KISHORE VAIGYANIK PROTSAHAN YOJANA - 2009

Date : 01-11-2009 **Duration : 3 Hours** **Max. Marks : 100**

STREAM - SA

GENERAL INSTRUCTIONS

- The Test Booklet consists of **80** questions.
- There are Two parts in the question paper. The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART-I :

MATHEMATICS

Question No. **1 to 15** consist of **ONE (1)** mark for each correct response.

PHYSICS

Question No. **16 to 30** consist of **ONE (1)** mark for each correct response.

CHEMISTRY

Question No. **31 to 45** consist of **ONE (1)** mark for each correct response.

BIOLOGY

Question No. **46 to 60** consist of **ONE (1)** mark for each correct response.

PART-II :

MATHEMATICS

Question No. **61 to 65** consist of **TWO (2)** marks for each correct response.

PHYSICS

Question No. **66 to 70** consist of **TWO (2)** marks for each correct response.

CHEMISTRY

Question No. **71 to 75** consist of **TWO (2)** marks for each correct response.

BIOLOGY

Question No. **76 to 80** consist of **TWO (2)** marks for each correct response.

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 $(1+2x)^{20} = a_0 + a_1 x + a_2 x^2 + \cdots + a_{20} x^{20}$. 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%

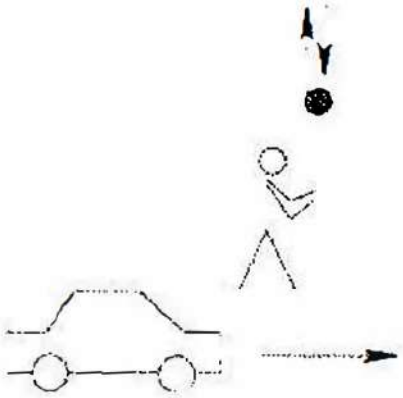
15. Let S_n be the sum of all integers k such that $2^n < k < 2^{n+1}$, for $n \geq 1$. Then 9 divides S_n if and only if

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

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

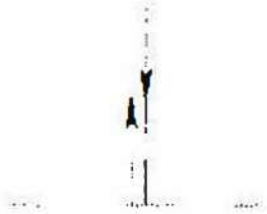
PHYSICS

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

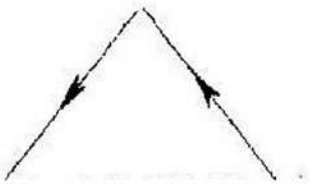
A.



C.

B.

D.

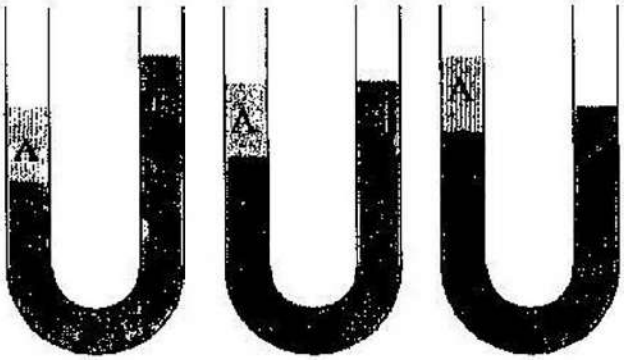


17 Consider two spherical planets of same average density. Planet 2 is 8 times as massive as planet 1. The ratio of the acceleration due to gravity of the second planet to that of the first is

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

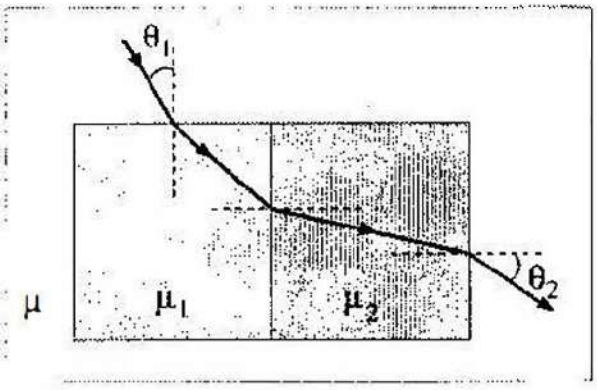
18 Two immiscible liquids, A and B are kept in a U-tube. If the density of liquid A is smaller than the density of liquid B, then the equilibrium situation is

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

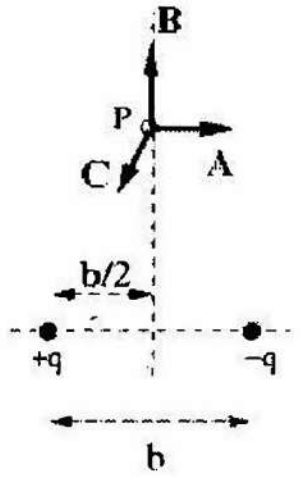
A. $W_1 = W_2 = 0$

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

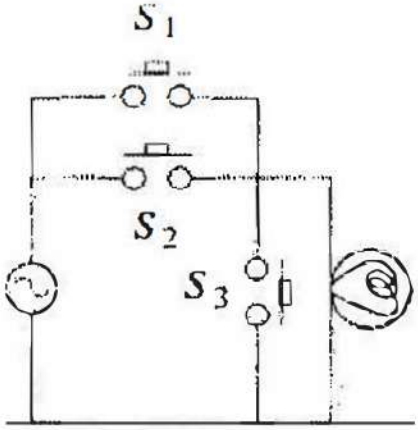
C. displacement amplitude

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



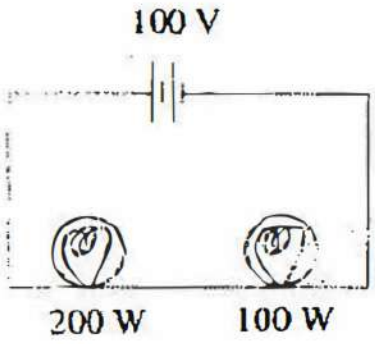
A. S_1, S_2 and S_3 are all closed.

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_3●H, CH_3CH_2OH

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

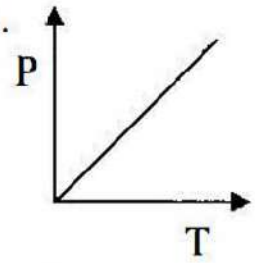
34 In the reaction $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$, the substance that is oxidized is

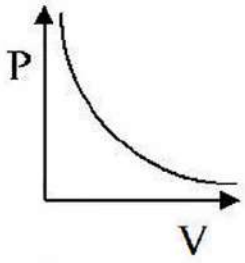
A. SO_2 B. H_2O C. S D. H_2S

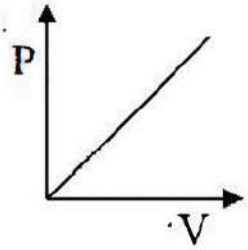
35 Sodium oxide dissolves in water to give sodium hydroxide which indicates its

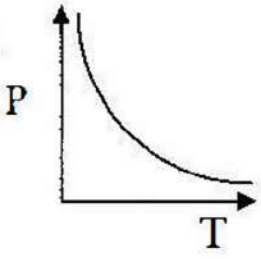
A. acidic character
B. basic character
C. amphoteric character
D. ionic character

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

A.


C.


B.


D.


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

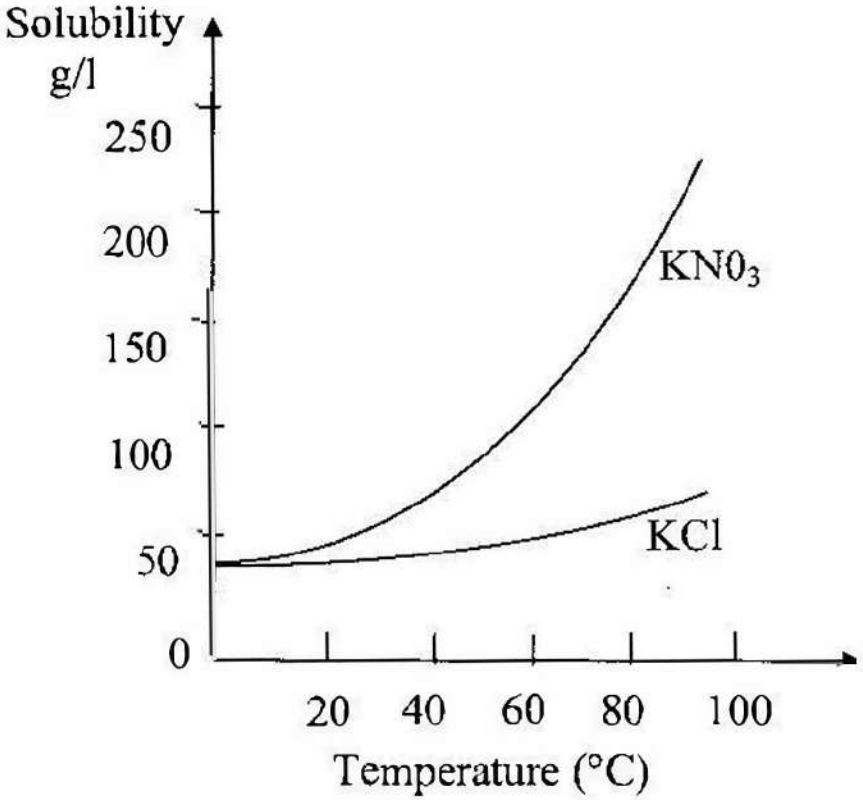
A. an iron vessel

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
C. Mammalian cell
B. Mitochondrion
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
C. does not change at all
B. increases by 10^0 C
D. decreases by 10^0 C

48 Ascorbic acid is a/an,

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

49 Bile salts,

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

50 Dietary fibers are composed of,

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

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

A. Hugo de Vries
C. Charles Dickens
B. Charles Darwin
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

PART-II (2 Marks)

MATHEMATICS

61. Let $\log_a b = 4$, $\log_c d = 2$ where a, b, c, d are natural numbers. Given that $b - d = 7$, the value of $c - a$ is

A. 1 **B.** -1 **C.** 2 **D.** -2

62. Let $P(x) = 1 + x + x^2 + x^3 + x^4 + x^5$. What is the remainder when $P(x^{12})$ is divided by $P(x)$?

A. 0 **B.** 6 **C.** $1 + x$ **D.** $1 + x + x^2 + x^3 + x^4$

63. In a triangle ABC, the altitudes from B and C on to the opposite sides are not shorter than their respective opposite sides. Then one of the angles of ABC is

A. 30° **B.** 45° **C.** 60° **D.** 72°

64. In a triangle ABC, $AB = AC = 37$. Let D be a point on BC such that $BD = 7$, $AD = 33$. The the length of CD is

A. 7 **B.** 11 **C.** 40 **D.** not determinable

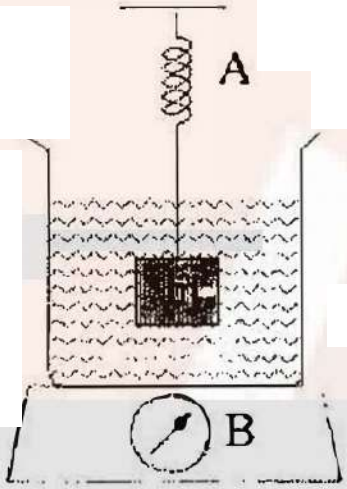
65. A line segment l of length a cm is rotated about a vertical line L keeping the line l in one of the following three positions: (I) l is parallel to L and is at a distance of r cm. from L; (II) l is perpendicular to L and its mid-point is at a distance r cm,. from L; (III) l and L are in the same plane and l is inclined to L at an angle 30° with its mid-point at a distance r cm. from L. Let A_1, A_2, A_3 be the areas so generated. If $r > (a/2)$, then

A. $A_1 < A_3 < A_2$ **C.** $A_2 < A_1 < A_3$

B. $A_1 = A_3 < A_2$ **D.** $A_1 = A_2 = A_3$

PHYSICS

66 A spring balance A reads 2 kg with a block of mass m suspended from it. Another balance B reads 3 kg when a beaker with a liquid is put on its pan. The two balances are now so arranged that the hanging mass m is fully immersed inside the liquid in the beaker as shown in the figure. In this situation



A. the balance A will read 2 kg and B will read 5 kg.

B. the balance A will read 2 kg and B will read 3 kg.

C. the balance A will read less than 2 kg and B will read between 3 kg and 5 kg.

D. the balance A will read less than 2 kg and B will read 3 kg.

67 According to the quantum theory, a photon of electromagnetic radiation of frequency ν has energy $E = h\nu$ where h is known as Planck's constant. According to the theory of relativity, a particle of mass m has equivalent energy $E = mc^2$, where c is speed of light. Thus a photon can be treated as a particle having effective mass $m = \frac{h\nu}{c^2}$. If a flash of light is sent horizontally in earth's gravitational field, then photons while traveling a horizontal distance d would fall through a distance given by

A. $\frac{gd^2}{2c^2}$ B. $\frac{h}{mc}$ C. $\frac{mcd^2}{h}$ D. zero

68 A solid square plate is spun around different axes with the same angular speed. In which of the following choice of axis of rotation will the kinetic energy of the plate be the largest ?

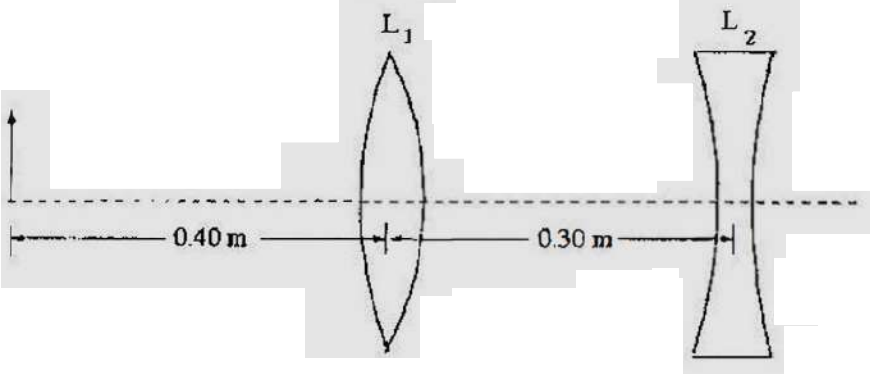
A. Through the center normal to the plate.

B. Along one of the diagonals of the plate.

C. Along one of the edges of the plate.

D. Through one corner normal to the plate.

69 An object is placed 0.40 m from one of the two lenses L_1 and L_2 of focal lengths 0.20 m and 0.10 m respectively as depicted in the figure. The separation between the lenses is 0.30 m.



The final image formed by this two lens system is at

A. 0.13 m to the right of the second lens.

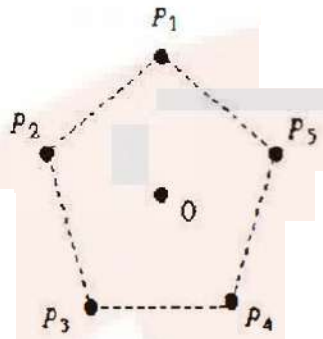
B. 0.05 m to the right of the second lens.

C. 0.13 m to the left of the second lens.

D. Infinity.

70 5 charges each of magnitude 10^{-5}C and mass 1 kg are placed (fixed) symmetrically about a movable central charge of magnitude 5×10^{-5}C

and mass 0.5 kg as shown. The charge at P_1 is removed. The acceleration of the central charge is



[Given: $OP_1 = OP_2 = OP_3 = OP_4 = OP_5 = 1$m; $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ in SI units.]

A. 9 m s^{-2} upwards.
B. 4.5 m s^{-2} upwards.
C. 9 m s^{-2} downwards.
D. 4.5 m s^{-2} downwards.

CHEMISTRY

71 Reaction of NaCl with conc. H_2SO_4 liberates a gas, **X** that turns moist blue litmus paper red. When gas **X** is passed into a test tube containing egg shell powder suspended in water another gas, **Y** is generated which when passed through lime water makes it milky. The gases **X** and **Y**, respectively, are

A. HCl and CO_2
B. SO_2 and CO_2
C. Cl_2 and CO_2
D. SO_2 and HCl

72 10 ml of an aqueous solution containing 222 mg of calcium chloride (mol. wt. = 111) is diluted to 100 ml. The concentration of chloride ion in the resulting solution is

A. 0.02 mol/lit
B. 0.01 mol/lit
C. 0.04 mol/lit
D. 2.0 mol/lit

73 Aluminium reduces manganese dioxide to manganese at high temperature. The amount of aluminium required to reduce one gram mole of manganese dioxide is

A. 1/2 gram mole
B. 3/4 gram mole
C. 1 gram mole
D. 4/3 gram mole

74 Ethanol on reaction with alkaline $KMnO_4$ gives **X** which when reacted with methanol in the presence of an acid gives a sweet smelling compound, **Y**. **X** and **Y**, respectively, are

A. acetaldehyde and acetone
B. acetic acid and methyl acetate
C. formic acid and methyl formate
D. ethylene and ethyl methyl ether

75 The pH of a 10 ml aqueous solution of HCl is 4. The amount of water to be added to this solution in order to change its pH from 4 to 5 is

A. 30 ml
B. 60 ml
C. 90 ml
D. 120 ml

BIOLOGY

76 Proteins are synthesized on,

A. Cytoskeleton
B. Mitochondria
C. Ribosomes
D. Golgi apparatus

77 Which of the following allows light to focus in visual perception?

A. Retina
B. Iris
C. Retinal pigment
D. Cornea

78 During cell division if there is one round of chromosome duplication followed by one round of cell division, the number of chromosomes the daughter cells will have as compared to the mother is,

A. equal B. double C. half D. one fourth

79 Similar type of vegetation can be observed, in the same,

A. latitude B. longitude C. country D. continent

80 Which of the following ecological food chain does NOT represent an erect pyramid of numbers?

A. Grass-Rodent-Snake C. Grass-Deer-Tiger

B. Tree-Bird-Avian parasite D. Insect-Chicken-Human