SA

KVPY QUESTION PAPER –STREAM SA
November 01, 2009

PART-I (1 Mark)

MATHEMATICS

1. The real numbers x satisfying

$$\frac{\sqrt{x+5}}{1-x} > 1$$

are precisely those which satisfy

A. $x < 1$ **B.** $0 < x < 1$ **C.** $-5 < x < 1$ **D.** $-1 < x < 1$

2. Let t_n denote the number of integral-sided triangles with distinct sides chosen from $\{1, 2, 3, \ldots, n\}$. Then $t_{20} - t_{19}$ equals

A. 81 **B.** 153 **C.** 163 **D.** 173

3. The number of pairs of reals (x, y) such that $x = x^2 + y^2$ and $y = 2xy$ is

A. 4 **B.** 3 **C.** 2 **D.** 1

4. How many positive real numbers x satisfy the equation

$$x^3 - 3|x| + 2 = 0?$$

A. 1 **B.** 3 **C.** 4 **D.** 6

5. Let $(1+2x)^{20} = a_0 + a_1x + a_2x^2 + \cdots + a_{20}x^{20}$. Then

$$3a_0 + 2a_1 + 3a_2 + 2a_3 + 3a_4 + 2a_5 + \cdots + 2a_{19} + 3a_{20}$$

equals

A. $\frac{5 \cdot 3^{20} - 3}{2}$ **B.** $\frac{5 \cdot 3^{20} + 3}{2}$ **C.** $\frac{5 \cdot 3^{20} + 1}{2}$ **D.** $\frac{5 \cdot 3^{20} - 1}{2}$

6. Let P_1, P_2, P_3, P_4, P_5 be five equally spaced points on the circumference of a circle of radius 1, centred at O. Let R be the set of points in the plane of the circle that are closer to O than any of P_1, P_2, P_3, P_4, P_5. Then R is a

A. circular region **C.** pentagonal region

B. rectangular region **D.** oval region that is not circular

7. A company situated at $(2, 0)$ in the xy-plane charges Rs. 2 per km for delivery. A second company at $(0, 3)$ charges Rs. 3 per km for delivery. The region of the plane where it is cheaper to use the first company is

A. the inside of the circle $(x+5.4)^2 + y^2 = 18.72$

B. the outside of the circle $(x+1.6)^2 + (y-5.4)^2 = 18.72$

C. the inside of the circle $(x-1.6)^2 + (y+5.4)^2 = 18.72$

D. the outside of the circle $(x-5.4)^2 + (y+1.6)^2 = 18.72$

8. In a right triangle ABC, the incircle touches the hypotenuse AC at D. If $AD = 10$ and $DC = 3$, the inradius of ABC is

A. 5 **B.** 4 **C.** 3 **D.** 2

9. The sides of a quadrilateral are all positive integers and three of them are 5, 10, 20. How many possible value are there for the fourth side?

A. 29 **B.** 31 **C.** 32 **D.** 34

10. If the volume of a sphere increases by 72.8%, then its surface area increases by

A. 20% **B.** 44% **C.** 24.3% **D.** 48.6%

11. If the decimal $0.d25d25d25\cdots$ is expressible in the form $n/27$, then $d+n$ must be

A. 9 **B.** 28 **C.** 30 **D.** 34

12. At what time between 10 O'clock and 11 O'clock are the two hands of a clock symmetric with respect to the vertical line(give the answer to the nearest second)?

A. 10h 9m 13s **B.** 10h 9m 14s **C.** 10h 9m 22s **D.** 10h 9m 50s

13. A woman has 10 keys out of which only one opens a lock. She tries the keys one after the another(keeping aside the failed ones) till she succeeds in opening the lock. What is the chance that it is the seventh key that works?

A. $\frac{7}{10}$ **B.** $\frac{1}{2}$ **C.** $\frac{3}{10}$ **D.** $\frac{1}{10}$

14. In a certain school, 74% students like cricket, 76% students like football and 82% like tennis. Then all the three sports are liked by at least

A. 68% **B.** 32% **C.** 77% **D.** 36%

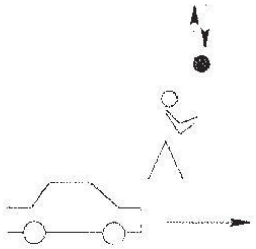
15. Let S_n be the sum of all integers k such that $2^n < k < 2^{n+1}$, for $n \geq 1$. Then 9 divides S_n if and only if

A. n is odd **C.** n is of the form $3k+1$

B. n is even **D.** n is of the form $3k+2$

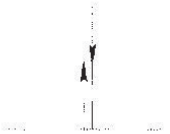
PHYSICS

16 A boy standing on the footpath tosses a ball straight up and catches it. The driver of a car passing by moving with uniform velocity sees this.



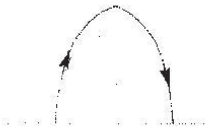
The trajectory of the ball as seen by the driver will be

A.

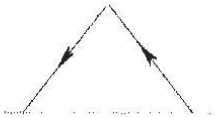


C.

B.



D.

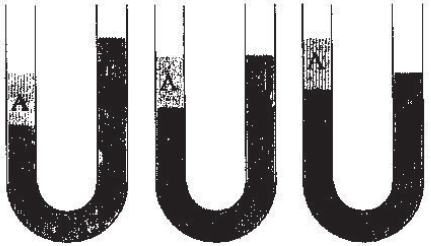


17 Consider two spherical planets of same average density. Planet 2 is 8 times as massive as planet 1. The ratio of the acceleration due to gravity of the second planet to that of the first is

A. 1 B. 2 C. 4 D. 8

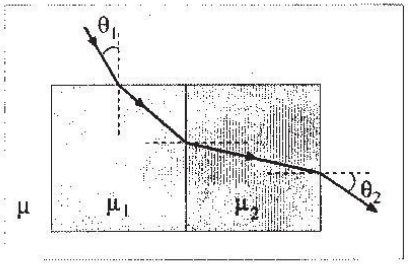
18 Two immiscible liquids, A and B are kept in a U-tube. If the density of liquid A is smaller than the density of liquid B, then the equilibrium situation is

A. B. C. D.



None of these

19 In the figure below, a ray of light travelling in a medium of refractive index μ passes through two different connected rectangular blocks of refractive indices μ_1 and μ_2 ($\mu_2 > \mu_1$).



The angle of incidence θ_1 is increased slightly. The angle θ_2

A. increases.

B. decreases.

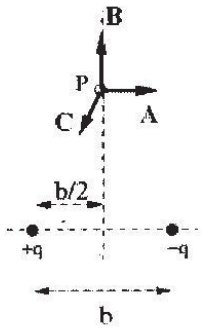
C. remains the same.

D. increases or decreases depending on the value of (μ_1/μ_2).

20 Two charges of same magnitude move in two circles of radii $R_1 = R$ and $R_2 = 2R$ in a region of constant uniform magnetic field $\overrightarrow{B_O}$. The work W_1 and W_2 done by the magnetic field in the two cases, respectively, are such that

A. $W_1 = W_2 = 0$
B. $W_1 > W_2$
C. $W_1 = W_2 \neq 0$
D. $W_1 < W_2$

21 Two charges $+q$ and $-q$ are placed at a distance b apart as shown in the figure below.



The electric field at a point P on the perpendicular bisector as shown is:

A. along vector $\vec{A}$
B. along vector $\vec{B}$
C. along vector $\vec{C}$
D. zero.

22 A block of mass M is at rest on a plane surface inclined at an angle θ to the horizontal. The magnitude of force exerted by the plane on the block is

A. Mg cos θ
B. Mg sin θ
C. Mg tan θ
D. Mg

23 We are able to squeeze snow and make balls out of it because of

A. anomalous behaviour of water.
B. large latent heat of ice.
C. large specific heat of water.
D. low melting point of ice.

24 Which of the following phenomena can be demonstrated by light, but not with sound waves in an air column?

A. Reflection
B. Refraction
C. Diffraction
D. Polarization

25 The temperature of a metal coin is increased by 100 °C and its diameter increases by 0.15%. Its area increases by nearly

A. 0.15%
B. 0.60%
C. 0.30%
D. 0.0225%

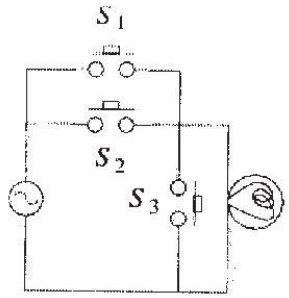
26 The note "Saa" on the Sarod and the Sitar have the same pitch. The property of sound that is most important in distinguishing between the two instruments is

A. fundamental frequency
B. intensity
C. displacement amplitude
D. waveform

27 $^{235}_{92}U$ atom disintegrates to $^{207}_{82}Pb$ with a half-life of 10^9 years. In the process it emits 7 alpha particles and n β^- particles. Here n is

A. 7 B. 3 C. 4 D. 14

28 Consider the circuit below. The bulb will light up if



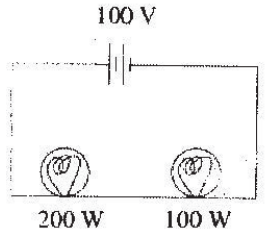
A. S_1, S_2 and S_3 are all closed.

B. S_1 is closed but S_2 and S_3 are open.

C. S_2 and S_3 are closed but S_1 is open.

D. S_1 and S_3 are closed but S_2 is open.

29 Two bulbs, one of 200W and the other of 100W, are connected in series with a 100V battery which has no internal resistance. Then,



A. the current passing through the 200W bulb is more than that through the 100W bulb.

B. the power dissipation in the 200W bulb is more than that in the 100W bulb.

C. the voltage drop across the 200W bulb is more than that across the 100W bulb.

D. the power dissipation in the 100W bulb is more than that in the 200W bulb.

30 A solid cube and a solid sphere of identical material and equal masses are heated to the same temperature and left to cool in the same surroundings. Then

A. the cube will cool faster because of its sharp edges.

B. the cube will cool faster because it has a larger surface area.

C. the sphere will cool faster because it is smooth.

D. the sphere will cool faster because it has a larger surface area.

CHEMISTRY

31 The element X which forms a stable product of the type XCl_4 is

A. Al B. Na C. Ca D. Si

32 A mixture of NH_4Cl and NaCl can be separated by

A. Filtration C. Sublimation

B. Distillation D. Decantation

33 The pair in which the first compound is ionic and the second compound is covalent, is

A. $Fe(OH)_2$, CH_3OH C. CH_3OH, CH_3CH_2OH

B. $Fe(OH)_2$, $Cu(OH)_2$ D. $Ca(OH)_2$, $Cu(OH)_2$

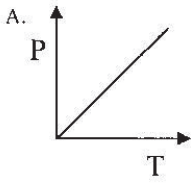
34 In the reaction $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$, the substance that is oxidized is

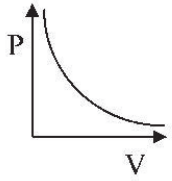
A. SO_2 B. H_2O C. S D. H_2S

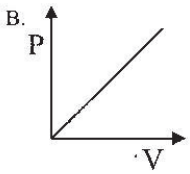
35 Sodium oxide dissolves in water to give sodium hydroxide which indicates its

A. acidic character
B. basic character
C. amphoteric character
D. ionic character

36 For an ideal gas, Boyle's law is best described by

A.


C.


B.


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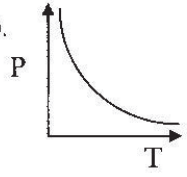


37 The pH values of (i) 0.1 M HCl_{aq}, (ii) 0.1 M KOH, (iii) tomato juice and (iv) pure water follow the order

A. (i) < (iii) < (iv) < (ii)
B. (iii) < (i) < (iv) < (ii)
C. (i) < (ii) < (iii) < (iv)
D. (iv) < (iii) < (ii) < (i)

38 When calcium carbide is added to water, the gas that is evolved is

A. carbon dioxide
B. hydrogen
C. acetylene
D. methane

39 The atomic radii of the alkali metals follow the order

A. Li > Na > K > Cs
B. K > Cs > Li > Na
C. Na > K > Cs > Li
D. Cs > K > Na > Li

40 The number of possible structural isomers of C_3H_4 is

A. 1 B. 2 C. 3 D. 4

41 Among the four compounds: (i) acetone, (ii) propanol, (iii) methyl acetate and (iv) propionic acid, the two that are isomeric are

A. methyl acetate and acetone
B. methyl acetate and propanol
C. propionic acid and methyl acetate
D. propionic acid and acetone

42 One mole of nitrogen gas on reaction with 3.01×10^{23} molecules of hydrogen gas produces

A. one mole of ammonia
B. 2.0×10^{23} molecules of ammonia
C. 2 moles of ammonia
D. 3.01×10^{23} molecules of ammonia

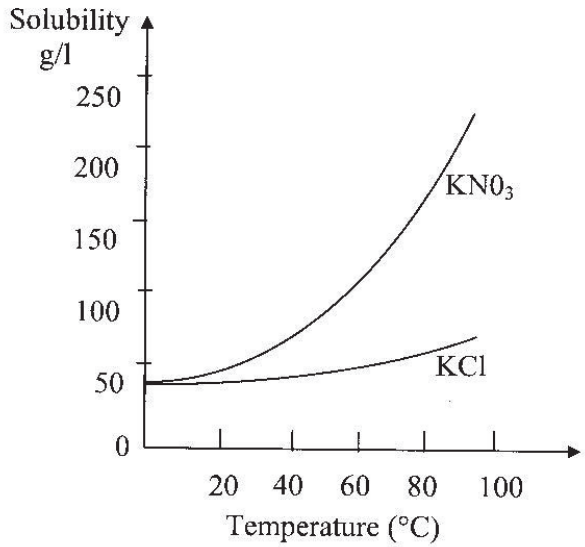
43 Saponification is

A. hydrolysis of an ester
B. hydrolysis of an amide
C. hydrolysis of an ether
D. hydrolysis of an acid chloride

44 A concentrated solution of lead nitrate in water can be stored in

A. an iron vessel
B. a copper vessel
C. a zinc vessel
D. a magnesium vessel

45



Given the solubility curves of KNO_3 and KCl, which of the following statements is not true?

A. At room temperature the solubility of KNO_3 and KCl are not equal

B. The solubilities of both KNO_3 and KCl increase with temperature

C. The solubility of KCl decreases with temperature

D. The solubility of KNO_3 increases much more compared to that of KCl with increase in temperature

BIOLOGY

46 Which one of the following is the smallest in size?

A. Bacteria
B. Mitochondrion
C. Mammalian cell
D. Virus

47 If birds are moved from 30^0 C to 10^0 C, their body temperature

A. changes from 30^0 C to 10^0 C
B. increases by 10^0 C
C. does not change at all
D. decreases by 10^0 C

48 Ascorbic acid is a/an,

A. Strong inorganic acid
B. Hormone
C. Vitamin
D. Enzyme

49 Bile salts,

A. break down polypeptide chains
B. emulsify fats and solubilize them
C. digest fats
D. help breakdown of polysaccharides

50 Dietary fibers are composed of,

A. Cellulose
B. Proteins
C. Amylose
D. Unsaturated fats

51 'On the origin of species, by means of Natural selection' was written by,

A. Hugo de Vries
B. Charles Darwin
C. Charles Dickens
D. Alfred Russell Wallace

52 Unlike humans, dogs cannot perspire to get rid of excess metabolic heat. They lose metabolic heat by,

A. panting
B. taking a bath
C. running in windy conditions
D. rolling in the mud

53 Haemodialysis is a treatment option for patients with malfunctions of ,

A. Kidney
B. Liver
C. Heart
D. Lungs

54 An individual has O blood group if his/her blood sample,

A. Clumps only when antiserum A is added
B. Clumps only when antiserum B is added
C. Clumps when both antiserum A and antiserum B are added
D. Does not clump when either antiserum A or antiserum B is added

55 In warmer weather, curds from milk forms faster because,

A. Bacteria diffuse better in warmer milk
B. The rate of bacterial multiplication increases
C. Lactogen is better dissolved
D. It is easier to separate protein from water

56 Seedlings grown in dark are

A. similar to those grown in light
B. taller than those grown in light
C. shorter than those grown in light
D. they don't grow at all

57 In humans, Rhesus condition can arise when,

A. father is Rh+ and mother is Rh-
B. father is Rh- and mother is Rh+
C. either father or mother is Rh+

D. either father or mother is Rh-

58 The part of the human brain that governs memory and intelligence is,

A. Cerebrum
B. Medulla
C. Hypothalamus
D. Cerebellum

59 Saturated dietary fats increase the risk of heart disease by,

A. widening arteries by thinning their walls
B. narrowing veins by carbohydrate deposition
C. narrowing arteries by fat deposition
D. narrowing arteries by carbohydrate deposition

60 Rotation of crops is carried out to,

A. increase variation in the mineral content of the soil
B. increase diversity of plant habitats
C. increase in nitrogen content of the soil
D. increase convenience for the farmer