

MATHEMATICS

1. The value of $\sqrt{i} + \sqrt{-i}$ is _____.
 (A) 1 (B) $\sqrt{2}$ (C) $-i$ (D) -3

 2. From a container of wine, a thief has stolen 15 litres of wine and replaced it with same quantity of water. He again repeated the same process. Thus in three attempts the ratio of wine and water became 343 : 169. The initial amount of wine in the container was
 (A) 75 litres (B) 100 litres (C) 136 litres (D) 120 litres

 3. The diagonal BD of a cyclic quadrilateral $ABCD$ bisects $\angle ABC$. It is given that $AC = BC$, $\angle BDC = 80^\circ$, $\angle ACB = 20^\circ$. $\angle BAD$ is _____.
 (A) 110° (B) 120° (C) 130° (D) 140°

 4. The number of solutions for real x , which satisfy the equation $2\log_2 \log_2 x + \log_{1/2} \log_2 (2\sqrt{2}x) = 1$ is _____.
 (A) 1 (B) 2 (C) 4 (D) None of these

 5. When an article is sold for ₹ 703, loss incurred is 25% less than the profit earned on selling it at ₹ 836. What is the selling price of the article when it earns a profit of 20% ?
 (A) ₹ 912 (B) ₹ 1576 (C) ₹ 1532 (D) ₹ 1092

 6. In the given diagram, four semicircles of radius 1 cm each with their centres at the mid points of the sides of square are drawn. A circle is inscribed touching all the four semicircles. The radius of the inner circle is _____.
 (A) $\sqrt{2} - 1$ (B) $\frac{\pi}{2} - 1$
 (C) $\sqrt{3} - 1$ (D) $2\sqrt{2} - 2$
-
-
7. In a class of 80 students, 25 passed in Maths and Physics, 25 passed in Physics and English, 20 passed in Maths and English. 10 student passed in all the three subjects. How many students passed only in Maths ?
 (A) 20 (B) 15 (C) 12 (D) Can't be determined
-
8. Dia has 5 friends. In how many ways can she invite one or more of them to a dinner?
 (A) 31 (B) 5^5 (C) 13 (D) 2^5
-
9. In a triangle ABC , AD is the angle bisector of $\angle BAC$ and $\angle BAD = 60^\circ$. What is the length of AD ?
 (A) $\frac{b+c}{bc}$ (B) $\frac{bc}{b+c}$
 (C) $\sqrt{b^2 + c^2}$ (D) $\frac{(b+c)^2}{bc}$
-
-
10. $ABCD$ is a rectangle and there are four equilateral triangles. Area of $\triangle ASD$ equals to area of $\triangle BQC$ and area of $\triangle DRC$ equals to area of $\triangle APB$. The perimeter of the rectangle is 12 cm. Also the sum of the areas of the four triangles is $10\sqrt{3}$ cm², then the total area of the figure thus formed is _____.
 (A) $2(4 + 5\sqrt{3})$ cm² (B) $5(4 + 2\sqrt{3})$ cm² (C) $42\sqrt{3}$ cm² (D) None of these
-

11. Five persons entered the lift cabin on the ground floor of an 8-floor house. Suppose each of them independently and with equal probability can leave the cabin at any floor beginning with the first. Find out the probability that all persons leave at different floors.

(A) $\frac{365}{2401}$ (B) $\frac{360}{2401}$ (C) $\frac{35}{2410}$ (D) None of these

12. A table below shows the production and imports of crude oil (in litres). Domestic production of crude oil is total of on-shore and off-shore production, which is supplemented by imports to meet the total demand of crude oil in the country.

Year	2001	2002	2003
On shore	12,000	11,500	11,000
Off shore	11,000	19,000	16,000
Imports	21,000	24,000	30,000

What is the average of total demand of crude oil over the period?

(A) 185×10^3 L (B) 52×10^3 L (C) 18.5×10^3 L (D) 35×10^3 L

13. How many meaningful words can be formed with the first, the third, the seventh and the ninth letters of the word "SEPARATION" using each letter only once in each word ?

(A) Two (B) Three (C) Four (D) More than four

14. Today is Varun's birthday. One year from today he will be twice as old as he was 12 years ago. How old is Varun today?

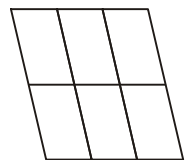
(A) 20 years (B) 22 years (C) 25 years (D) 27 years

15. Choose the odd figure out of the given options.

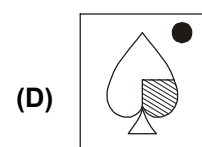
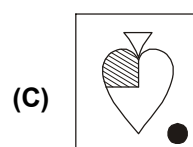
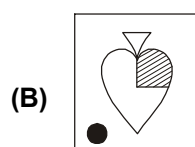
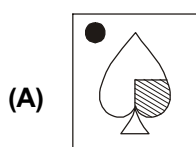
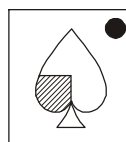


16. Count the number of parallelograms in the given figure.

(A) 20
(B) 18
(C) 16
(D) 12



17. Find the mirror image of the Figure X if the mirror is placed vertically left.



18. Select a figure from amongst the alternatives which when placed in the blank space of Fig. (X) would complete the pattern.

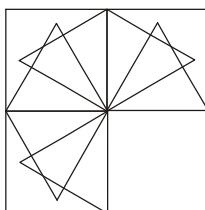


Fig. (X)



19. In a certain coding system, 'rbm std bro pus' means 'the cat is beautiful', 'etnh pus dim std' means 'the dog is brown', 'pus dim bro pus cus' means 'the dog has the cat'. What is the code for 'has' ?

(A) std (B) dim (C) bro (D) cus

20. In a certain code language, GERMINATION is written as IMGRENNOAIT. How is ESTABLISHED written in that code ?

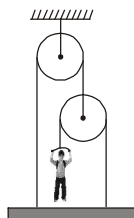
(A) BEATSLDEIHS (B) BAETSLEDIHS (C) BATESLDEIHS (D) BAETSLDEIHS

PHYSICS

21. A thick-walled hollow sphere has outside radius R_0 . It rolls down an incline without slipping and its velocity at the bottom is v_0 . Now the incline is waxed so that it is practically frictionless and the sphere is observed to slide down (without rolling) the same incline when its speed at the bottom is observed to be $\frac{5v_0}{4}$. The radius of gyration of the hollow sphere about an axis through its centre is

(A) $\frac{R_0}{2}$ (B) $\frac{2R_0}{3}$ (C) $\frac{3R_0}{4}$ (D) $\frac{4R_0}{5}$

22. In the given diagram, with what force must the man pull the rope to hold the plank in position? Weight of the man is 60 kgf. Neglect the weights of plank, rope and pulley.

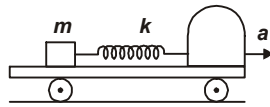


(A) 20 kgf (B) 30 kgf (C) 60 kgf (D) 15 kgf

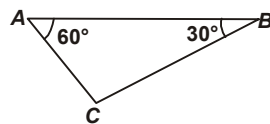
23. A sound wave passes from a medium A to another medium B. The velocity of sound in B is greater than that in A. Assume that there is no absorption or reflection at the boundary. As the wave moves across the boundary

(A) The frequency of sound will not change (B) The wavelength will increase
(C) The wavelength will decrease (D) The intensity of sound will not change

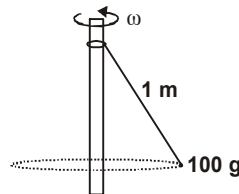
24. One end of an ideal spring is connected with a smooth block and the other end with rear wall of driving cabin of a truck as shown in the figure. Initially, the system is at rest. If truck starts to accelerate with a constant acceleration then the block (relative to truck)



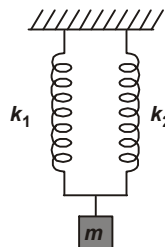
- (A) Will remain stationary
 (B) Will start oscillating with constant amplitude
 (C) Will start oscillating with increasing amplitude
 (D) Moves such that the length of the spring first increases and then becomes constant
-
25. ACB is right-angled prism with other angles as 60° and 30° . The refractive index of prism is 1.5. AB has a thin layer of liquid on it as shown. Light falls normally on the face AC . For total internal reflection, maximum refractive index of the liquid is



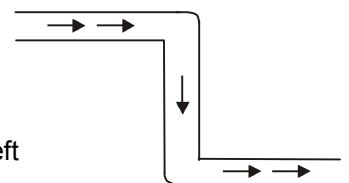
- (A) 1.4 (B) 1.3 (C) 1.2 (D) 1.6
-
26. A string of length 1 m is fixed at one end and carries a mass of 100 g at the other end. The string makes $(2/\pi)$ revolutions per second around vertical axis through the fixed end. What is the tension in the string?



- (A) 1.6 N (B) 0.8 N (C) 3.2 N (D) 2.4 N
-
27. In the arrangement shown in the figure, for vertical oscillation of the mass m , the time period is



- (A) $T = 2\pi\sqrt{\frac{m(k_1 + k_2)}{k_1 k_2}}$ (B) $T = 2\pi\sqrt{\frac{k_1 + k_2}{m}}$ (C) $T = 2\pi\sqrt{\frac{m}{k_1 + k_2}}$ (D) $T = 2\pi\sqrt{\frac{mg}{k_1 + k_2}}$
-
28. The tube shown is of uniform cross-section. Liquid flows through it at a constant speed in the direction shown by the arrows. The liquid exerts on the tube



- (A) A net force to the right (B) A net force to the left
 (C) A clockwise torque (D) An anticlockwise torque

DIRECTION : Read the following paragraph to answer Q. nos. 29, 30 and 31.

Projectile motion is a combination of two one dimensional motions-one in horizontal and other in vertical direction. Motion in 2 dimensions means motion in a plane. Necessary condition for 2 dimensional motion is that the velocity vector is coplanar to the acceleration vector. In case of projectile motion, the angle between velocity and acceleration will be $0^\circ < \theta < 180^\circ$. During the projectile motion the horizontal component of velocity remains unchanged but vertical component of velocity is time dependent.

29. A particle is projected from the origin in x-y plane. Acceleration of particle in negative y direction is α . If equation of path of the particle is $y = ax - bx^2$, then initial velocity of the particle is

(A) $\sqrt{\frac{\alpha}{2b}}$ (B) $\sqrt{\frac{\alpha(1+a^2)}{2b}}$ (C) $\sqrt{\frac{\alpha}{a^2}}$ (D) $\sqrt{\frac{\alpha b}{a^2}}$

30. An object is projected from origin in x-y plane in which velocity changes according to relation $\vec{v} = a\hat{i} + bx\hat{j}$. Path of particle is

(A) Hyperbolic (B) Circular (C) Elliptical (D) Parabolic

31. A body is projected at angles of 30° and 60° with same velocity. Their horizontal ranges are R_1 and R_2 , and maximum heights are H_1 and H_2 respectively. Then,

(A) $\frac{R_1}{R_2} > 1$ (B) $\frac{H_1}{H_2} > 1$ (C) $\frac{R_1}{R_2} < 1$ (D) $\frac{H_1}{H_2} < 1$

32. Statement I : A solid and hollow sphere of same diameter and same material when heated through the same temperature will expand by the same amount.

Statement II : The change in volume is independent of the original mass but depends on original volume.

- (A) Both statements I and II are true and statement II is the correct explanation of statement I.
 (B) Both statements I and II are true but statement II is not the correct explanation of statement I.
 (C) Statement I is true but statement II is false. (D) Statement I is false but statement II is true.

33. Statement I : When a bottle of cold carbonated drink is opened, a slight fog forms around the opening.

Statement II : Adiabatic expansion of the gas causes lowering of temperature and condensation of water vapours.

- (A) Both statements I and II are true and statement II is the correct explanation of statement I.
 (B) Both statements I and II are true but statement II is not the correct explanation of statement I.
 (C) Statement I is true but statement II is false.
 (D) Statement I is false but statement II is true.

34. Column I gives some devices and column II gives some processes on which the functioning of these devices depend. Match the device in column I with the processes in column II and select the correct option from the codes given below.

Column I

- (i) Bimetallic strip
 (ii) Steam engine
 (iii) Incandescent lamp
 (iv) Electric fuse

- (A) (i) - (p), (ii) - (q), (iii) - (r), (iv) - (s)
 (C) (i) - (r), (ii) - (p), (iii) - (s), (iv) - (q)

Column II

- (p) Radiation from a hot body
 (q) Energy conversion
 (r) Melting
 (s) Thermal expansion of solids
 (B) (i) - (q), (ii) - (s), (iii) - (p), (iv) - (r)
 (D) (i) - (s), (ii) - (q), (iii) - (p), (iv) - (r)

35. Some physical quantities are given in column I and some possible SI units in which these quantities may be expressed are given in column II. Match the columns and select the correct option from the codes given below.

Column I	Column II
(i) $GM_e M_s$, where G = universal gravitational constant, M_e = mass of the Earth, M_s = mass of the Sun	(p) Joule
(ii) $\frac{3RT}{M}$, where R = universal gas constant, T = absolute temperature, M = molar mass	(q) $\text{kg m}^3 \text{s}^{-2}$
(iii) $\frac{I\omega^2}{2}$, where I = moment of inertia ω = angular velocity of rotation	(r) $\text{m}^2 \text{s}^{-2}$
(iv) $\frac{GM_e}{R_e^2}$, where G = universal gravitational constant, M_e = mass of the Earth, R_e = radius of the Earth	(s) m s^{-2}
(A) (i) - (p), (ii) - (q), (iii) - (r), (iv) - (s)	(B) (i) - (q), (ii) - (r), (iii) - (p), (iv) - (s)
(C) (i) - (r), (ii) - (p), (iii) - (s), (iv) - (q)	(D) (i) - (s), (ii) - (r), (iii) - (q), (iv) - (p)

CHEMISTRY

36. Match both the columns and mark the correct option from the codes given below.

Column I	Column II
(a) Action of dilute sulphuric acid on Zn	(i) Ammonia
(b) Heating limestone	(ii) Oxygen
(c) Heating potassium chlorate	(iii) Hydrogen
(d) Heating ammonium chloride	(iv) Carbon dioxide
a	b
c	d
(A) (ii)	(iv)
(B) (iii)	(iv)
(C) (iv)	(iii)
(D) (iii)	(i)

37. Statement I : pH of hydrochloric acid solution is less than that of acetic acid solution of the same concentration.

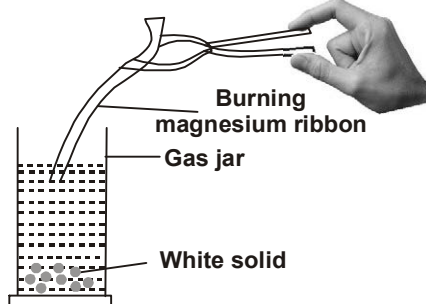
Statement II : In equimolar solutions, the number of titratable protons present in hydrochloric acid is less than that present in acetic acid.

- (A) Both statements I and II are true and statement II is the correct explanation of statement I.
 (B) Both statements I and II are true but statement II is not the correct explanation of statement I.
 (C) Statement I is true but statement II is false.
 (D) Statement I is false but statement II is true.

38. Cupric carbonate upon heating gives a black residue *X* and a colourless gas *Y*. When residue *X* is dissolved in dilute sulphuric acid, blue solution was formed. This upon evaporation gave blue crystals of compound *Z*. The gas *Y* when passed into aqueous solution of *W*, turned the solution milky and when more of gas *Y* was passed into milky liquid, it turned colourless again. Identify *X*, *Y*, *Z* and *W*.

	<i>X</i>	<i>Y</i>	<i>Z</i>	<i>W</i>
(A)	CuO	CO ₂	CaCO ₃	Ca(HCO ₃) ₂
(B)	CuO	CO ₂	CuSO ₄	Ca(OH) ₂
(C)	CuSO ₄	CuO	CO ₂	CuCO ₃
(D)	CuCO ₃	CuO	CO ₂	Ca(HCO ₃) ₂

39. A student wants to test the nature of the oxides formed by reactions of metals and non-metals with oxygen. He burns a magnesium ribbon by holding it with a pair of tongs and collects the white solid formed in a gas jar. He then adds a small amount of water to the jar and tests it with the help of a litmus paper. What will happen to the litmus paper?



- (A) Red litmus paper turns blue. (B) Blue litmus paper turns red.
(C) First red litmus turns blue and then again red. (D) No change in the colour of litmus paper.

40. The given table shows the position of six elements *P*, *Q*, *R*, *S*, *T* and *U* in the periodic table. Using the table identify the incorrect statement.

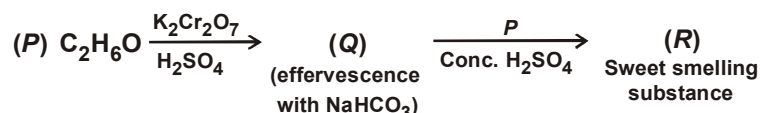
Group Period	1	2	3-12	13	14	15	16	17	18
2		<i>P</i>					<i>Q</i>		<i>R</i>
3		<i>S</i>				<i>T</i>			<i>U</i>

- (A) Element *S* present in group 2 is a metal and it exhibits a valency of 2.
(B) The element *T* present in group 15 is a non-metal and it exhibits a valency of 3.
(C) Element *S* has bigger atomic radius than element *T*. (D) Elements *R* and *U* are known as halogens.

41. A student poured some bromine water in a test tube. He passed vapours of two hydrocarbons from the jars *X* and *Y*, one after the other. He observed that on passing vapours from jar *Y* the reddish brown colour of bromine got discharged. When he reacted both the gases separately with oxygen, he observed that both the gases on combustion gave carbon dioxide and water vapour. What inference does he draw from his experiments?

- (A) Jar *X* contains a saturated hydrocarbon while jar *Y* contains unsaturated hydrocarbon.
(B) Jar *X* contains an unsaturated hydrocarbon while jar *Y* contains saturated hydrocarbon.
(C) Jar *X* and *Y* contain saturated hydrocarbons. (D) Jar *X* and *Y* contain unsaturated hydrocarbons.

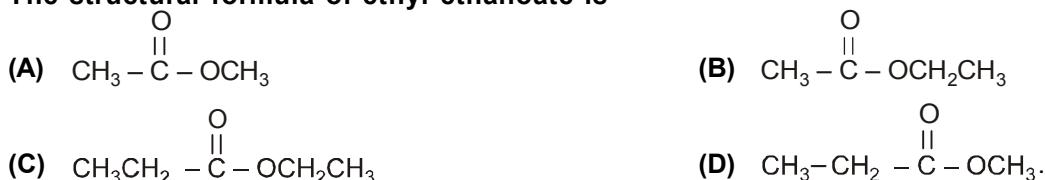
42. A neutral organic compound *P* of molecular formula C_2H_6O on oxidation with potassium dichromate and sulphuric acid gives a compound *Q* which gives brisk effervescence with sodium bicarbonate. Compound *P* is an important constituent of wine and it reacts with *Q* to give a sweet smelling substance *R*. *P*, *Q* and *R* respectively are



- (A) *P* – CH_3COOH , *Q* – C_2H_5OH , *R* – $C_2H_5COOCH_3$
 (B) *P* – CH_3CH_2OH , *Q* – CH_3CH_2COOH , *R* – $CH_3CH_2COOCH_3$
 (C) *P* – CH_3CH_2COOH , *Q* – CH_3CH_2OH , *R* – $CH_3COOCH_2CH_3$
 (D) *P* – CH_3CH_2OH , *Q* – CH_3COOH , *R* – $CH_3COOCH_2CH_3$
43. Aluminium carbonate reacts with dilute nitric acid to form aluminium nitrate, water and carbon dioxide. The reaction can be written as $Al_2(CO_3)_3 + xHNO_3 \longrightarrow yAl(NO_3)_3 + zCO_2 + 3H_2O$. The stoichiometric constants *x*, *y* and *z* are

- (A) 6, 2, 4 (B) 6, 2, 3 (C) 2, 4, 6 (D) 4, 2, 3

44. The structural formula of ethyl ethanoate is

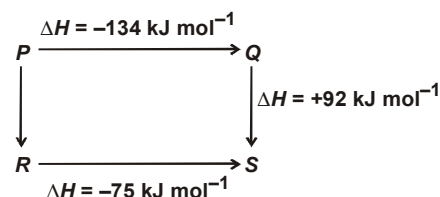


45. '*M*' g of an element gave '*N*' g of oxide. Equivalent weight of the element is

- (A) $\frac{M+N}{M} \times 8$ (B) $\frac{M}{N+M} \times 8$ (C) $(N-M) \times 8$ (D) $\frac{M}{N-M} \times 8$

46. The given diagram illustrates the energy changes of a set of reactions. Which of the following statements is incorrect ?

- (A) The enthalpy change for the reaction $P \rightarrow R$ is + 33 kJ mol^{-1} .
 (B) The enthalpy change for the transformation $R \rightarrow Q$ will be endothermic.
 (C) The enthalpy change for the transformation $P \rightarrow Q$ is –134 kJ mol^{-1} .
 (D) The enthalpy change for the transformation $S \rightarrow P$ will be + 42 kJ mol^{-1} .



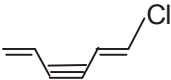
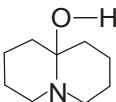
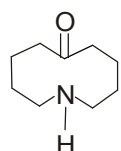
47. For two gases, *A* and *B* with molecular weights M_A and M_B , it is observed that at a certain temperature *T*, the mean velocity of *A* is equal to the u_{rms} of *B*. Thus, the mean velocity of *A* can be made equal to the mean velocity of *B*, if

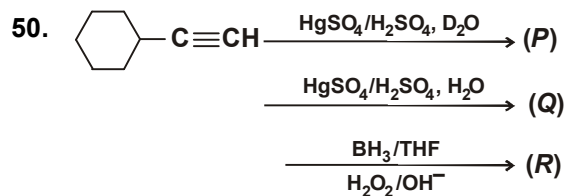
- (A) *A* is at temperature *T* and *B* at *T'*; $T > T'$ (B) Both *A* and *B* are raised to a higher temperature
 (C) Both *A* and *B* are lowered in temperature (D) None of these

48. Al and Ga have nearly the same covalent radii because of

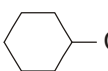
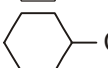
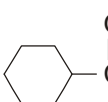
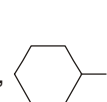
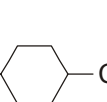
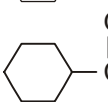
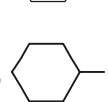
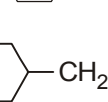
- (A) Greater shielding effect of *s* electrons of Ga atoms (B) Poor shielding effect of *s* electrons of Ga atoms
 (C) Poor shielding effect of *d* electrons of Ga atoms (D) Greater shielding effect of *d* electrons of Ga atoms

49. Which of the following statements is incorrect ?

- (A) Phenol is more acidic than *p*-cresol.
- (B)  forms white precipitate with $\text{Ag}^+_{(\text{aq})}$ most readily
- (C) $\text{CH}_3\ddot{\text{N}}\text{H}_2$ is more basic than $\text{CH}_3-\ddot{\text{N}}=\text{CHCH}_3$
- (D)  and  are not resonating structures of each other



(P), (Q) and (R) respectively are

- (A) - CH_2CHO in all cases
- (B) - COCH_3 in all cases
- (C) - $\overset{\text{O}}{\parallel}\text{C}-\text{CH}_2\text{D}$, - $\overset{\text{O}}{\parallel}\text{C}-\text{CH}_3$, - CH_2CHO
- (D) - $\overset{\text{O}}{\parallel}\text{C}-\text{C}_6\text{H}_{11}$, - OCH_3 , - CH_2CHO

SPACE FOR ROUGH WORK

ANSWER KEYS

- [illegible]