B. Suppose C ($\neq$ B), with coordinates (a, b), is a point on the line such that PB = PC, where P = (10, 10). Then 8a + 2b equals :
(A) 60 (B) 62 (C) 66 (D) 79

8. If $\text{cosec}^2(\alpha+\beta) - \sin^2(\beta-\alpha) + \sin^2(2\alpha-\beta) = \cos^2(\alpha-\beta)$, where $\alpha, \beta \in (0, \pi/2)$ then $\sin(\alpha-\beta)$ is equal to :
(A) $\frac{-1}{2}$ (B) $\frac{1}{2}$ (C) $\frac{-\sqrt{3}}{2}$ (D) $\frac{\sqrt{3}}{2}$

9. If $\sin x + \sin y = \frac{7}{5}$ and $\cos x + \cos y = \frac{1}{5}$, the $\sin(x + y)$ equals :
(A) $\frac{7}{25}$ (B) $\frac{24}{25}$ (C) $\frac{-7}{25}$ (D) $\frac{-24}{25}$

10. The number of solutions to $\sin x = \frac{6}{x}$ with $0 \le x \le 12\pi$ is :
(A) 1 (B) 6 (C) 10 (D) 12

11. Define a function $f : R \to R$ given by :

$$f(x) = \begin{cases} \dfrac{\sin x^2}{x}, & \text{for } x < 0 \\ x^2 + ax + b, & \text{for } x \geq 0 \end{cases}$$

Suppose f(x) differentiable on R. Then,

(A) a =0, b = 0 (B) a = 1, b = 0 (C) a = 0, b = 1 (D) a = 1, b = 1

12. The shortest distance from (0, 3) to the parabola $y^2 = 4x$ is :

(A) 2 (B) $\sqrt{2}$ (C) 5 (D) $\sqrt{5}$

13. Ten trucks, numbered 1 to 10, are carrying packets of sugar. Each packet weighs either 999 gms or 1000 gms and each truck carries only the packets equal weights. The combined weight of 1 packet selected from the first truck, 2 packets from the second, 4 packet from the third, and so on and 2^9 packets from the tenth truck is1022870 gms. The trucks that have the lighter bags are :

(A) 1, 3, 5 (B) 2, 4, 5 (C) 1, 9 (D) 2, 8

14. What is the value of $\int_0^1 \cos(\pi x)\cos([2x]\pi)dx$? (Here | t | denotes the integral part of the real number t)

(A) 1 (B) – 1 (C) $\frac{2}{\pi}$ (D) $\frac{-2}{\pi}$

15. The value of the limit $\lim_{n\to\infty} \int_0^1 x^{10} \sin(nx)dx$ equals :

(A) 0 (B) $\frac{1}{10!}$ (C) $\frac{\pi}{2}$ (D) 1

16. The area bounded by the parabolas $y = x^2$ and $y = 1 – x^2$ equals :

(A) $\frac{\sqrt{2}}{3}$ (B) $\frac{2\sqrt{2}}{3}$ (C) $\frac{1}{3}$ (D) $\frac{2}{3}$

17. A vector which bisects the angle between $\vec{a} = 3\vec{i} - 4\vec{k}$ and $\vec{b} = 5\vec{j} + 12\vec{k}$ is :

(A) $39\vec{i} – 25\vec{j} + 8\vec{k}$ (B) $3\vec{i} - 5\vec{j} + \frac{5}{8}\vec{k}$ (C) $39\vec{i} + 25\vec{j} + 8\vec{k}$ (D) $3\vec{i} + 5\vec{j} + \frac{5}{8}\vec{k}$

18. An envelope has space for at most 3 stamps. If you are given three stamps of denomination 1, and three stamps of denomination a (a > 1), the least positive integer for which there is no stamp value is :

(A) 7 (B) 8 (C) 9 (D) 10

19. If m, n are positive integers such that m < n and $\sum_{d/m} d = \sum_{d/n} d$ (here d | k moeans d is a positive of k), then :

(A) $\sum_{d/m} \frac{1}{d} < \sum_{d/n} \frac{1}{d}$ (B) $\sum_{d/m} \frac{1}{d} = \sum_{d/n} \frac{1}{d}$

(C) $\sum_{d/m} \frac{1}{d} > \sum_{d/n} \frac{1}{d}$ (D) no relationship can be determined

20. The number of relation R from an m-element set A to an n-element set B satisfying the condition : $(a, b_1) \in R, (a, b_2) \in R \Rightarrow b_1 = b_2$ for $a \in A, b_1, b_2 \in B$ is :

(A) n^m (B) $2^{m+n} – 2^m – 2^n$ (C) mn (D) $(n + 1)^m$

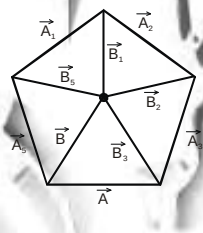
PHYSICS

21. The relation $C_p - C_v = R$(C_p, C_v : Molar specific heats at constant pressure, volume) is exactly true for :
(A) an ideal mono-atomic gas (B) any ideal gas, whether mono-dia poly atoimc
(C) any real gas above its critical temperature (D) all real gases

22. The molecules of air in the room that you are sitting are all experieneing the force of gravity tending to bring them down. The molecules are also frequently and randomly undergoing collisions, which tend to oppose the effect of fall under gravity. The density of air is nearly uniform throughout the room because
(A) the mass of the molecules is very small
(B) the gravitational potential energy mgh is such lesser than the average thermal energy kT.
(C) the gravitational potential enrgy mgh is mush greater the the average thermal energy kT.
(D) mgh is nearly of the same magnitude as kT, which results in the cancellation of the two opposing factors.

23. A parallel plate capacitor is charged fully by using a battery. Then without disconnecting the battery, the plates are moved further apart. Then,
(A) the charge on the capacitor increases
(B) the voltage difference between the plates decreases
(C) the capacitance increases
(D) the electrostatic energy stored in the capacitor decreases

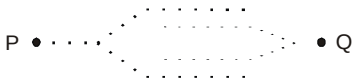
24. The five sides of a regular pentagon are represented by vectors $\vec{A}_1$, $\vec{A}_2$, $\vec{A}_3$, $\vec{A}_4$ and $\vec{A}_5$, in cyclic order as shown. Corresponding vertices are represented by $\vec{B}_1$, $\vec{B}_2$, $\vec{B}_3$, $\vec{B}_4$ and $\vec{B}_5$ drawn from the centre of the pentagon.



Then $\vec{B}_2 + \vec{B}_3 + \vec{B}_4 + \vec{B}_5 =$

(A) $\vec{A}_1$ (B) $-\vec{A}_1$ (C) $\vec{B}_1$ (D) $-\vec{B}_1$

25. Four melallic plates each of surface area (of one side) A, are placed at a distance d apart from each other. The two outer plates are connected to a point P and the two inner plates to another point Q as shown in figure.



Then the capcitance of the system is

(A) $\varepsilon_0 \frac{A}{2d}$ (B) $\varepsilon_0 \frac{A}{d}$ (C) $2\varepsilon_0 \frac{A}{d}$ (D) $3\varepsilon_0 \frac{A}{d}$

26. A progressive wave travelling in positve x-direction given by $y = a\cos(kx - \omega t)$ meets a denser surface at $x = 0$, $t = 0$. The reflected wave is then given by
(A) $y = -a\sin(kx - ax)$ (B) $y = -a\cos(kx + ax)$ (C) $y = a\sin(\omega t - kx)$ (D) $y = a\cos(kx - \omega t)$

27. A charge Q is spread non uniformly on the surface of a hollow sphere of radius R, such that the charge density is given by $\sigma = \sigma_0(1 - \sin\theta)$, where θ is the usual polar angle. The potential at the centre of the sphere is

(A) $\frac{Q}{2\pi\varepsilon_0 R}$ (B) $\frac{Q}{\pi\varepsilon_0 R}$ (C) $\frac{Q}{8\pi\varepsilon_0 R}$ (D) $\frac{Q}{4\pi\varepsilon_0 R}$

28. An ideal diatomic gas is heated at constant pressure. The ratio of the work done to the heat supplied is

(A) $\frac{3}{5}$ (B) $\frac{2}{5}$ (C) $\frac{2}{7}$ (D) $\frac{4}{7}$

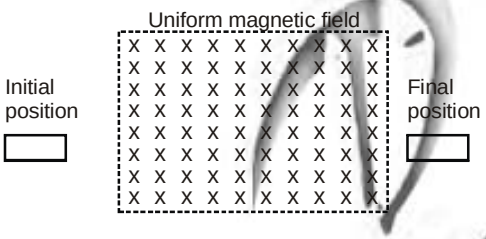
29. In the hydrogen spectrum, the ratio of the wavelengths for Lyman α – radiation to Balmer – α radiation is

(A) $\frac{5}{27}$ (B) $\frac{5}{48}$ (C) $\frac{27}{5}$ (D) $\frac{1}{3}$

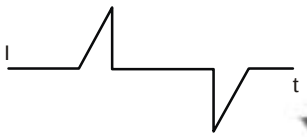
30. Two identical conducting spheres carry identical charges. If the spheres are set at a certain distance apart, they repel each other with a force F. A third conducting sphere, identical to the other two, but initially uncharged, is then touched to one sphere, and then to the other before being removed. The force-between the original two spheres is now

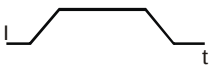
(A) $\frac{F}{2}$ (B) $\frac{F}{4}$ (C) $\frac{3F}{4}$ (D) $\frac{3F}{8}$

31. A small rectangular loop of wire in the plane of the paper is moved with uniform speed across a limited region of uniform magnetic field perpendicular to the plane of the paper, as shown.

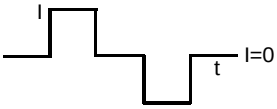


Which graph would best represent the variation of the electric current, I, in the wire with time t ?

(A) 

(B) 

(C) 

(D) 

32. The moment of inertia of a solid disc made of thin metal of radius R and mass M about one of its diameter is given by $\frac{MR^2}{4}$. What will be the moment of inertia about this axis if the disc is folded in half about this diameter ?

(A) $\frac{MR^2}{8}$ (B) $\frac{MR^2}{2}$ (C) $\frac{MR^2}{4}$ (D) MR^2

33. A plane electromagnetic weve propagating in the direction of the unit vector $\hat{n}$ with a speed c is described by electric and magnetic field vectors $\vec{E}$ and $\vec{B}$, respectively. Which of the following relations (in SI units) between $\vec{E}$ and $\vec{B}$ can be ruled out on dimensional grounds alone ?

(A) $\vec{E} = \frac{\hat{n}\times\vec{B}}{c}$ (B) $\vec{E} = c\hat{n}\times\vec{B}$ (C) $\vec{B} = \frac{\hat{n}\times\vec{E}}{c}$ (D) $\hat{n}\times\vec{E}\times\vec{B} = 0$

34. A point electric dipole placed at the origin has a potential given by $V(r, \theta) = \frac{p\cos\theta}{4\pi\varepsilon_0 r^2}$ where θ is the angle made by the position vector with the direction of the dipole. Then

(A) since the potential vanishes at $\theta = \frac{\pi}{2}$, the electric field is zero everywhere on the $\theta = \frac{\pi}{2}$ plane

(B) the electric field everywhere on the $\theta = \frac{\pi}{2}$ plane is normal to the plane.

(C) the electric field everywhere on the $\theta = \frac{\pi}{2}$ plane is along the plane

(D) the electric field vanishes on the $\theta = 0$ the

35. A uniform non-deformable cylinder of mass m and radius R is rolling without slipping on a horizontal rough surface. The force of friction is

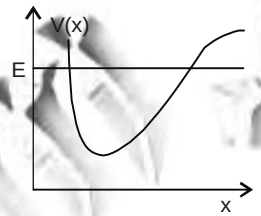
(A) μ mg, where μ is the coefficient of sliding friction

(B) zero

(C) increases with time

(D) decreases with time

36. Consider a one-dimensional potential V(x) as shown in the figure below. A classical particle of mass m moves under its influence and has total energy E as shown.



The motion is

(A) non-periodic

(B) stationary

(C) periodic but not simple harmonic

(D) simple harmonic

37. A source of frequency f is emitting sound waves. If temperature of the medium increases, then

(A) wavelength of the sound wave increases

(B) speed of the sound wave decreases

(C) wavelength of the sound wave decreases

(D) amplitude of the sound wave increases

38. A block of mass m is stationary on a rough plane of mass M inclined at an angle θ to the horizontal while the whole set up is accelerating upwards at an acceleration a. If the coefficient of friction between the block and the plane is μ, then the force that the plane exerts on the block is

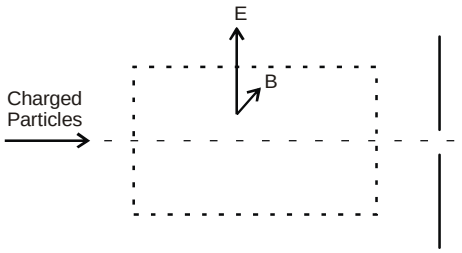
(A) m (g + a) upwards

(B) mg cos θ normal to the plane

(C) resultant of mag cos θ normal to the plane and μ mg cos θ along the plane

(D) resultant of m (g + a) cos θ normal to the plane and μmg cos θ along the plane.

39. A stream of charged particles enter into a region with crossed electric and magnetic fields as shown in the figure. On the other side is a screen with a hole that is right on the original path of the particles then,

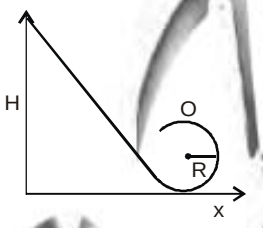


(A) no particle can get through the hole
(B) all particles can get through the hole

(C) only positively charged particles with speed $\frac{E}{B}$ can get through the hole

(D) all particles with speed $\frac{E}{B}$ can get through the hole.

40. A small body is released from a height H of an inclined plane. At the bottom of the plane is a loop of radius R as shown.



Ignoring friction, the minimum H required for the body to just complete the loop (that is, reach the point 0) is

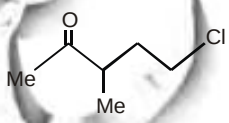
(A) 2R (B) $\frac{5R}{2}$ (C) 3R (D) $\frac{7R}{2}$

CHEMISTRY

41. The gas that has the slowest rate of diffusion among O_2, H_2, CO_2 and CH_4 is
(A) O_2 (B) H_2 (C) CO_2 (D) CH_4

42. Assuming ideal behaviour the ratio of kinetic energies of 3 g of H_2 and 4g of O_2 at any temperature is
(A) 3 : 4 (B) 1 : 16 (C) 4 : 3 (D) 12 : 1

43. The IUPAC name for the compound



is

(A) 1-chloro - 3-methyl- 4-pentanone (B) 1-chloro - 2-methyl- 4-pentanone
(C) 5-chloro - 3 - methyl- 2-pentanone (D) 5-chloro - 2-methyl- 3-pentanone

44. The shape of the molecule ClF_3 is
(A) triangular (B) pyramidal (C) T-shape (D) linear

45. Among CO_3^{2-}, OH^-, NH_3 and HCO_3^-, the species that acts as a Bronsted acid as well as a Bronsted base is
(A) Na_2CO_3 (B) NH_3 (C) OH^- (D) HCO_3^-

46. The ratio of the heat capacities C_p/C_v for one mole of a gas is 1.67. The gas is :
(A) He (B) H_2 (C) CO_2 (D) CH_4

47. The ion that is isoelectronic with CO is
(A) O_2^+ (B) O_2^- (C) CN^- (D) N_2^+

48. Among CH_4, CO_2, H_2O and SO_2, the bond angle is the highest in
(A) CH_4 (B) CO_2 (C) H_2O (D) SO_2

49. The solvent of choice for carrying out a Grignard reaction is
(A) diethyl ether (B) chloroform (C) ethyl acetate (D) ethanol

50. The reaction of butanal with n-propylmagnesium bromide gives a
(A) chiral secondary alcohol (B) achiral secondary alcohol
(C) chiral tertiary alcohol (D) achiral tertiary alcohol

51. The hybridization of Ni centre in $Ni[(PPh_3)_2Cl_2]$ and $[NiCl_4]^{2-}$ respectively are
(A) dsp^2 and sp^3 (B) dsp^2 and sp^2d (C) sp^3 and sp^3 (D) sp^3 and dsp^2

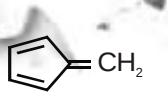
52. Oxalic acid when treated with potassium permanganate in the presence of an acid, produces
(A) O_2 (B) C (C) CO (D) CO_2

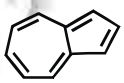
53. The equilibrium constant for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 400 K is 41. The equilibrium constant for the reaction $1/2N_2 + 3/2H_2 \rightleftharpoons NH_3$ at the same temperature will be closest to
(A) 41 (B) 20.5 (C) 6.4 (D) 1681

54. In a one component second order reaction, if the concentration of the reactant is reduced to half, the rate
(A) increases two times (B) increases four times
(C) decreases to one half (D) decreases to one fourth

55. The conjugate bases for HCO_3^- and NH_3, respectively, are
(A) H_2CO_3 and NH_4^+ (B) CO_3^{2-} and NH_2^- (C) H_2CO_3 and NH_2^- (D) CO_3^{2-} and NH_4^+

56. Among the following


I


II


III


IV

the aromatic compounds are
(A) I & II (B) I & III (C) II & III (D) II & IV

57. Among the compounds


I

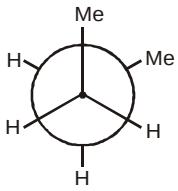

II


III


IV

the order of basicity is
(A) I > III > II > IV (B) II > IV > I > III (C) III > I > IV > II (D) II > I > III > IV

58. The Newman projection of -



is known as the
(A) eclipsed conformer (B) staggered conformer (C) skewed conformer (D) gauche conformer

59. The half-life of a first order reaction is 30 min. The time required for 75% completion of the same reaction-will be
(A) 45 min (B) 60 min (C) 75 min (D) 90 min

60. The hydrogen ion concentration in a mixture of 10 ml of 0.1 M H_2SO_4 and 10 ml of 0.1 M KOH solution in water, is
(A) 0.1 M (B) 0.05 M (C) 0.2 M (D) 0.02 M

BIOLOGY

61. During photosynthesis the chemical conversion of water is termed :
(A) photolysis (B) hydrolysis (C) hydration (D) condensation

62. In the organism muscels, oxygen is carried by :
(A) albumin (B) myosin (C) myoglobin (D) hemoglobin

63. Enzymes do the following :
(A) make products and reactants of equal energy
(B) help the chemical processes by lowering the energy of products
(C) reduce the activation barrier and speed up chemical processes
(D) hydrolyze all the biopolymers indiscriminately

64. Glycolysis is :
(A) biosynthesis of glucose (B) biosynthesis of glycine
(C) degradation of glucose (D) reaction of glucose with proteins

65. Plants are attracted to light through the hormonal action of :
(A) Gibberelic acid (B) Auxin (C) Chlorophyll (D) Thiamine

66. During development, unspecified cells become cells having unique functions. This process is called :
(A) evolution (B) differentiation (C) translation (D) replication

67. The chromosomal attachment site of the spindle microtubule is :
(A) centrosome (B) liposome (C) centromere (D) telomere

68. Which fo the following diseases is NOT sexually transmitted ?
(A) Syphilis (B) Gonorrhoea (C) AIDS (D) Tuberculosis

69. This cell organelle consists of two granule-like centrioles and is found in animal cells only. It helps in cell division. What is it called ?
(A) centrosome (B) chromosome (C) centromere (D) chromatids

70. Nucleotides are monomers of DNA. What does each nucleotide consist of ?
(A) A nitrogenous base and a pentose sugar
(B) A nitrogenous base and a phosphate group
(C) A pentose sugar and a phosphate group
(D) A nitrogenous base, a pentose sugar and a phosphate group

71. Fetilization in humans usually takes place in :
(A) Uterus (B) Graafian follicle (C) Ovary (D) Fallopian tube

72. ELISA, the standard screening test for HIV, detects which of the following ?
(A) HIV DNA (B) HIV RNA
(C) HIV proteins (D) Antibodies to HIV proteins

73. Sickle cell anemia is caused by :
(A) complete absence of the haemoglobin gene (B) point mutation of the haemoglobin gene
(C) increased affinity of haemoglobin for oxygen (D) truncation of the haemoglobin protein

74. The natural source of Ti plasmid is :
(A) bacteria (B) virus (C) plants (D) animals

75. Earthworms are bisexual but still cross-fertilization is common. This is because :
(A) spermatozoa of different earthworms are different
(B) spermatozoa and ova mature at different times in the same earthworm
(C) ova from other earthworms may be larger
(D) sperm and ova from the same earth worm cannot fertilize

76. One difference between blood and lymph is that :
(A) blood contains WBC and lymph contains RBC
(B) blood contains RBC and WBC and lymph contains only WBC
(C) blood contains RBC and lymph contains WBC
(D) blood is liquid while lymph is solid

77. The abnormal development of which of the following lymphoid organs would result in the most severe immunodeficiency ?
(A) Spleen (B) Thymus (C) Tonsil (D) Lymph node

78. Mitochondria are associated with all of the following function, EXCEPT :
(A) ATP synthesis (B) DNA syntheis (C) Protein synthesis (D) Protein glycosylation

79. The probability of having a girl child with blood group O when the parents have blood group A and B is :
(A) 0% (B) at least 50% (C) at most 25% (D) exactly 75 %

80. Wooden doors and windows swell up in the rainy season by :
(A) a special type of diffusion called imbibition
(B) evaporation of stored water wood
(C) conduction of water from walls
(D) transpiration

MATHEMATICS

81. Let $p(x) = a_0 + a_1x + ...+ a_nx^n$. If $p(-2) = -15$, $p(-1) = 1$, $p(0) = 7$, $p(1) = 9$, $p(2) = 13$ and $p(3) = 25$, then the smallest possible value of n is :

(A) 5 (B) 4 (C) 3 (D) 2

82. Let a, b, c be the sides of triangle. If t denotes the expression $(a^2 + b^2 + c^2)/(ab + bc + ca)$, the set of all possible values of t is :

(A) $\{x \in R | x > 1\}$ (B) $\{x \in R \mid 1 \le x < 2\}$

(C) $\{x \in R \mid 1 < x < 2\}$ (D) $\{x \in R \mid 1 \le x \le 2\}$

83. The area of the region bounded by $y = \big|\,|x-3|-4\big| - 5$ and the x-axis is

(A) 24.5 (B) 37 (C) 49 (D) $35\sqrt{2}$

84. The lengths of the sides and the diagonal of an isosceles trapezium from a two-element set {a, b}. If a > b, then a/b equals

(A) $\frac{1}{2}(\sqrt{6}+\sqrt{2})$ (B) $\frac{1}{2}(\sqrt{5}+1)$ (C) $\sqrt{3}$ (D) $\sqrt{2}$

85. Define a sequence $\{a_n\}_{n \ge 0}$ by $a_n = \sqrt{\frac{1+a_{n-1}}{2}}$ for $n \ge 1$. $a_0 = \cos\theta \ne 1$.

Then $\lim_{n\to\infty} 4^n(1 - a_n)$ equals

(A) θ^2 (B) $\theta^2/2$ (C) $\theta/2$ (D) θ

86. The range of the function $f(x) = (\sin x)^{\sin x}$ defined on $(0, \pi)$ is

(A) (0.1) (B) $(e^{-1/e}, 1)$ (C) $[e^{-1/e}, 1)$ (D) $[e^{-1/e}, 1]$

87. Let A denote the area bounded by the curve $y = 1/x$ and the lines $y = 0$, $x = 1$, $x = 10$, Let $B = 1 + \frac{1}{2} + ...+ \frac{1}{9}$, and let $C = \frac{1}{2} + \frac{1}{3} + ...+ \frac{1}{10}$. Then

(A) C < B < A (B) A < C < B

(C) C < A < B and A – C < B – A (D) C < A < B and B – A < A – C

88. Two points are randomly choses on the circumference of a circle of radius r. The probability that the distance between the two points is at least r is equal to

(A) $\frac{2}{\pi}$ (B) sin r (C) $\frac{2}{\pi}$ (D) $\frac{2}{3}$

89. Consider al natural numbers whose decimal expansion has only then even digits 0, 2, 4, 6, 8. Suppose these are arranged in increasing order. If a_n denotes the n-th number in this sequence, then $\lim_{n\to\infty} \log a_n / \log n$ equals :

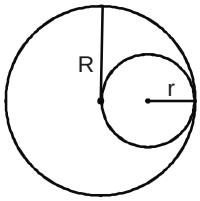
(A) 0 (B) $\log_5 10$ (C) $\log_2 10$ (D) 2

90. The sum of all absolute values of the differences of the numbers 1, 2, 3....., n, taken two at a time, i.e. $\sum_{j \le i \le n} |i - j|$ equals :

(A) $\binom{n-1}{3}$ (B) $\binom{n}{3}$ (C) $\binom{n+1}{3}$ (D) $\binom{n+2}{3}$

PHYSICS

91. A spherical cavity of radius r is carved out of a uniform solid sphere of radius R as shown in the figure.



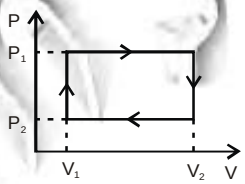
The distance of the center of mass of the resulting body from that of the solid sphere is given by

(A) $\frac{R-r}{2}$ (B) $\frac{R+r}{2}$ (C) 0 (D) $\frac{r^3}{R^2+Rr+r^2}$

92. A plano-convex less made of material of refractive index μ with radius of curvature R is silvered on the curved side. How far away from the lens-mirror must you place a point object so that the image coincides with the object ?

(A) $\frac{R}{\mu}$ (B) R (C) $\frac{R}{\mu-1}$ (D) μR

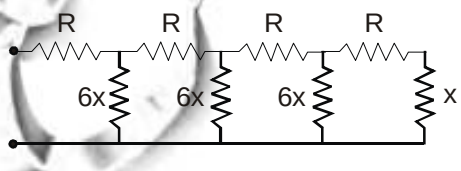
93. n moles of a van der Wasls gas obeying the equation of state $\left(P+\frac{n^2a}{V^2}\right)(V-nb) = nRT$, where a and b are gas dependent constants, is made to undergo a cyclic process that is depicted by a rectangle in the PV diagram as shown in the figure. What is the heat absorbed by the gas in one cycle?

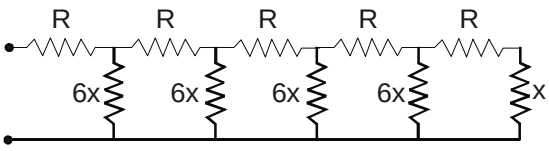


(A) $n(P_1 - P_2)(V_2 - V_1)$ (B) $(P_1 - P_2)(V_2 - V_1)$

(C) $\left(P_1+\frac{n^2a}{V_1^2}-P_2-\frac{n^2a}{V_2^2}\right)(V_1 - V_2)$ (D) $\left(P_1+\frac{n^2a}{V_1^2}-P_2-\frac{n^2a}{V_2^2}\right)(V_2 - V_1)$

94. For what value of the resistor X will the equivalent resistance of the two circuits shown be the same ?





(A) R (B) 6R (C) 2R (D) $\frac{\sqrt{5}-1}{2}R$

95. A solid uniform sphere having a mass M, radius R, and moment of inertia of $\frac{2}{5}MR^2$ rolls down a plane inclined at an angle θ to the horizontal starting from rest. The coefficient of static friction between the sphere and plane is μ. Then,

(A) the sphere will always roll without slipping

(B) the sphere will always slide

(C) the sphere will roll without slipping only if $\theta \le \sin \frac{7\mu}{2}$

(D) the sphere will roll without slipping only if $\theta \le \tan^{-1} \frac{7\mu}{2}$

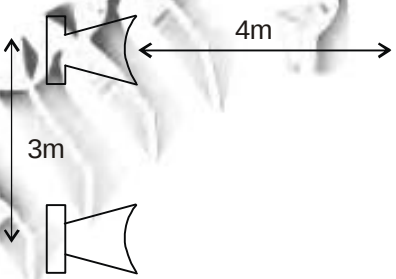
96. A cubical box of side a sitting on a rough table-top is pushed horizontally with a gradually increasing force until the box moves. If the force is applied at a height from the table top which is greater than a critical height H, the box topples first. If it is appliced at a height less than H, the box starts sliding first. Then the coefficient of friction between the box and the table top is :

(A) $\frac{a}{2H}$ (B) $\frac{2H}{a}$ (C) $\frac{a}{H}$ (D) $\frac{H}{a}$

97. A vehicle is moving with speed v on a curved road of radius r. The coefficient of friction between the vehicle and the road is μ. The angle θ of banking needed is given by

(A) $\tan\theta = \frac{v^2 - \mu r g}{v^2 - r g}$ (B) $\tan\theta = \frac{v^2 - \mu r g}{v^2 + \mu r g}$ (C) $\tan\theta = \frac{v^2 - \mu r g}{r g + \mu v^2}$ (D) $\tan\theta = \frac{\mu r g - v^2}{r g + \mu v^2}$

98. Two small identical speakers are connected in phase to the same source. The speakers are 3m apart and at ear level. An observer stands at P, 4m in front of one speaker as shown. The sound she hears is least intense when the wavelength is λ_1 and most intense when the wavelength is λ_2.

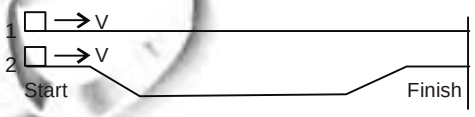


Then possible values of λ_1 and λ_2 are :

(A) λ_1 = 1m and λ_2 = 2m (B) λ_1 = 4m and λ_2 = 3m

(C) λ_1 = 2m and λ_2 = 1m (D) λ_1 = 0.5m and λ_2 = 0.25m

99. Two small blocks slide without losing contact with the surface along two frictionless tracks 1 and 2, starting at the same time with same initial speed v. Track 1 is perfectly horizontal, while track 2 has a dip in the middle, as shown.



Which block reaches the finish line first ?

[Hint : Use velocity-time graph to solve]

(A) Block on track 1 reaches the finish line first

(B) Block on track to reaches the finish line first

(C) Both blocks reach the finish line at the same time

(D) It depends on the length of the dip in the second track, relative to the total length of the tracks.

100. Consider 1 kg of liquid water undergoing change in phase to water vapour at 100ºC. At 100ºC, the vapour pressure 1.01×10^5 Nm^2 and the latent heat of vaporization is 22.6×10^5 J kg^{-1}. The density of liquid water is 10^3 kg m^{-3} and that of vapour is $\frac{1}{1.8}$ kg m^{-3}. The change in internal energy in this phase change is nearly.

(A) 1.8×10^5 J kg^{-1} (B) 20.8×10^5 J kg^{-1} (C) 22.6×10^5 J kg^{-1} (D) 11.3×10^5 J kg^{-1}

CHEMISTRY

101. If the pH of a mixture of 10 ml of 0.1 M NH_4OH and 10 ml of 1 M NH_4Cl solution is 8, the pK_b value of NH_4OH is then closest to

(A) 3 (B) 5 (C) 7 (D) 9

102. A cylinder of cooking gas in a household contains 11.6 kg of butane.The thermochemical reaction for the combustion of butane is

$2C_4H_{10}(g) + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O(\ell)$; $\Delta H = -2658$ KJ/mol. If the household needs15000 KJ of energy per day, the cooking gas cylinder will last for about

(A) 64 days (B) 45 days (C) 20 days (D) 35 days

103. The addition of 0.643 g of a compound to 50 ml of benzene (density = 0.879 g ml^{-1}) lowers the freezing point from 5.51ºC to 5.03ºC. If the freezing point constant, K_f for benzene is 5.12 K Kg mol^{-1}, the molar mass of the compound is approximately

(A) 156 g mol^{-1} (B) 88 g mol^{-1} (C) 60 g mol^{-1} (D) 312 g mol^{-1}

104. Consider the following electrochemical cell :

$Zn(s) + 2Ag^+(0.04\ M) \rightarrow Zn^{2+}(0.28M) + 2Ag(s)$. If $E_{cell}^{\circ} = 2.57$ V, then e.m.f. of the cell at 298 K, is

(A) 2.5 V (B) 1.5 V (C) 0.5 V (D) – 0.5 V

105. When Co(II) chloride is dissolved in concentrated HCl a blue solution is obtained. Upon dilution with water, the color changes to pink because

(A) $CoCl_6^{4-}$ is converted to $CoCl_6^{3-}$ (B) $CoCl_4^{2-}$ is converted to $Co(OH_2)_6^{2+}$

(C) $Co(OH_2)_6^{2+}$ is converted to $Co(OH_2)_6^{3+}$ (D) $CoCl_4^{2-}$ is converted to $Co(OH_2)_6^{3+}$

106. The rate constant for the reaction $COCl_2(g) \rightarrow CO(g) + Cl_2(g)$ is given by ln [k/(min^{-1})] = – 11067/T K + 31.33. The temperature at which the rate of this reaction will be doubled from that at 25ºC is

(A) 75ºC (B) 100ºC (C) 31ºC (D) 50ºC

107. Some reactions and their equilibrium constants given below

$CuCl_4^{2-} + Br^- \rightleftharpoons CuCl_3Br^{2-} + Cl^-$ K_1

$CuCl_3Br^{2-} + Br^- \rightleftharpoons CuCl_2Br_2^{2-} + Cl^-$ K_2

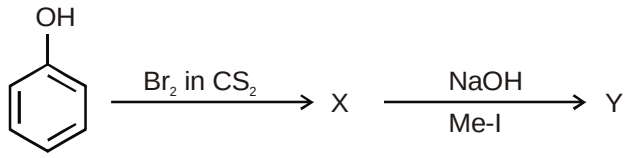
$CuCl_2Br_2^{2-} + Br^- \rightleftharpoons CuClBr_3^{2-} + Cl^-$ K_3

$CuClBr_3^{2-} + Br^- \rightleftharpoons CuBr_4^{2-} + Cl^-$ K_4

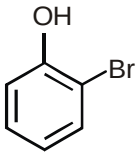
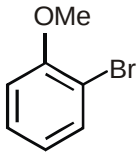
The equilibrium constant, K for the reaction

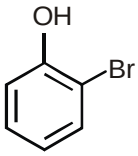
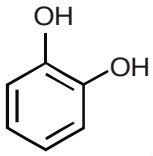
$CuCl_4^{2-} + 3Br^- \rightleftharpoons CuClBr_3^{2-} + 3\ Cl^-$, is

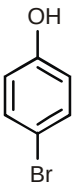
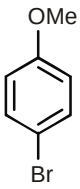
(A) $K_1K_2K_3$ (B) $K_1K_2K_3K_4$ (C) $K_1 + K_2 + K_3$ (D) $1/(K_1K_2K_3)$

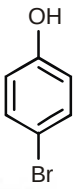
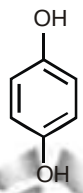
108. 

In the above sequence of reactions, the major products X and Y are

(A) X =  Y = 

(B) X =  Y = 

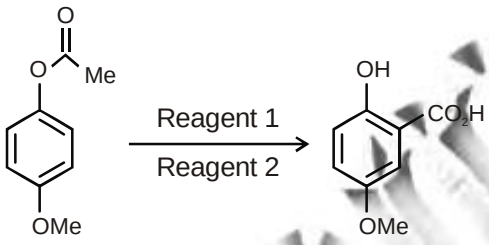
(C) X =  Y = 

(D) X =  Y = 

109. $^{234}Th_{90}$ gets converted to $^{206}Pb_{82}$ through a series of radioactive decay processes. The number of alpha and beta particles lost in this transformation respectively, are

(A) 6 and 6 (B) 6 and 7 (C) 4 and 2 (D) 7 and 6

110. In the following transformation



reagents 1 and 2 are :

(A) H_2SO_4 ; alkaline $KMnO_4$ (B) $AlCl_3$; I_2 / NaOH

(C) H_3PO_4 ; $CHCl_3$/KOH (D) KOH;$CHCl_3$ / KOH

BIOLOGY

111. The mode of action of penicillin is as follows :

(A) It inhibits viral replication (B) It enhances immunity

(C) It inhibits bacterial cell wall synthesis (D) It inhibits transcription

112. Which of the following statements is true for meiosis ?

(A) One round of chromosome duplication and one round of cell division

(B) One round of chromosome duplication and two rounds of cell division

(C) Two rounds of chromosome duplication and one round of cell division

(D) Two rounds of chromosome duplication and two rounds of cell division

113. Instead of 3, if 2 bases code for an amino acid, the degeneracy of codons coding for the same amino acid would have :
(A) increased (B) decreased
(C) remained the same (D) been uncertain

114. Gregor Mendel showed that unit factors exist in pairs and exhibit as dominant-recessive relationship. These unit factors, in modern terminology, are called :
(A) genes (B) alleles (C) loci (D) determinants

115. E.coli has optimal growh temperature of 37ºC. Which of the following in an INCORRECT explanation for this ?
(A) The membrane is most permeable at this temperature
(B) DNA synthesis makes the least mistakes at this temperature
(C) Most enzymes in the cell have the highest activity at this temperature
(D) Protein synthesis is most efficient at this temperature

116. Male offsprings of which of the following couples have the highest chance of haemophilia ?
(A) Haemophiliac father and normal, non-carrier mother
(B) Haemophiliac father and normal, carrier mother
(C) Normal father and normal, carrier mother
(D) Normal father and haemophiliac mother

117. The effect of consumption of excess protein by normal individuals would result in :
(A) excretion of excess protein in urine
(B) increase in the amount of adipose tissue
(C) increase in the synthesis of muscle protein
(D) increase in the circulatory plasma proteins

118. The condition varicose veins in swelling of veins, that occurs due to :
(A) loss of elasticity of the muscular layer
(B) condition of high blood pressure
(C) condition of low blood pressure
(D) condition of anoxia

119. Greatest proportion of photosyntheis in the world is carried out by :
(A) trees in the rain forests of the world
(B) trees in the temperate forests of the world
(C) algae in oceans
(D) irrigated crop fields

120. Energetically unfavourable reactions occur in human cells through :
(A) heat energy supplied by the body
(B) heat energy released through exercise
(C) coupling of energetically favourable reactions with unfavourable ones
(D) photosynthesis