

and 4x = 3y

 \Rightarrow x = 6, y = 8

 $\Rightarrow 2x + 2y = 28$

KVPY QUESTION PAPER 2015 Class XI Part-I (One-Mark Questions) [MATHEMATICS]

1. Two distinct polynomials f(x) and g(x) are defined as follows :

 $f = (x) = x^2 + ax + 2; g(x) = x^2 + 2x + a.$

If the equation f(x) = 0 and g(x) = 0 have a common root then the sum of the roots of the equation f(x) + g(x) = 0 is

(A)
$$-\frac{1}{2}$$
 (B) 0 (C) $\frac{1}{2}$ (D) 1
Ans. (C)
Sol. $f(\alpha) = g(\alpha) \Rightarrow \alpha = 1 \text{ or } a = -2$
 $\Rightarrow a = 2 \text{ or } a = -3$
Using $a = -3$, $f(x) + g(x) = 0$
 $\Rightarrow 2x^2 - x - 1 = 0$
 $\Rightarrow \text{ sum of roots } = \frac{1}{2}$
2. If n is the smallest natural number natural number such that n + 2n + 3n + 99n is a perfect square
then the number of digits in n² is
(A) 1 (B) 2 (C) 3 (D) More than 3
Ans. (C)
Sol. Sum = 99×50×n = (3)²(5)²(22)(n) = perfect square
 $\Rightarrow n_{min} = 22 \Rightarrow n^2 = 484 \Rightarrow \text{ number of digits } = 3$
3. Let x, y, z be positive reals. Which of the following implies x = y = z ?
(I) x² + y³ + z³ = 3xyz (II) x³ + y²z + yz² = 3xyz
(III) x³ + y²z + z²x = 3xyz (IV) (x + y + z)³ = 27 xyz
(A) I, IV only (B) I, II and IV only (C) I, II and III only (D) All of them
Ans. (B)
Sol. (B) ga AM ≥ GM on x³, y³, z³ only possibility is x = y = z
(IV) Using AM ≥ GM on x, y, z only possibility is x = y = z
Hence I, II & IV are true
4. In the figure given below, a rectangle of perimeter
76 units is divided into 7 congruent rectangles.
What is the perimeter of each of the smaller rectangles ?
(A) 38 (B) 32 (C) 28 (D) 19
Ans. (C)
Sol.
 $\Rightarrow 6x + 5y = 76$

у

х

y

y

Х

y



5. The largest non-negative integer k such that 24^k divides 13! is :

Ans. (B)

Sol. Exponent of 2 in |13

$$= \left[\frac{13}{2}\right] + \left[\frac{13}{2^2}\right] + \left[\frac{13}{2^3}\right] + \left[\frac{13}{2^4}\right] + \dots = 10$$

Exponent of 3 in |13

$$= \left[\frac{13}{3}\right] + \left[\frac{13}{3^2}\right] + \left[\frac{13}{3^3}\right] + \dots = 5$$

$$\frac{13}{3} = 2^{10} \cdot 3^5 \times 5^2 \times 7 \times 11 \times 13$$

$$= (24)^3 (2 \cdot 3^2 \cdot 5^2 \cdot 7 \cdot 11 \cdot 13)$$

So $K_{max} = 3$

- 6. In a triangle ABC, points X and Y are on AB on AC, respectively such that XY is parallel to BC, Which of the two following equalities alywas hold ? (Here [PQR] denotes the area of triangle PQR)
 - (I) [BCX = [BCY]]
 - (II)[ACX] . [ABY] = [AXY].[ABC](A) Neither (I) nor (II) (B) (I) Only (C) (II) only

(D) Both (I) and (II)

Ans. (D)

Sol. (I) [BCX] = [BCY] is true as base & height same for both triangles (II) Check [ACX][ABY] = [AXY][ABC]

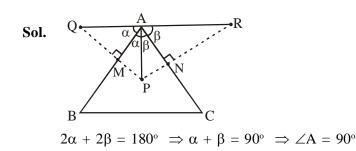
 \Rightarrow Check $\frac{[ACX]}{[AXY]} = \frac{[ABC]}{[ABY]}$

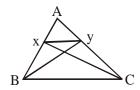
$$\Rightarrow \frac{[AXY] + [XCY]}{[AXY]} = \frac{[ABY] + [BYC]}{[ABY]}$$

 $\Rightarrow \frac{[XYC]}{[AXY]} = \frac{[BYC]}{[ABY]}$ is true Hence I & II both true

7. Let P be an interior point of a triangle ABC. Let Q and R be the reflections of P in AB and AC, respectively. If Q, A, R are collinear then $\angle A$ equals

(A) 30° (B) 60° (C) 90° (D) 120° Ans. (C)



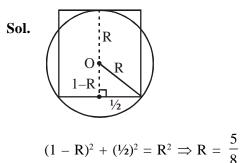




8. Let ABCD be a square of side length 1, I⁻ a circle passing through B and C, and touching AD. The radius of I⁻ is :-

(A)
$$\frac{3}{8}$$
 (B) $\frac{1}{2}$ (C) $\frac{1}{\sqrt{2}}$ (D) $\frac{5}{8}$





9. Let ABCD be a square of side length 1. Let P, Q, R, S be points in the interiors of the sides AD, BC, AB, CD, respectively, such that PQ and RS intersect at right angles. If $PQ = \frac{3\sqrt{3}}{4}$ then RS equals :-

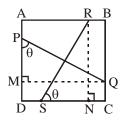
(A) $\frac{2}{\sqrt{3}}$ (B) $\frac{3\sqrt{3}}{4}$ (C) $\frac{\sqrt{2}+1}{2}$ (D) $4-2\sqrt{2}$

Ans. (B)

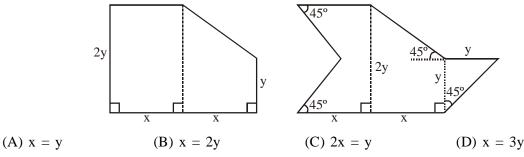
Sol.

In ΔPQM , $PQsin\theta = 1$ In ΔRSN , $RSsin\theta = 1$

 \Rightarrow PQ = RS = $\frac{3\sqrt{3}}{4}$



10. In the figure given below, if the areas of the two regions are equals then which of the following is true ?



Ans. (B)

Sol. From given figure $A_1 = 2xy + \frac{1}{2}(2y+y)x$,

$$A_{2} = (2x + y)(2y) - 3y^{2}$$
$$\therefore A_{1} = A_{2} \Longrightarrow 2y = x$$

11. A man standing on a railway platform noticed that a train took 21 seconds to cross the platform (this means the time elapsed from the moment the engine enters the platform till the last compartment leaves the platform) which is 88 metres long, and that it took 9 seconds to pass him. Assuming that train was moving with uniform speed, what is the length of the train in meters ?

Ans. (C)

Sol. Let length of train be ℓ' and speed be 'v'

$$\therefore \frac{88+\ell}{v} = 21 \quad \& \quad \frac{\ell}{v} = 9 \implies \frac{88}{v} + 9 = 21 \qquad \implies v = \frac{88}{12} \quad \& \quad \ell = 66$$

12. The least positive integer n for which $\sqrt[3]{n+1} - \sqrt[3]{n} < \frac{1}{12}$ is

Ans. (C)

Sol.
$$(n+1)^{1/3} - (n)^{1/3} < \frac{1}{12}$$

 $\Rightarrow n^{\frac{1}{3}} \left(\left(1 + \frac{1}{n} \right)^{\frac{1}{3}} - 1 \right) < \frac{1}{12}$
 $\Rightarrow n^{\frac{1}{3}} \left(\left(1 + \frac{1}{n} - \delta \right) - 1 \right) < \frac{1}{12}, \ \delta > 0$
 $\Rightarrow n^{\frac{1}{3}} \frac{(1-3n\delta)}{3n} < \frac{1}{12} \Rightarrow n^{2/3} > 4(1-3n\delta)$
 $\Rightarrow n > 8(1-3n\delta)^{3/2} \Rightarrow n_{\min} = 8$

13. Let n > 1 be an integer. Which of the following sets of numbers necessarily contains a multiple of 3 ? (A) $n^{19} - 1$, $n^{19} + 1$ (B) n^{19} , $n^{38} - 1$ (C) n^{38} , $n^{38} + 1$ (D) n^{38} , $n^{19} - 1$

Ans. (B)

Sol. numbers will be of type 3λ , $3\lambda + 1$, $3\lambda - 1$ If $n = 3\lambda \Rightarrow n^{19} \& n^{38}$ are multiples of 3 If $n = 3\lambda + 1 \Rightarrow n^{19} - 1 \& n^{38} - 1$ are multiples of 3 If $n = 3\lambda - 1 \Rightarrow n^{19} + 1 \& n^{38} - 1$ are multiples of 3 $\Rightarrow n^{19} \& n^{38} - 1$ necessarily contain multiple of 3

 14. The number of distinct primes dividing 12! + 13! + 14! is

 (A) 5
 (B) 6
 (C) 7

Ans. (A)

Sol. $|\underline{12}(1 + 13 + (14)(13)) = (|\underline{12})(14)^2 \implies 2, 3, 5, 7, 11$ divide this

So 5 distinct prime divisors

15. How many ways are there to arrange the letters of the word EDUCATION so that all the following three conditions hold ?

(D) 8

- The vowels occur in the same order (EUAIO);
- The consonants occur in the same order (DCTN);
- No two consonants are next to each other.
- (A)15 (B) 24 (C) 72 (D) 120

Ans. (A)

Sol. Vowels can be arranged in one way, due to which there will be 6 gaps, out of which we need to choose 4 So ${}^{6}C_{4} = 15$

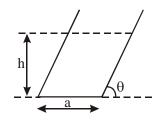


PHYSICS

- 16. In an experiment, mass of an object is measured by applying a known force on it, and then measuring its acceleration. If, in the experiment, the measured values of applied force and the measured acceleration are F = 10.0 ± 0.2N and a = 1.00 ± 0.01 m/s², respectively, the mass of the object is :
 (A)10.0 Kg
 (B) 10.0 ± 0.1 Kg
 (C) 10.0 ± 0.3 Kg
 (D) 10.0 ± 0.4 Kg
- Sol. Ans. (C)

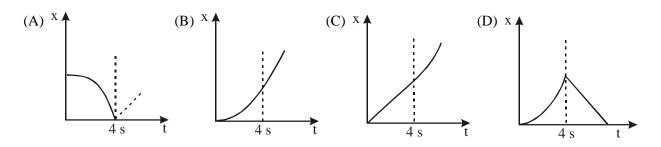
Sol.
$$m = \frac{F}{a}$$
; $\left(\frac{\Delta m}{m}\right)_{max} = \frac{\Delta F}{F} + \frac{\Delta a}{a} = \frac{0.2}{10} + \frac{0.01}{1} = 0.03$ \therefore $m = (10.0 \pm 0.3)$ kg

17. A hollow tilted cylindrical vessel of negligible mass rest on a horizontal plane as shown. The diameter of the base is a and the side of the cylinder makes an angle θ with the horizontal. Water is then slowly poured into the cylinder. The cylinder topples over when the water reaches a certain height h, given by :-



(A)
$$h = 2a \tan\theta$$
 (B) $h = a \tan^2\theta$ (B) $h = a \tan\theta$ (D) $h = \frac{a}{2} \tan\theta$
Ans. (C)
Sol.
 $\tan\theta = \frac{y}{x} = \frac{h}{2}$
 $h = a \tan\theta$
 $h = a \tan\theta$

18. An object at rest at the origin begins to move in the +x direction with a uniform acceleration of 1 m/s² for 4s and then it continues moving with a uniform velocity of 4 m/s in the same direction. The x-t graph for object's motion will be :-



Ans. (B)

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Sol. Initially, velocity will increase, so will be the slope of x-t curve, then velocity will become constant and slope of x-t curve will also become constant.

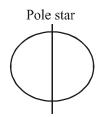


19. If the axis of rotation of the earth were extended into space then it would pass close to

- (A) the moon
- (B) the sun
- (C) the pole star
- (D) the centre of mass of all the planets in the solar system

Ans. (C)

Sol. A pole star is a visible star, which lies approximately directly overhead when viewed from earth's north pole or south pole. In practice the term pole star usually refers to polars, which is the current northern pole star, also known as north star. The south celestial pole lacks a bright star like polarise to mark its position.



- 20. Methane is a greenhouse gas because
 - (A) it absobs longer wavelengths of the electromagnetic spectrum while transmitting shorter wavelengths.
 - (B) it absorbs shorter wavelengths of the electromagnetic spectrum while transmitting longer wavelengths.
 - (C) it absorbs all wavelengths of the electromagnetic spectrum
 - (D) it transmits all wavelengths of the electromagnetic spectrum

Ans. (A)

- **Sol.** Green house gases act much like the roof of a green house that trap heat on earth. The process happens in two steps. First green house gases let the visible and uv light (shorter wavelength) in sunlight to pass through earth's atmosphere unimpeded. When light strikes the earth's surface and is refelcted back to atmosphere as infrared energy (longer wavelength), green house gases absorb this heat.
- 21. A parachutist with total weight 75 kg drops vertically onto a sandy ground with a speed of 2ms⁻¹ and comes to a halt over a distance of 0.25 m. The average force from the ground on her is close to :- (A) 600 N (B) 1200 N (C) 1350 N (D) 1950 N

Ans. (C)

Sol. $a_{av} = \frac{4}{0.5} = 8 \text{ m/s}^2$ $(F_{av})_{ground} - \text{mg} = \text{ma}$

 $(F_{av})_{ground} = (75)[18] = 1350N$

The beta particles of a radioactive metal originate from

- (A) the free electrons in the metal (B) the orbiting electrons of the metal atoms
- (C) the photons released from the nucleus (D) the nucleus of the metal atoms

Ans. (D)

22.

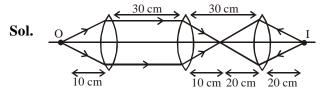
Sol. When neutron gets converted into a proton, inside a nucleus, β -particles are emitted.

 $\begin{array}{cccc} n \rightarrow p + & e^- & + & \overline{\nu} \\ & \downarrow & \\ & Beta \\ & particles \end{array}$

- **23.** An optical device is constructed by fixing three identical convex lenses of focal lengths 10 cm each inside a hollow tube at equal spacing of 30 cm each. One end of the device is placed 10 cm away from a point source. How much does the images shift when the device is moved away from the source by another 10 cm ?
 - (A) 0 (B) 5 cm (C) 15 cm (D) 45 cm



Ans. (A)



In second case when object is at 20 cm from first lens, image will still be at its original position because of principle of reversibility.

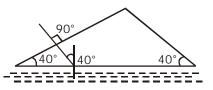
24. An isosceles glass prism with base angles 40° is clamped over a tray of water in a position such that the base is just dipped in water. A ray of light incident normally on the inclined face suffers total internal reflection at the base. If the refractive index of water is 1.33 then the condition imposed on the refractive index μ of the glass is :-

(A)
$$\mu < 2.07$$
 (B) $\mu > 2.07$ (C) $\mu < 1.74$ (D) $\mu > 1.74$

Ans. (B)

Sol. $40^\circ > \theta_c$

$$\sin 40^{\circ} > \frac{\mu_{w}}{\mu_{g}}$$
$$\mu_{g} > \frac{\mu_{w}}{\sin 40^{\circ}} \quad ; \quad \mu_{g} > \frac{1.33}{\frac{3}{5}}$$



 $\mu_{g} > 2.07$

A point source of light is moving at a rate of 2 cm-s⁻¹ towards a thin convex lens of focal length 10 25. cm along its optical axis. When the source is 15 cm away from the lens the image is moving at

(A) 4 cm-s⁻¹ towards the lens

(B) 8 cm-s⁻¹ towards the lens

(C) 4 cm- s^{-1} away from the lens

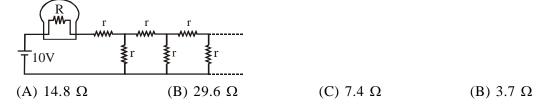
Ans. (D)

Sol.
$$\frac{1}{V} - \frac{1}{-15} = \frac{1}{10}$$

 $m = \frac{30}{-15} = -2$
 $= (4) (2)$
 \vdots (D)
 $\frac{1}{V} - \frac{2}{60} = \frac{1}{30}$
 $V_{I/\ell} = m^2 V_{0/\ell}$

(D) 8 cm- s^{-1} away from the lens

26. A light bulb of resistance $R = 16\Omega$ is attached in series with an infinite network with identical resistance r as shown below. A 10V battery drives current in the circuit. What should be the value of r such that the bulb dissipates about 1 W of power





Ans. (A)

Sol.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	
	Let $r_{PQ} = r_{eq}$	
	then $r_{eq} = r + \frac{r_{eq}r}{r_{eq} + r}$	(i)
	Also $P = i^2 R \implies 1 = i^2(16)$	
	$i = \frac{1}{4}A$; $\frac{1}{4} = \frac{10}{R + r_{eq}}$	
	$r_{eq} = 40 - 16 = 24$ $\Rightarrow r = 14.8\Omega$	(ii)

- A ball is launched from the top of Mt. Everest which is at elevation of 9000 m. The ball moves in 27. circular orbit around earth. Acceleration due to gravity near the earth's surface is g. The magnitude of the ball's acceleration while in orbit is
 - (A) close to g/2(B) zero (C) much greater than g (D) nearly equal to g

Ans. (D)

Sol.	mv^2	1	G	Men	1)
	r	=		r^2	-)

r

$$\frac{V^2}{r} \approx \frac{GMe}{R_e^2} \quad \left\langle r \approx R_e \right\rangle$$
$$\frac{v^2}{r} \approx g$$

- 28. A planet is orbiting the sun in an elliptical orbit. Let U denote the potential energy and K denote the kinetic energy of the planet at an arbitrary point on the orbit. Choose the correct statement.
 - (A) K < |U| always
 - (B) K > |U| always
 - (C) K = |U| always
 - (D) K = |U| for two positions of the planet in the orbit

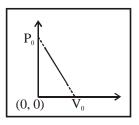
Ans. (A)

Sol. For bounded orbits

|U| > K

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29. One mole of ideal gas undergoes a linear process as shown in figure below. Its temperature expressed as a function of volume V is



(A)
$$\frac{P_0 V_0}{R}$$
 (B) $\frac{P_0 V}{R}$ (C) $\frac{P_0 V}{R} \left(1 - \frac{V}{V_0}\right)$ (D) $\frac{P_0 V_0}{R} \left(1 - \left(\frac{V}{V_0}\right)^2\right)$

Ans. (C)

Sol.
$$P = P_0 - \frac{P_0}{V_0}$$

 $T = \frac{PV}{nR}$
 $T = (P_0 - \frac{P_0}{V_0}V) V \frac{1}{nR}$
 $T = (P_0 - \frac{P_0}{V_0}V) V \frac{1}{nR}$

- **30.** The international station is maintained in a nearly circular orbit with a mean altitude of 330 km and a maximum of 410 km. An astronaut is floating in the space station's cabin. The acceleration of astronaut as measured from the earth is
 - (A) zero
 - (B) nearly zero and directed towards the earth
 - (C) nearly g and directed along the line of travel of the station
 - (D) nearly g and directed towards the earth

Ans. (D)

Sol.
$$\frac{V^2}{R} \approx g$$
 as $g' = \frac{g}{\left(1 + \frac{h}{R_e}\right)^2}$

 $h \ll R_{e}$

CHEMISTRY

31. The percentage of nitrogen by mass in ammonium sulphate is closest to (atomic masses H = 1, N = 14, O = 16, S = 32):
(A) 21%
(B) 24%
(C) 36%
(D) 16%

Ans. (A)
Sol. (NH₄)₂SO₄
Molecular mass = 132 amu

Mass of Nitrogen = 28 amu % N =
$$\frac{28}{132} \times 100 = 21\%$$

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32. Mendeleev's periodic law states that the properties of elements are a periodic function of their :-(A) reactivity of elements (B) atomic size (C) atomic mass (D) electronic configuration Ans. (C) Sol. By definition Maximum number of electrons that can be accommodated in the subshell with azimuthal quantum 33. number 1 = 4, is:-(A) 10 (B) 8 (C) 16 (D) 18 Ans. (D) Sol. Maximum no. of electrons accornodated in a subshell = $2[2\ell + 1] = 2[2 \times 4 + 1] = 18$ 34. The correct order of acidity of the following compounds is :-OCH₂ NO₂ COOH COOH COOH 2 3 (A) 1>2>3 (B) 1>3>2 (C) 3>1>2 (D) 3>2>1 Ans. (C) NO. OH (Acidic strength order) Sol. ĊO,H CO.H CO,H -I, -M effect -NO₂ (E.W.G.) increases acidic strength. $-OCH_3$ (E.D.G.) (-I < +M) decreases acidic strength. 35. Reaction of 2-butene with acidic KMnO₄ gives:-(A) CH₂CHO (B) HCOOH $(C) CH_3CH_2OH$ (D) CH₃COOH Ans. (D) Sol. CH₃-CH=CH-CH₃ Acidic KMnO → $CH_3CO_2H(2eq)$ 2-Butene strong oxidising reagent 36. The gas released when baking soda is mixed with vinegar is :-(B) CO₂ (A) CO (C) CH_{4} (D) O_{2} Ans. (B) CH_3 –C– $ONa + H_2O + CO_2$ -OH -Sol. $NaHCO_3 + CH_3$ Baking soda Vinegar So, gas released is CO_2 . 10/21

CAREER INSTITUTE

The element which readily form an ionic bond has the electronic configuration :-37. (A) $1s^22s^22p^3$ (B) $1s^22s^22P^1$ (C) $1s^22s^22p^2$ (D) $1s^2s^22p^63s^1$ Ans. (D) It is the electronic configuration of Na and forms ionic bond readily campared to orthers given Sol. 38. The major products of the following reaction $ZnS(s) + O_2(g) \xrightarrow{heat} \rightarrow$ are (A) ZnO and SO₂ (B) ZnSO₄ and SO₃ (C) ZnSO₄ and SO₂ (D) Zn and SO₂ Ans. (A) **Sol.** $\operatorname{ZnS}(s) + \frac{3}{2}O_2(g) \rightarrow \operatorname{ZnO} + \operatorname{SO}_2(\operatorname{Major})$ If Avogadro's number is A_0 , the number of sulphur atoms present in 200 mL of 1N H_2SO_4 is :-39. (A) $A_0/5$ (B) $A_0/2$ (C) $A_0/10$ (D) A_0 Ans. (C) **Sol.** Molarity = $\frac{\text{Normality}}{\text{'n'factor}}$ For H_2SO_4 ; 'n' factor = 2molarity = $\frac{1}{2}$ No. of moles of H_2SO_4 = Molarity × Vol. (in lt.) = $\frac{1}{2} \times \frac{200}{100} = \frac{1}{10}$ No. of molecules of $H_2SO_4 = \frac{1}{10} \times A_0$ No. of sulphur atom = $\frac{1}{10} \times A_0$ **40.** The functional group present in a molecule having the formula $C_{12}O_{q}$ is :-(A) carboxylic acid (C) aldehyde (B) anhydride (D) alcohol Ans. (B) **Sol.** $C_{12}O_{9} \Rightarrow$ One type of carbon suboxide Which is example of cyclictrianhydride side. The structure is



41. A sweet smelling compound formed by reacting acetic acid with ethanol in the presence of hydrochloric acid is :-

(A)
$$CH_3COOC_2H_5$$
 (B) C_2H_5COOH (C) $C_2H_5COOCH_3$ (D) CH_3OH

Ans. (A)

Sol.
$$CH_3CO_2H + C_2H_5OH \xrightarrow{\text{esterification} \text{in presence of} HCl} CH_3-CO-C_2H_5 + H_2O O CH_3-CO-C_2H_5 + H_2O O Ethyl acetate (Sweet smelling compound)$$

42. Among Mg, Cu, Fe, Zn, the metal that does not produce hydrogen gas in reaction with hydrochloric acid is:-(A) Cu(B) Zn(C) Mg(D) Fe

Ans. (A)

- Sol. Because Cu is above H in the reactivity series
- **43.** The maximum number of isomeric ethers with the molecular formula $C_4H_{10}O$ is:-(A) 2 (B) 3 (C) 4 (D) 5

Ans. (B)

- Sol. The maximum number of isomeric ethers with the molecular formula $C_4H_{10}O$ is 3. They are given below.
 - (i) $H_3C-CH_2-O-CH_2-CH_3$ Ethoxyethane
 - (ii) $H_3C-O-CH_2-CH_2-CH_3$ 1-methoxy propane

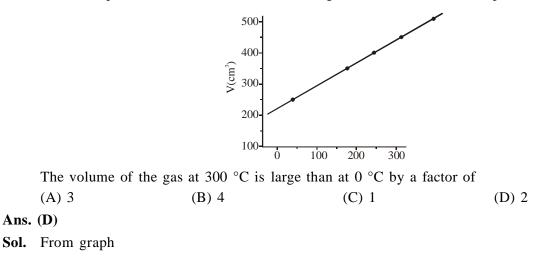
2-methoxy propane

44. The number of electrons required to reduce chromium completely in $\operatorname{Cr}_2 O_7^{2-}$ to Cr^{3+} in acidic medium, is:-(A) 5 (B) 3 (C) 6 (D) 2

Ans. (C)

Sol. $6e^- + Cr_2O_7^{-2} + 14H^{\oplus} \rightarrow 2Cr^{3+} + 7H_2O$

45. At constant pressure, the volume of fixed mass of a gas varies as a function of temperature as shown in the graph



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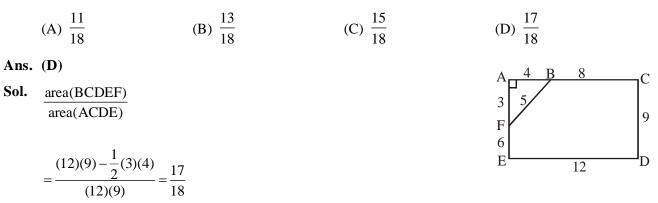
46.	Excess slat inhibits bacterial growth in pickles by :-				
	(A) endosmosis	(B) exosmosis	(C) oxidation	(D) denaturation	
Ans.	В				
47.	Restriction endonuclea	ases are enzymes that are	e used by biotechnologis	sts to :-	
	(A) cut DNA at specif	ic base sequences			
	(B) join fragments of	DNA			
	(C) digest DNA from	the 3' end			
	(D) digest DNA from	the 5' end			
Ans.	(A)				
48.	Enzyme X extracted fro probable candidates to	• •	hydrolyses peptide bonds	s. Which of the following are	
	(A) Amylase	(B) Lipase	(C) Trypsin	(D) Maltase	
Ans.	(C)				
49.	A person with blood g	group AB has :-			
	(A) antigen A and B of	on RBCs and both anti-A	A and anti-B antibodies i	in plasma	
	(B) antigen A and B o	n RBCs but neither anti	-A nor anti-B antibodies	in plasma	
	(C) no antigen on RBC	Cs but both anti-A and a	nti-B antibodies present	in plasma	
	(D) antigen A on RBC	Cs and anti-B antibodies	in plasma		
Ans.	(B)				
50.	Glycolysis is the break	kdown of glucose to pyr	uvic acid. How many m	olecules of pyruvic acid are	
	formed from one mole	ecule of glucose :-			
	(A) 1	(B) 2	(C) 3	(D) 4	
Ans.					
51.	-	r of electrons from gluco	se to molecular oxygen	in bacteria and mitochondria	
	is known as :-				
	(A) TCA cycle		(B) Oxidative phosphorylation		
	(C) Fermentation		(D) Glycolysis		
Ans.					
52.		owing cell types is part of	-		
	(A) Skin epithelial cell	Is (B) cells	(C) T lymphocytes	(D) Liver cells	
Ans.					
53.	-	ne of the following vita	-	-	
	(A) Vitamin B	(B) Vitamin C	(C) Vitamin D	(D) Vitamin K	
Ans.					
54.		wing is detrimental to s			
	(A) Saprophytic bacter	ria	(B) Nitrosomes		
	(C) Nitrobacter		(D) Pseudomonas		
Ans.					
55.		ollowing phyla is the bo			
	(A) Porifera	(B) Platyhelminthes	(C) Annelida	(D) Echinodermata	
Ans.	(C)				



56.	Widal test is prescribed to diagnose :-				
	(A) Typhoid	(B) Pneumonia	(C) Malaria	(D) Filaria	
Ans.	(A)				
57.	Which, among grass, goat, tiger and vulture, in a food chain, will have the maximum concentration of harmful chemicals in its body due to contamination of pesticides in the soil :-				
	(A) Grass since it gr	ows in the contaminate	d soil		
	(B) Goat since it eats	s the grass			
	(C) Tiger since it feeds on the goat which feeds on the grass				
	(D) Vulture since it eats the tiger, which in turn eats the goat, which eats the grass				
Ans.	(D)				
58.	Considering the average molecular mass of a base to be 500 Da, what is the molecular mass of a double stranded DNA of 10 base pairs :-				
	(A) 500 Da	(B) 5 kDa	(C) 10 kDa	(D) 1 kDa	
Ans.	(C)				
59.	Which of the following pairs are both polysaccharides :-				
	(A) Cellulose and glycogen		(B) Starch and glucose		
	(C) Cellulose and fructose		(D) Ribose and sucrose		
Ans.	(A)				
60.	Whic one of the following is a modified leaf :-				
	(A) Sweet potato	(B) Ginger	(C) Onion	(D) Carrot	
Ans.	(C)				

Part-II (Two-Mark Questions) MATHEMATICS

61. A triangular corner is cut from a rectangular piece of paper and the resulting pentagon has sides 5, 6, 8, 9, 12 in some order. The ratio of the area of the pentagon to the area of the rectangle is



62. For a real number x, let [x] denote the largest integer less than or equal to x, and let $\{x\} = x - [x]$. The number of solutions x to the equation $[x] \{x\} = 5$ with $0 \le x \le 2015$ is

(A) 0 (B) 3 (C) 2008 (D) 2009

Ans. (D)



Sol. $[x]{x} = 5, x \in [0, 2015],$

$$\{x\} = \frac{5}{[x]} \& \{x\} \in [0,1)$$

 \therefore [x] = 6, 7, 8,, 2015, \therefore 2009 solutions

63. Let ABCD be a trapezium with AD parallel to BC. Assume there is a point M in the interior of the segment BC such that AB = AM and DC = DM. Then the ratio of the area of the trapezium to the area of triangle AMD.

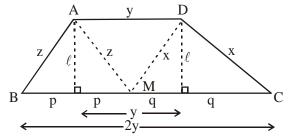
- (A) 2
- (C) 4

(B) 3

(D) not determinable from the data

Ans. (B)

Sol.



Let AB = AM = z, height =
$$\ell$$

DC = DM = x AD = y
 \Rightarrow BC = 2y p + q = y

$$\frac{\text{Area ABCD}}{\text{Area AMD}} = \frac{\left(\frac{1}{2}\right)(3y)(\ell)}{\left(\frac{1}{2}\right)(y)(\ell)} = 3$$

64. Given are three cylindrical buckets X, Y, Z whose circular bases are of radii 1, 2, 3 units respectively. Initially water is filled in these buckets upto the same height. Some water is then transferred from Z to X so that they both have the same volume of water. Is then transferred between X and Y so that they both have the same volume of water. If h_y, h_z denote the heights of water at this stage in the buckets

Y, Z, respectively, then the ratio $\frac{h_{Y}}{h_{Z}}$ equals

(A)
$$\frac{4}{9}$$
 (B) 1 (C) $\frac{9}{4}$ (D) $\frac{81}{40}$

Ans. (D)

Sol. Let initial height in all buckets be H Let height in z be h_z \Rightarrow Volume transferred = $9\pi(H - h_z)$ New volume in $x = \pi H + 9\pi(H - h_z)$ = $10\pi H - 9\pi h_z$

$$\therefore 10\pi H - 9\pi h_z = 9\pi H_z \implies \frac{H}{h_z} = \frac{9}{5}$$



Now after second transfer, let height in X be h_x

$$\Rightarrow \text{ volume transferred} = 10\pi H - 9\pi h_z - \pi h_x \Rightarrow \text{New volume in } Y = 4\pi H + 10\pi H - 9\pi h_z - \pi h_x \Rightarrow \text{New volume in } Y = 4\pi H + 10\pi H - 9\pi h_z - \pi h_x \Rightarrow \text{Volume in } X = \text{Volume in } Y \Rightarrow \pi h_x = 14\pi h - 9\pi h_z - \pi h_x \Rightarrow \pi h_z = \frac{14\pi h}{h_z} - 9 - \frac{h_x}{h_z} \Rightarrow \frac{h_x}{h_z} = \frac{81}{10}, \text{ Now let height in } Y \text{ be } h_y \Rightarrow h_y = \frac{\text{volume in } Y}{4\pi} \Rightarrow h_y = \frac{14\pi h - 9\pi h_z - \pi h_x}{4\pi} \Rightarrow \frac{h_y}{h_z} = \frac{14}{4} \cdot \frac{H}{h_z} - \frac{9}{4} - \frac{1}{4} \cdot \frac{4h_x}{h_z} \Rightarrow \frac{h_y}{h_z} = \frac{14}{4} \cdot \frac{9}{4} - \frac{1}{4} \cdot \frac{4h_x}{h_z}$$
The average incomes of the people in two villages are P and O, respectively. Assume that P ≠

65. The average incomes of the people in two villages are P and Q, respectively. Assume that $P \neq Q$. A person moves from the first village to the second village. The new average incomes are P' and Q', respectively. Which of the following is not possible ?

Ans. (C))

Sol. Let number of people in two villages be a & b respectively

Average income	No. of People	Total income	Total income after movement	New Population	New average income
Р	Q	P.a	$Pa - \lambda$	a – 1	$\mathbf{P'} = \frac{\mathbf{Pa} - \lambda}{\mathbf{a} - 1}$
Q	b	Qb	$Qb + \lambda$	b+1	$Q' = \frac{Qb + \lambda}{b + 1}$

$$\label{eq:posterior} \text{if } P' = P \Longrightarrow \frac{Pa - \lambda}{a-1} = P \ \Longrightarrow \lambda = P$$

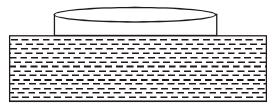
and also $Q' = Q \implies \frac{Qb + \lambda}{b+1} = Q$

 $\Rightarrow \lambda = Q \Rightarrow P = Q \text{ but } P \neq Q$

Hence C option not possible

PHYSICS

66. A girl sees through a circular glass slab (refractive index 1.5) of thickness 20 mm and diameter 60 cm to the bottom of a swimming pool. Refreactive index of water is 1.33. The bottom surface of the slab is in contact with the water surface.

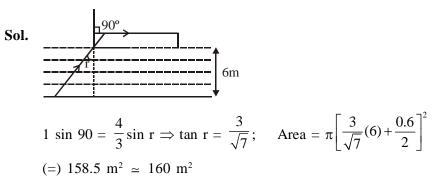


The depth of swimming pool is 6m. The area of bottom of swimming pool that can be seen through the slab is approximately

(A)
$$100 \text{ m}^2$$
 (B) 160 m^2 (C) 190 m^2 (D) 220 m^2



Ans. (B)



67. 1 Kg of ice at -20°C is mixed with 2 Kg of water at 90°C. Assuming that there is no loss of energy to the environment, what will be the final temperature of the mixture ? (Assume latent heat of ice = 334.4 KJ/Kg, specific heat of water and ice are 4.18 kJ/(kg.K) and 2.09kJ/(kg.K), respectively.) (A) 30°C (B) 0°C (C) 80°C (D) 45°C

Ans. (A)

Sol. (1)
$$(2.09)(0 + 20) + (1)(334.4) + (1) (4.18)(T)$$

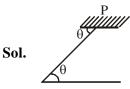
= (2) (4.18) (90 - T)

$$T = 30^{\circ}C$$

68. A rigid body in the shape of a "V" has two equal arms made of uniform rods. What must the angle between the two rods be so that when the body is suspended from one end, the other arm is horizontal?

(A)
$$\cos^{-1}\left(\frac{1}{3}\right)$$
 (B) $\cos^{-1}\left(\frac{1}{2}\right)$ (C) $\cos^{-1}\left(\frac{1}{4}\right)$ (D) $\cos^{-1}\left(\frac{1}{6}\right)$

Ans. (A)

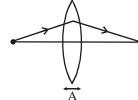


Centre of mass must be vertically below point P.

$$m\left(\frac{\ell}{2} - \ell\cos\theta\right) = m\frac{\ell}{2}\cos\theta$$

$$\frac{3}{2}\ell\cos\theta = \frac{\ell}{2} \Longrightarrow \cos = \frac{1}{3}$$

- 69. A point object is placed 20cm left of a convex lens of focal length f = 5cm (see the figure). The lens is made to oscillate with small amplitude A along the horizontal axis. The image of the object will also oscillate along the axis with
 - (A) amplitude A/9, out of phase with the oscillations of the lens.
 - (B) amplitude A/3, out of phase with the oscillations of the lens
 - (C) amplitude A/3, in phase with the oscillations of the lens
 - (D) amplitude A/9, in phase with the oscillations of the lens



Ans. (A)



Sol.
$$u = -20 \text{ cm}$$
 $v = \frac{20}{3} \text{ CM}$

 ${\sf X}_{_{I/\ell}} = \, m^2 \, \, {\rm X}_{_{o/\ell}} \qquad \qquad {\sf A}^{_1} = \, \frac{1}{9} {\sf A}$

If lens moves rightward image moves leftward.

70. Stoke's law states that the viscous drag force F experienced by a sphere of radius a, moving with a speed v through a fluid with coefficient of viscosity η , is given by $F = 6\pi\eta av$

If this fluid is flowing through a cylindrical pipe of radius r, length l and a pressure difference of P across its two ends, then the volume of water V which flows through the pipe in time t can be written as

$$\frac{v}{t} = k \left(\frac{p}{\ell}\right)^a \eta^b r^c,$$

where k is a dimensionless constant. Correct values of a, b and c are

(A) a = 1, b = -1, c = 4(B) a = -1, b = 1, c = 4(C) a = 2, b = -2, c = 3(D) a = 1, b = -2, c = -4

Ans. (A)

Sol.

$$[L^{3}T^{-1}] = [ML^{-2}T^{-2}]^{a}[ML^{-1}T^{-1}]^{b}[L]^{c}$$

-2a - b + C = 3
a + b = 0
-2a - b = -1
 \Rightarrow a = 1 b = -1 C = 4

 $\frac{\mathbf{V}}{\mathbf{t}} = \mathbf{k} \left(\frac{\mathbf{P}}{\ell}\right)^{a} (\mathbf{\eta})^{b} (\mathbf{r})^{c}$

CHEMISTRY

71. When 262 g of xenon (atomic mass = 131) reacted completely with 152 g of fluorine (atomic mass = 19), a mixture of XeF_2 and XeF_6 was produced. The molar ratio XeF_2 : XeF_6 is :-

(A)
$$1:2$$
 (B) $1:4$ (C) $1:1$ (D) $1:3$

Ans. (C))

Sol. Moles of
$$Xe = \frac{262}{131} = 2$$
 moles
Moles of F atoms $= \frac{152}{19} = 8$ moles
Let x moles of XeF₂ and y moles of XeF₆ are formed then
By applying P.O.A.C. on Xe;
 $X + Y = 2$
By applying P.O.A.C. on F
 $2x + 6y = 8$ (2)
By Solving (1) & (2)
 $x = 1; y = 1$

72. Reaction of ethanol with conc. sulphuric acid at 170 °C produces a gas which is then treated with bromine in carbon tetrachloride. The major product obtained in this reaction is :(A) 1.2 difference (D) athelene alread as (C) have a stread as (D) athelene at the brown of the stread as (D).

(A) 1,2-dibromoethane (B) ethylene glycol (C) bromoethane (D) ethyl sulphate **Ans. (A)**

Sol $CH_3 \longrightarrow CH_2 \xrightarrow{OH} (Dehydration of ethanol) \xrightarrow{H_2C} H_2C = CH_2 \xrightarrow{Br_2/ccl_4} H_2C \longrightarrow CH_2$ ethene (g) $H_2C = CH_2 \xrightarrow{Br_2/ccl_4} H_2C \longrightarrow CH_2$ In the set of the

mechanism
$$H_3C-CH_2 + HHSO_4 \Longrightarrow H_3C-CH_2 + HSO_4$$

 $H_2C-CH_2 + HHSO_4 \Longrightarrow H_3C-CH_2 + HSO_4$
 $H_2C-CH_2 + H_2O$
 $C_1H_0 \oplus HSO_4$
 $HSO_4 \oplus H_2C = CH_2$ (Ethene Gas)
 $H_2SO_4 + H_2C = CH_2$ (Ethene Gas)
 $H_2C-CH_2 \oplus Br_2/CCI_4$
 $H_2C-CH_2 \oplus Br_4$

73. When 22.4 L of C_4H_8 at STP is burnt completely, 89.6 L of CO_2 gas at STP and 72 g of water are produced. The volume of the oxygen gas at STP consumed in the reaction is closest to :-

(A) 89.6 L (B) 112 L (C) 134.4 L (D) 22.4 L Ans. (C)) Sol. $C_4H_{8(g)} + 6O_{2(g)} \rightarrow 4CO_{2(g)} + 4H_2O_{(\ell)}$ moles of $C_4H_8 = \frac{22.4}{22.4} = 1$ mole moles of O, required = 6 moles

volume of O_2 required = $6 \times 22.4 = 134.4$ lt

74. The amount of Ag (atomic mass = 108) deposited at the cathode when a current of 0.5 amp is passed through a solution of AgNO₃ for 1 hour is closes to :-

(A) 2 g (B) 5 g (C) 108 g (D) 11 g

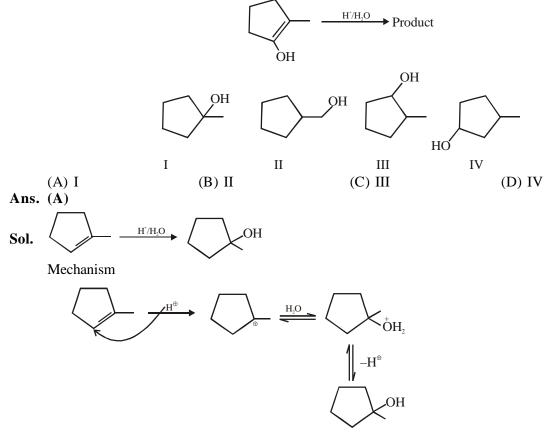
Ans. (A)

Sol. No. of equivalent of Ag deposited = No. of faraday = $\frac{0.5 \times 60 \times 60}{96500} = \frac{18}{965}$

Wt. of 'Ag' deposited = $\frac{18}{965} \times 108 \approx 2$ gm



75. The major product of the reaction is :-



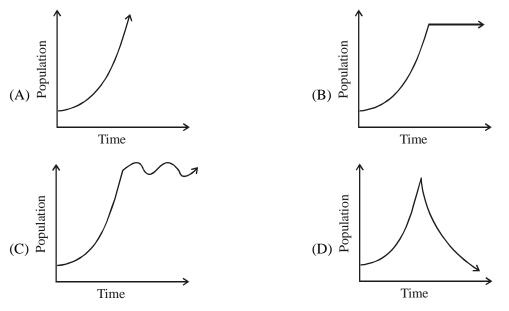
BIOLOGY

76. Genomic DNA is digested with Alu I, a restriction enzyme which is a four base-pair cutter. What is the frequency with which it will cut the DNA assuming a random distribution of bases in the genome:-

(A) 1/4 (B) 1/24 (C) 1/256 (D) 1/1296

- Ans. (C)
- 77. I rice is cooked in a pressure cooker on the Siachen glacier, at sea beach and on Deccan plain, which of the following is correct about the time taken for cooking rice :-
 - (A) Gets cooked faster on the Siachen glacier
 - (B) Gets cooked faster at sea beach
 - (C) Gets cooked faster on Deccan plain
 - (D) Gets cooked at the same time at all the three places
- Ans. (B)

78. A few rabbits are introduced in an un-inhabited island with plenty of food. If these rabbits breed in the absence of any disease, natural calamity and predation, which one of the following graphs best represents their population growth :-



Ans. (B)

- 79. What is the advantage of storing glucose as glycogen in animals instead of as monomeric glucose:-
 - (A) Energy obtained from glycogen is more than that from the corresponding glucose monomers
 - (B) Glucose present as monomers within the cells exerts more osmotic pressure than a single glycogen molecule, resulting in loss of water from the cells.
 - (C) Glucose present as monomers within the cell exerts more osmotic pressure than a single glycogen molecule, resulting in excess water within the cells.
 - (D) Glycogen gives more rigidity to the cells.
- Ans. (C)
- **80.** A line is draw from the exterior of an animal cell to the centre of the nucleus, crossing through one mitochondrion. What is the minimum number of membrane bilayers that the line will cross :-

(A) 4 (B) 3 (C) 8 (D) 6

Ans. (B)