

INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE 2012-2013

Total time : 120 minutes
[Ques. Paper Code : 5-1-4]

(Total Marks : 240)

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT

1. If equal weights of oxygen and nitrogen are kept in separate containers at the same temperature then
- (a) Both the containers have the same numbers of molecules.
 - (b) The pressure of the nitrogen container is greater than that of the oxygen container.
 - (c) More molecules are present in the oxygen container.
 - (d) The pressure of the oxygen container is greater than that of the nitrogen container.

Ans. [b]

Sol.

	O ₂	N ₂
wt	x	x
moles	$\frac{x}{32}$	$\frac{x}{28}$

pressure \propto no. of moles

2. A boy is standing on a truck which is moving with constant speed along a straight road. On a day when wind is negligible, the boy throws a ball vertically up with some velocity. The ball comes back and falls



- (a) Behind the boy
- (b) In front of the boy
- (c) Behind or in front of the boy depending on the speed of the truck and ball
- (d) into boy's hand

Ans. [d]

3. If $\sqrt[3]{75} = \sqrt[4]{45} = \sqrt[5]{15} = k$, then which of the statement is true

- (a) $x + y = 2z$
- (b) $x + y = 3z$
- (c) $x - y = 2z$
- (d) $x - y = 3z$

Ans. [b]

Sol. $\sqrt[3]{75} = \sqrt[4]{45} = \sqrt[5]{15} = k$ (Let)

$$\Rightarrow 75 = k^x$$

$$45 = k^y$$

$$15 = k^z$$

$$\Rightarrow \ln 75 = x \ln k$$

$$\ln 45 = y \ln k$$

$$\ln 15 = z \ln k$$

$$\Rightarrow x = \frac{\ln 75}{\ln k}$$

$$y = \frac{\ln 45}{\ln k}$$

$$z = \frac{\ln 15}{\ln k}$$

$$\text{the eq. } x + y = \frac{1}{\ln k} [\ln 75 + \ln 45]$$

$$= \frac{1}{\ln k} [\ln 3375]$$

$$\text{As } 15^3 = 3375$$

$$x + y = \frac{1}{\ln k} [\ln 15^3]$$

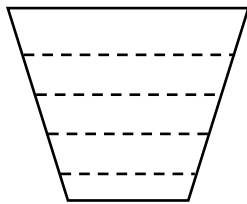
$$= \frac{1}{\ln k} [3 \ln 15]$$

$$\text{but } \ln 15 = z \ln k$$

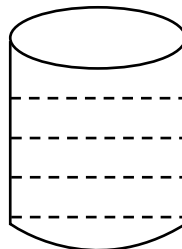
$$\therefore x + y = \frac{1}{\ln k} 3 \times z \ln k$$

$$\therefore x + y = 3z.$$

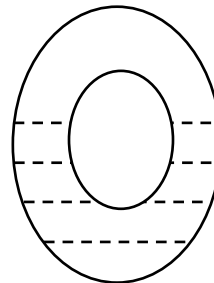
4. The pressure at the bottom of the four vessels filled with water to the same level is P_1 , P_2 , P_3 and P_4 respectively. Then which of the following conclusion is correct



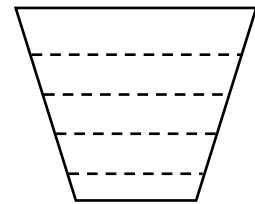
P_1



P_2



P_3



P_4

- (a) $P_1 > P_2 > P_3 > P_4$ (b) $P_1 < P_2 < P_3 < P_4$ (c) $P_1 = P_2 = P_3 = P_4$ (d) $P_1 = P_4 = P_2 > P_3$

Ans. [c]

5. If $x + y + z = 1$; $x \neq y \neq z$; x, y, z are real numbers and $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = m$. How many of the following statements are always true.

- (i) $m = 6$ (ii) $m = 8$ (iii) $m = 10$ (iv) $m = 12$
 (a) 2 (b) 1 (c) 3 (d) all

Ans. [a]

Sol. As $AM \geq HM$

$$\therefore \frac{x+y+z}{3} \geq \frac{3}{\frac{1}{x} + \frac{1}{y} + \frac{1}{z}}$$

$$\Rightarrow \frac{1}{3} \geq \frac{3}{\frac{1}{x} + \frac{1}{y} + \frac{1}{z}}$$

$$\Rightarrow \frac{1}{x} + \frac{1}{y} + \frac{1}{z} \geq 9$$

\therefore may be 10 or 12

6. Two liters of oxygen gas diffused through a membrane in 600 seconds. 0.6 liter of an unknown gas diffused through the same membrane in half the time required for oxygen to diffuse. The molecular weight of the unknown gas is

- (a) 16 (b) 89 (c) 44 (d) 64

Ans. [b]

$$r_{O_2} = \frac{2}{600} \quad r_{\text{unknown}} = \frac{0.6}{300}$$

$$\frac{r_{O_2}}{r_{\text{unknown}}} = \frac{2}{600} \times \frac{300}{0.6} = \frac{10}{6} = \frac{5}{3}$$

$$\frac{r_{O_2}}{r_{\text{unknown}}} = \sqrt{\frac{M_{\text{unknown}}}{M_{O_2}}}$$

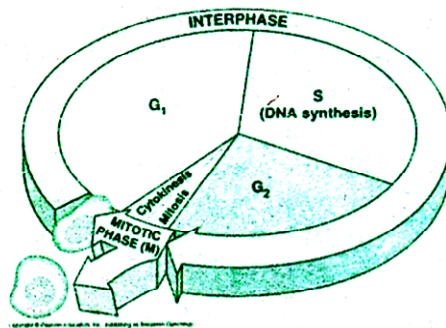
$$\frac{5}{3} = \sqrt{\frac{M_{\text{unknown}}}{32}}$$

$$\frac{25}{9} = \frac{M_{\text{unknown}}}{32}$$

$$M_{\text{unknown}} = \frac{32 \times 25}{9} = \frac{800}{9} = 88.88 \approx 89$$

Read the following carefully and answer the questions from 7 to 10

A student treats some onion root tips with colchicine that is responsible for arresting cell division at the metaphase state (by dissolving spindle fibres) and further prepared a slide of the root tip staining with acetoorcein (stains chromatin) and observed under high power of compound microscope. He is well aware of the cell cycle given alongside.



7. Which of the following is not true about his observation ?
- Most cells are in the metaphase
 - Most cells are in interphase
 - No cells are in anaphase or telophase
 - Chromosomes could be observed better than a slide prepared without colchicine treatment

Ans. [b]

8. Why did the student choose root tips of onion
- Roots grow fast and considerable length of tips can be used
 - Roots tips have meristematic tissue
 - Root tips are easy to smear and stain
 - Cell division occurs only at the root tips in plants

Ans. [b]

9. What might be the purpose of the student?
- Observing stages of cell division
 - Comparing number of cells in various stages of cell division
 - Preventing further growth of the root tips
 - Observing chromosomes

Ans. [a]

10. Considering the action of colchicines, it may be considered for the treatment of
- Hairfall
 - Cancer
 - Anemia
 - Bacterial infection

Ans. [b]

11. The element with electronic configuration $1s^2 2s^2 2p^6 3s^2$ is a/an
- Inert gas
 - Non-metal
 - Metalloid
 - Metal

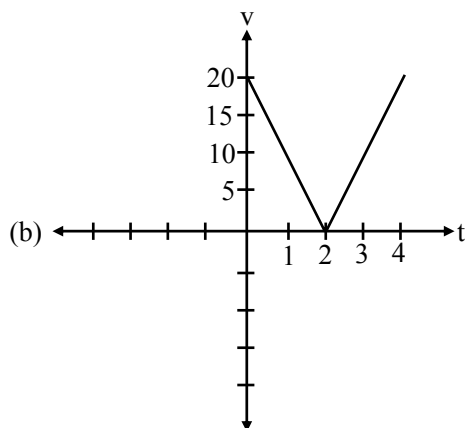
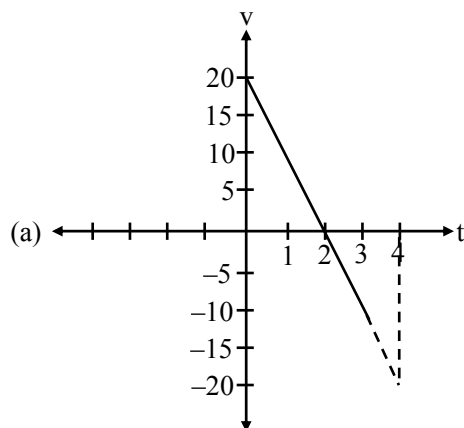
Ans. [d]

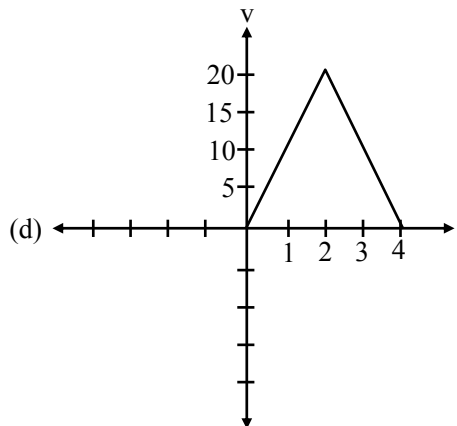
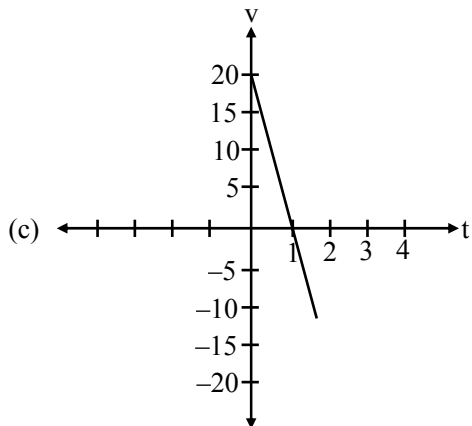
$$\text{E.C.} = 1s^2 2s^2 2p^6 3s^2$$

i.e. ns^2 is general E.C. of Alkaline earth metal

Atomic number is 12 i.e. element is Mg

12. A ball is thrown up vertically in still air with a velocity of 20ms^{-1} . It comes back to ground. The velocity-time graph is ($g = 10\text{ms}^{-2}$).





Ans. [a]

Sol. $v = u + gt$

$$t = \frac{20}{10} = \frac{2}{1}$$

$\therefore t = 2$ sec. to reach max height so total time is 4 sec.

13. The sixty sixth independence day was on Wednesday. After how many years the next independence day will be on Wednesday ?

- (a) 28 years (b) 7 years (c) 11 years (d) 6 years

Ans. [c]

14. Sound waves travelling in air enters water at an angle i with the normal. It gets refracted at angle r with

- (a) $r > i$ (b) $i > r$
 (c) $i = r$ (d) Sound waves do not get refracted

Ans. [a]

Water is rarer medium for sound.

15. What will be the remainder if the number 7^{2012} is divided by 25?

- (a) 24 (b) 18 (c) 1 (d) 7

Ans. [c]

Sol. $(7^2)^{1006}$

$$(50-1)^{1006} \div 25$$

$$\left[{}^{1006}C_0(50)^{1006} \dots\dots\dots + {}^{1006}C_{1006}(50)^0 \right]$$

\therefore Remainder is = 1

16. The last electron of the element of atomic member 31 will have the following quantum numbers

- | | n | l | m | s |
|-----|---|---|----|------|
| (a) | 3 | 0 | 0 | -1/2 |
| (b) | 4 | 1 | -1 | -1/2 |
| (c) | 3 | 1 | 1 | +1/2 |
| (d) | 4 | 0 | 0 | +1/2 |

Ans. [b]

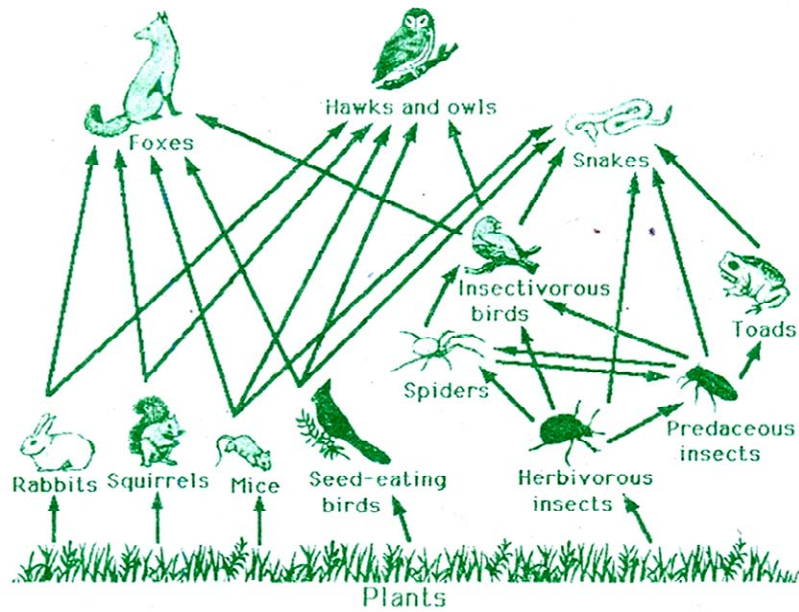
Sol. Atomic number (31) = [Ar] $3d^{10} 4s^2 4p^1$

Element Ga

Last e^- will enters in $4p^1$

$$n = 4, l = 1, m = -1, s = -\frac{1}{2}$$

Study the following diagram and answer the questions 17 to 21



17. Which of the following are tertiary consumers ?
- (a) Spiders, Predacious insects and herbivorous insects
 - (b) Foxes, Hawks and Snakes
 - (c) Rabbit, Squirrels and Mice
 - (d) Snake, Toads and spiders

Ans. [d]

18. The shortest and the longest food chains have..... and Number of organisms respectively
- (a) 2 and 6
 - (b) 2 and 5
 - (c) 3 and 6
 - (d) 3 and 5

Ans. [b]

19. An insecticide is sprayed to protect the plants. Which of the following statements is true ?
- (a) Toads and insectivorous birds will prosper as they will get ample supply of dead insects
 - (b) Some insects will die, some will become resistant and prolifer more and top carnivore will be affected most
 - (c) Herbivores will be greatly affected, plants will be safe and carnivores will move to other area and will not be affected greatly
 - (d) Some insects will die, but there will be no long term effects as the pesticides will get washed away

Ans. [b]

20. What should be the preferred food of snakes to ensure minimum loss of solar energy
(a) Foxes (b) Toads (c) Insectivorous birds (d) Mice

Ans. [d]

21. Organisms having low chances of survival produce larger number of offsprings to ensure their survival. Which of the following can be a characteristic feature of such organisms.

- (a) Good parental care (b) Better defense strategies
(c) Large body size (d) Short lifecycle

Ans. [d]

22. The compound which contains both ionic and covalent bonds is

- (a) KCl (b) CS₂ (c) KCN (d) C₂H₆

Ans. [c]

Sol. KCN → K⁺ C⁻ ≡ N

23. A particle of mass 0.5 kg travelling with a velocity of 2ms⁻¹ experiences acceleration of 2m⁻² for 9s. The workdone by the force on the particle during this period is

- (a) 396J (b) 101J (c) 190J (d) 99J

Ans. [d]

Sol. v = u + at

$$= 2 + 2 \times 9$$

$$= 20 \text{ m/s}$$

$$w = \frac{1}{2} m (v^2 - u^2)$$

$$\frac{1}{2} \times \frac{1}{2} (400 - 4)$$

$$\frac{1}{4} \times (396) = 99$$

24. The product of three consecutive natural numbers is 124850054994. What is their average?

- (a) 4993 (b) 4994 (c) 4998 (d) 4997

Ans. [c]

Sol. Let no. are x, x + 1, x + 2
then by options (total of no. are)
14979, 14982, 14994, 14991

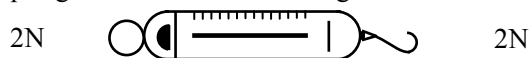
$$\therefore 3x + 3 = 14994$$

$$x = \frac{14994 - 3}{3} = \frac{14991}{3} = 4997$$

∴ other no. are 4998, 4999

$$\therefore \text{average} = \frac{4997 + 4998 + 4999}{3} = 4998$$

25. What is the reading of the spring balance shown in the figure below ?



- (a) 2N (b) 0 (c) 4N (d) 6N

Ans. [a]

26. If ABCD is a cyclic quadrilateral. $AB = 204$, $BC = 104$, $CD = 195$, $DA = 85$ and $BD = 221$. Then find AC

- (a) 205 (b) 220 (c) 210 (d) 225

Ans. [b]

27. Molality of a solution is the number of

- (a) moles of the solute per 1000 mL of the solution
(b) moles of the solute per 1000 g of the solvent
(c) moles of the solute per 1000 mL of the solvent
(d) moles of the solute per 100 g of the solvent

Ans. [b]

28. A scientist wanted to check the effect of a certain hair straightening procedure on the tensile strength of hair. The scientist could take only 20 samples. Which of the following sampling pattern should she use to ensure that maximum parametes are controlled and the results reflect the effect of the straightening process alone.

- (a) 10 girls and 10 boys one each of age 15, 16, 17 and so on upto 25 after the procedure and another similar set of sample group who did not undergo the procedure
(b) 10 girls and 10 boys one each of age 15, 16, 17 and so on upto 25 before and after the procedure
(c) 10 girls and 10 boys of age 18 after the straightening procedure and another similar set of sample group who did not undergo the procedure
(d) 10 girls and 10 boys of age 18 before and after the straightening procedure

Ans. [*]

29. A lady has 4 kids with blood group AB and 1 kid with blood group O. If the father of these kids have blood group B, what is the possible genotype of the lady?

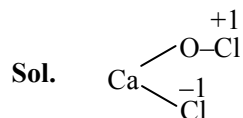
- (a) $I^A I^O$ (b) $I^A I^B$ (c) $I^A I^B$ (d) $I^B I^B$

Ans. [a]

30. The oxidation number of chlorine in CaOCl_2 is

- (a) +3 (b) -1 (c) +1 (d) 0

Ans. [d]



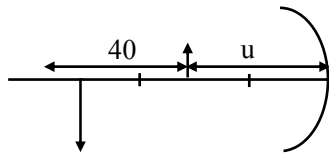
$$\text{Average oxidation number of Cl} = \frac{-1+1}{2} = 0$$

31. The real image of an extended object placed in front of a concave mirror is formed at a distance of 40 cm from the object. If the image is 3 times bigger than the object, the magnitude of focal length of the mirror is

- (a) 5 cm (b) 10 cm (c) 20 cm (d) 15 cm

Ans. [d]

Sol.



$$m = -\frac{v}{u}$$

$$-3 = -\left(\frac{u + 40}{u}\right)$$

$$3u = u + 40$$

$$2u = 40$$

$$u = 20$$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$= \frac{1}{60} - \frac{1}{20}$$

$$= \frac{-1 - 3}{60}$$

$$= \frac{-4}{60} = -\frac{1}{15}$$

$$f = -15 \text{ cm.}$$

32. If $\cot^2\theta(1 - 3\sec\theta + 2\sec^2\theta) = 1$ and $\theta > 90^\circ$, then θ is equal to

- (a) 120° (b) 300° (c) 210° (d) 330°

Ans. [b]

Sol. $\cos \theta = \frac{1}{2}$ & $\cos \theta = 1$

$\cos \theta = \cos 60^\circ$ $\cos \theta = 0$

$\cos \theta = \cos (360^\circ - 300^\circ)$ $\therefore \theta = 360^\circ$

$= \cos 300^\circ$

$\theta = 300^\circ$

33. A person suffering from short sight is advised to wear spectacles having concave lens of power 1.25D. What is the farthest distance he can see clearly without spectacles?

- (a) 60 cm (b) 100 cm (c) 80 cm (d) 120 cm

Ans. [c]

Sol. $p = \frac{1}{f}$

$$f = \frac{100}{125} \times 100 = 80 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$-\frac{1}{80} = \frac{1}{v} - \frac{1}{\infty}$$

$$v = 80 \text{ cm}$$

34. Consider triangles having integer sides such that no side is greater than 4 units. How many such triangles are possible ?

- (a) 64 (b) 17 (c) 24 (d) 13

Ans. [b]

Sol. Total triangles ${}^4C_1 \times {}^3C_1 \times {}^2C_1 = 24$
but 7 triangles are not possible

\therefore sum of two sides is more than third) like (1, 1, 2) (1, 2, 4)

\therefore Total triangles are $24 - 7 = 17$

35. Green house effect is related to

- (a) Carbon dioxide emission and absorption (b) Ozone layer depletion
(c) Nitrogen radiation (d) Oxygen radiation

Ans. [a]

Fact

36. What is the major difference between Bacteria and Virus

- (a) Viruses are precursors to bacteria
(b) Viruses use host machinery to reproduce unlike bacteria
(c) Viruses lack proteins that are present in viruses
(d) Viruses have proteins whereas bacteria do not

Ans. [b]

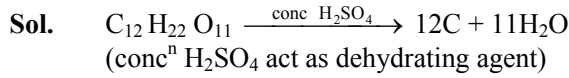
37. Of the following the combination of processes related to sexual reproduction are :

- i. Conjugation ii. Fragmentation iii. Gameta formation iv. Zygote
(a) only iii and iv (b) i,ii. and iv (c) ii, iii and iv (d) i, iii and iv

Ans. [a]

38. Charring of sugar in concentrated sulphuric acid is due to
 (a) Oxidation of sugar (b) Reduction of sugar
 (c) Dehydration of sugar (d) Hydrolysis of sugar

Ans. [c]



39. Two wire made of same material have length l and $2l$. If the masses of the wires are same, the ratio of the resistance of shorter wire to that of longer wire is
 (a) 1/2 (b) 1/4 (c) 2 (d) 4

Ans. [b]

Sol. $\frac{R_1}{R_2} = \frac{\rho \ell_1 A_2}{A_1 \rho \ell_2}$
 $= \frac{\ell_1 A_2}{A_1 \ell_2}$
 $= \frac{\ell A_2}{A_1 2\ell}$
 $= \frac{A_2}{2A_1}$

$$d = \frac{m}{v}$$

$$v_1 \times d = v_2 \times d$$

$$A_1 \ell_1 = A_2 \ell_2$$

$$A_1 \times \ell = A_2 \times 2\ell$$

$$\therefore \frac{1}{2} = \frac{A_2}{A_1} \quad \frac{R_1}{R_2} = \frac{1}{4}$$

40. Find $x^2 + y^2 + z^2$ if $x^2 + xy + xz = 135$, $y^2 + yz + yx = 351$ and $z^2 + zx + zy = 243$
 (a) 225 (b) 275 (c) 250 (d) 300

Ans. [b]

Sol. $x^2 + y^2 + z^2 = ?$

$$x^2 + xy + xz = 135 \quad \dots(1)$$

$$y^2 + yz + yx = 351 \quad \dots(2)$$

$$z^2 + zx + zy = 243 \quad \dots(3)$$

add equation (1), (2) & (3)

$$\Rightarrow (x^2 + y^2 + z^2) + 2(xy + yz + zx) = 729 \quad \dots(4)$$

$$\Rightarrow (x + y + z)^2 = 729$$

$$\Rightarrow x + y + z = \sqrt{729} = \sqrt{9 \times 81} = 27$$

$$x + y + z = 27 \quad \dots(5)$$

by (1) $x^2 + x(y + z) = 135$

$$x^2 + x(27 - x) = 135$$

$$27x = 135$$

$$x = \frac{135}{27} = \frac{15}{3} = 5$$

& by (2) $y^2 + y(27 - y) = 351$ & $z^2 + z(27 - z) = 243$

$$y = \frac{351}{27} = \frac{39}{3} = 13 \quad z = \frac{243}{27} = \frac{27}{3} = 9$$

$$\therefore x^2 + y^2 + z^2 = 25 + 169 + 81 = 275$$

41. Current passing through a wire increases by 20%. Due to Joule heating the resistance increases by 20%. The percentage increase in the power is
 (a) 40% (b) 44% (c) 33% (d) 72.8%

Ans. [d]

Sol. $P = i^2R$

$$P = \left(\frac{6i}{5}\right)^2 \left(\frac{6}{5}R\right)$$

$$= \frac{\left(\frac{216}{125}i^2R - i^2R\right) \times 100}{i^2R}$$

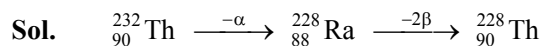
$$= 72.8\%$$

42. In a certain number system $363 + 1056 = 1452$. Find the value of $(654 - 456)$ in the same number system
 (a) 165 (b) 156 (c) 178 (d) 198

Ans. [a]

43. A radioactive element ${}_{90}\text{R}^{232}$ emits one alpha(α) particle and then two beta (β) particles. The daughter element will have
 (a) Atomic no. 88, Mass no. 232 (b) Atomic no. 90, Mass no. 232
 (c) Atomic no. 88, Mass No. 228 (d) Atomic no. 90, Mass No. 228

Ans. [d]



44. Dwarfness is a desirable agronomic character since such cereals:
 (a) Produce grains faster (b) Produce grains of better quality
 (c) Require lesser nutrients and water (d) Prove easier to harvest

Ans. [a]

45. The combination of the following structures possessing a single set of genome is:
 (i) ovary (ii) anther (iii) egg (iv) Zygote
 (v) sepal (vi) petal (vii) Pollen
 (a) i, ii, iv, v and vi (b) only iii and vii (c) ii, iii, iv and vii (d) only ii, iii and vii

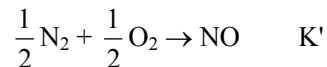
Ans. [b]

46. The equilibrium constant for the gaseous reaction $N_2 + O_2 \rightarrow 2NO$ is K. The equilibrium constant for the formation of one mole of NO will be

- (a) $K/2$ (b) K (c) \sqrt{K} (d) $2K$

Ans. [c]

Sol. $N_2 + O_2 \rightarrow 2NO$ K



$$K' = (K)^{1/2}$$

$$K' = \sqrt{K}$$

47. A bar magnet is placed on a table. There are n number of field lines connecting North pole to South pole of the magnet. Another identical magnet is placed on the first magnet with North Pole on North Pole and South Pole on South Pole. The number of field lines are now

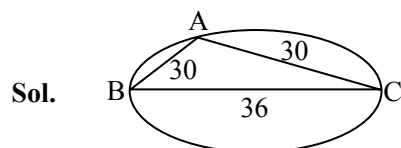
- (a) n (b) n^2 (c) 2n (d) $n/2$

Ans. [c]

48. What is the radius of the circumcircle of a triangle whose sides are 30 cm, 36 cm and 30 cm in length

- (a) 18 cm (b) 18.25 cm (c) 18.75 cm (d) 18.50 cm

Ans. [c]



$$s = 30 + 30 + 36 = 126$$

$$\text{And } (A \ \& \ C) = \frac{b}{4} \sqrt{4a^2 - b^2}$$

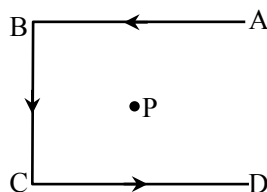
$$= 9\sqrt{4 \times 900 - 36^2}$$

$$= 9\sqrt{36000 - 36 \times 36}$$

$$= 9 \times 6 \times 8 = 432$$

$$R = \frac{abc}{4\Delta} = \frac{30 \times 30 \times 36}{4 \times 432} = \frac{75}{4} = 18.75$$

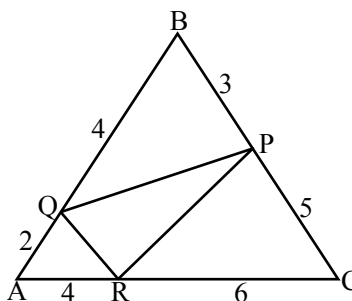
49. A conducting wire shown in the figure carries current I. Segments AB, BC and CD are of same length. The direction of the magnetic field at point P is given by



- (a) out of the plane of the paper (b) into the plane of the paper
(c) towards right (d) towards left

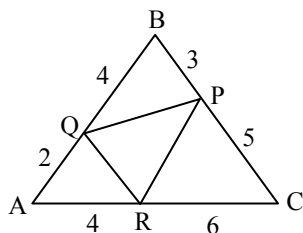
Ans. [a]

50. In the adjoining figure $AQ = 2$, $QB = 4$, $BP = 3$, $PC = 5$, $CR = 6$ and $RA = 4$. Find the area of triangle PQR.



- (a) 4.8 (b) 5.8 (c) 5.2 (d) 6.2

Ans. [d]



$$s = \frac{6 + 10 + 8}{2} = 12$$

Sol.

$$\text{Area (PQR)} = \frac{1}{4} (\text{ABC})$$

$$\text{Area of ABC} = \sqrt{12(12-6)(12-10)(12-8)}$$

$$= \sqrt{12 \times 6 \times 2 \times 4}$$

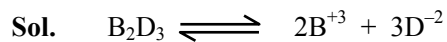
$$= 12 \times 2 = 24$$

$$\therefore \text{Area (PQR)} = 6$$

51. The solubility of a salt B_2D_3 is $X \text{ mol L}^{-1}$. Its solubility product is

- (a) X^5 (b) $6X^5$ (c) $108X^5$ (d) $36X^5$

Ans. [c]



$$X \text{ mol/litre} \quad 0 \quad 0$$

$$2x \quad 3x$$

$$K_{sp} = [B^{+3}]^2 [D^{-2}]^3$$

$$K_{sp} = (2x)^2 (3x)^3$$

$$K_{sp} = 108x^5$$

52. If and when proteins are oxidized during respiration the energy yield is lesser than when carbohydrates or lipids are oxidized. This is primarily due to the fact that they have:

- (a) relatively more oxygen (b) nitrogen that is not oxidized
(c) relatively less carbon (d) relatively less hydrogen

Ans. [c]

53. 8 Grams of oxygen at NTP contain

- (a) 1.5×10^{22} molecules (b) 3.0×10^{23} molecules
(c) 6.023×10^{23} molecules (d) 1.5×10^{23} molecules

Ans. [d]

Sol. $n_{\text{O}_2} = \frac{8}{32} = \frac{1}{4}$

$$\begin{aligned}\text{No. of molecules} &= \frac{1}{4} \times 6.0 \times 10^{23} \\ &= 1.5 \times 10^{23} \text{ molecules}\end{aligned}$$

54. In a nuclear reactor the fission process of each ^{235}U -atom gives out an energy of 200 MeV. According to Einstein's equation the amount of mass getting converted to energy in this process is

- (a) 3.55×10^{-30} Kg (b) 3.55×10^{-28} Kg
(c) 3.55×10^{-38} Kg (d) 3.55×10^{-27} Kg

Ans. [a]

Sol. $E = mc^2$

$$\frac{200 \times 1.6 \times 10^{-19} \times 10^6}{3 \times 10^8 \times 3 \times 10^8} = m$$

$$\frac{200 \times 1.6}{9} \times \frac{10^{-13}}{10^{16}}$$

$$= 35.55 \times 10^{-29}$$

$$= 3.55 \times 10^{-30}$$

55. If $\sin x + \sin y = a$ and $\cos x - \cos y = b$. Then find the value of $\frac{1}{2}(2 - a^2 - b^2)$

- (a) $\sin(x - y)$ (b) $\cos(x - y)$ (c) $\sin(x + y)$ (d) $\cos(x + y)$

Ans. [d]

Sol. $\sin x + \sin y = a$

$$\cos x - \cos y = b$$

$$\therefore a^2 + b^2 = \sin^2 x + \sin^2 y + 2 \sin x \sin y + \cos^2 x + \cos^2 y - 2 \cos x \cos y$$

$$a^2 + b^2 = 1 + 1 - 2 \cos(x + y)$$

$$2 \cos(x + y) = 2 - a^2 - b^2$$

$$\text{or } \cos(x + y) = +\frac{1}{2}(2 - a^2 - b^2)$$

$$\therefore \cos(x + y)$$

56. A ball is projected at an angle of 45° with horizontal. In the absence of air resistance, the ball follows

- (a) Elliptical orbit (b) parabolic path (c) sinusoidal path (d) linear path

Ans. [b]

57. A circle is inscribed in an isosceles trapezium ABCD in which AB is parallel DC. If AB = 10 and DC = 30. Find the area of the circle.

- (a) 45π (b) 50π (c) 75π (d) 60π

Ans. [c]

58. When 1g of CaCO_3 reacts with 50 mL of 0.1 M HCl, the volume of CO_2 produced is

- (a) 11.2 mL (b) 22.4 mL (c) 224 mL (d) 112 mL

Ans. [Bonus]

Sol. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$

Initial moles $\frac{1}{100}$ $\frac{1}{200}$

Limiting reagent is = HCl

2 Moles of HCl form = 1 mole of CO_2

$$\begin{aligned} \frac{1}{200} \text{ moles of HCl form} &= \frac{1}{2} \times \frac{1}{200} \\ &= \frac{1}{400} \text{ moles} \\ &= \frac{1}{400} \times 22.4 \\ &= 0.056 \text{ litres} \\ &= 0.056 \times 1000 = 56 \text{ ml} \end{aligned}$$

59. Neoteny or larva becoming large and developing into adult retaining larval features is common in amphibians since they are adapted to survive:

- (a) in dark places and lack of light induces early sexual maturation
(b) on insects that fail to supply enough nutrients
(c) on a high protein diet that induces early maturation
(d) in fresh water bodies where temperature and/or iodine content is less

Ans. [d]

60. Cheese is a colloidal system of

(a) Gas in solid

(b) Gas in liquid

(c) Liquid in solid

(d) Liquid in gas

Ans. [c]

Sol. Fact

61. 60g of ice at 0°C is added to 20g of water at 40°. The final temperature attained by the mixture is (given latent heat of melting of ice = 80 cal/g and specific heat of water is 1 cal/g°C)

(a) 5°C

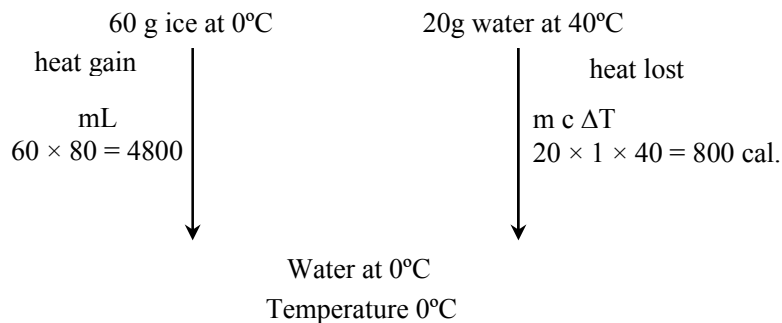
(b) 20°C

(c) 10°C

(d) 0°C

Ans. [d]

Sol.



heat gain > heat lost

so ice does not melt completely so temperature 0°C.

62. y varies inversely as x. If x is increased by 25%, then the value of percentage change to y is

(a) 62.5%

(b) 75%

(c) 60%

(d) 80%

Ans. [b]

Sol. $y \propto \frac{1}{x}$ or $y = \frac{1}{x}$

$$x_N = 1.25 x$$

$$\therefore y_N = \frac{1}{1.25x}$$

$$y_N = \frac{1}{1.25} y = 0.8 y$$

∴ y becomes

$$= 0.8 y$$

$$\Rightarrow 80\%$$

63. Wavelength is

(i) The distance traveled by the wave in one period of oscillation of particles in the medium.

(ii) The distance between two particles, which are in the same phase.

(iii) Half of the distance between two particles, which are in the same phase.

The correct definitions are

(a) (i) and (ii)

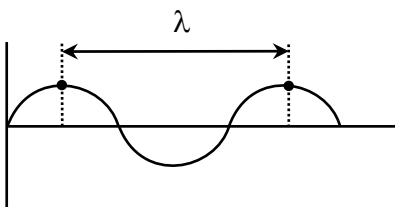
(b) (i) and (iii)

(c) (i), (ii) and (iii)

(d) (ii) and (iii)

Ans. [a]

Sol.



64. Find the value $\frac{2}{15} + \frac{2}{35} + \frac{2}{63} + \frac{2}{99} + \dots + \frac{2}{9999}$

(a) 8/33

(b) 98/303

(c) 2/11

(d) 222/909

Ans. [b]

Sol. $\frac{2}{15} + \frac{2}{35} + \frac{2}{63} + \frac{2}{99} + \dots + \frac{2}{9999}$

$$= \frac{1}{3} - \frac{1}{5} + \frac{1}{5} - \frac{1}{7} + \frac{1}{7} - \frac{1}{9} + \dots + \frac{1}{99} - \frac{1}{101}$$

$$\therefore \frac{1}{3} - \frac{1}{101} = \frac{98}{303}$$

65. When a dilute solution of sulphuric acid is electrolysed using platinum electrodes the gas evolved at the positive electrode is

(a) SO₂

(b) SO₃

(c) O₂

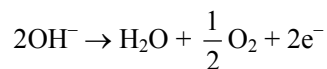
(d) H₂

Ans. [c]

Sol. $\text{H}_2\text{SO}_4 \rightarrow 2\text{H}^+ + \text{SO}_4^{2-}$



At anode (or at positive electrode)



66. To avoid damage to electricity cables trees are often trimmed before monsoon. Excessive trimming leaving only trunk often leads to death of a tree. The most probable reason is that:

(a) no food can be synthesized

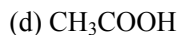
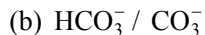
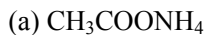
(b) no auxins (growth promoters) can be synthesized

(c) no buds are left to grow into new shoot/s

(d) they succumb to the excessive trauma of wounds

Ans. [b]

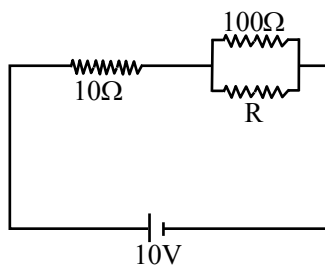
67. The pH of blood is maintained within the range 7.36 - 7.42 by



Ans. [b]

Sol. Fact

68. An ideal cell of emf 10V is connected across the network of resistors as shown in the figure. The value of the resistance R for which the power dissipated by the parallel combination is same as that in 10Ω resistance is.



(a) 20Ω

(b) 30Ω

(c) 11.11Ω

(d) 22.22Ω

Ans. [c]

Sol. $i^2 \times 10 = i^2 \left(\frac{10 \times R}{10 + R} \right)$

$$100 + 10R = 10R$$

$$i^2 \times 10 = i^2 \left(\frac{100 \times R}{100 + R} \right)$$

$$1000 + 10R = 100R$$

$$90R = 1000$$

$$R = \frac{100}{9} = 11.11\Omega$$

69. If one of the roots of the equation $x^2 - px + q = 0$ is m times the other root then $m/(1 + m^2)$ is equal to

(a) $\frac{p}{p^2 - 2q}$

(b) $\frac{p}{q^2 - 2p}$

(c) $\frac{q}{q^2 - 2p}$

(d) $\frac{q}{p^2 - 2p}$

Ans. [d]

Sol. $x^2 - px + q = 0$... (*)

Let roots are α & β

given $\alpha = m\beta$

also $\alpha + \beta = p$, $\alpha\beta = q$

$\therefore m\beta + \beta = p$

$\beta(1 + m) = p$

$$\beta = \frac{p}{1 + m} \quad \dots(1)$$

$$\& m\beta^2 = q \quad \dots(2)$$

$$\text{By (1) \& (2) } m \left(\frac{p^2}{(1+m)^2} \right) = q$$

$$\frac{m}{(1+m)^2} = \frac{q}{p^2}$$

$\because \alpha, \beta$ are roots

$$\& \beta^2 - \beta p + q = 0$$

$$-p\beta = \beta^2 + q \quad \dots (3)$$

$$\alpha^2 - p\alpha + q = 0$$

$$m^2\beta^2 - mp\beta + q = 0 \quad \dots (4)$$

\therefore (3) in (4)

$$m^2\beta^2 - m(\beta^2 + q) + q = 0$$

$$m^2\beta^2 - m\beta^2 - mq + q = 0$$

$$\therefore m = 1$$

$$\text{satisfies by } \frac{q}{p^2 - 2q}$$

70. Three particles each of mass m are placed at the vertices of a triangle of sides r . The force experienced by each mass is

(a) $2 \frac{Gm^2}{r^2}$

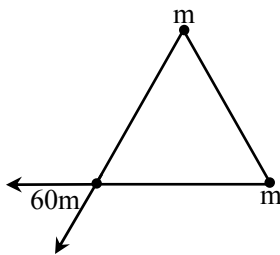
(b) $\sqrt{2} \left(\frac{Gm^2}{r^2} \right)$

(c) $\frac{Gm^2}{r^2}$

(d) $\sqrt{3} \left(\frac{Gm^2}{r^2} \right)$

Ans. [d]

Sol.



$$f_{\text{net}} = \sqrt{F^2 + F^2 + 2F^2 \cos 60}$$

$$= \sqrt{F^2 + F^2 + 2F^2 \frac{1}{2}}$$

$$= \sqrt{3}F$$

71. If $a + b + c = 1$, $a^2 + b^2 + c^2 = 21$ and $abc = 8$ then find the value of $(1 - a)(1 - b)(1 - c)$
 (a) -18 (b) -10 (c) -24 (d) -30

Ans. [c]

Sol. $a + b + c = 1 \quad \dots(1)$

$$a^2 + b^2 + c^2 = 21 \quad \dots(2)$$

$$abc = 8 \quad \dots(3)$$

$$(1 - a)(1 - b)(1 - c) = ?$$

by (1)

$$(a + b + c)^2 = 1$$

$$a^2 + b^2 + c^2 + 2(ab + bc + ca) = 1$$

$$21 + 2(ab + bc + ca) = 1$$

or

$$ab + bc + ca = -10 \quad \dots(4)$$

$$\text{also } abc = 8$$

$$\therefore (1 - a)(1 - b)(1 - c)$$

$$(1 - a)(1 - b - c + bc)$$

$$= 1 - b - c + bc - a + ab + ac - abc$$

$$= 1 - (b + c + a) + (ab + bc + ca) - abc$$

$$= 1 - 1 - 10 - 8$$

$$= -18$$

72. An alkaline solution of K_2HgI_4 is called

- (a) Fehling's reagent (b) Nessler's reagent (c) Benedict's reagent (d) Tollen's reagent

Ans. [b]

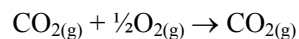
Sol. Fact

73. A film of oil on every water surface arrests the growth in mosquito population since:

- (a) mosquito larvae suffocate (b) it blocks sunlight and mosquito larvae cannot get food
(c) mosquito eggs cannot float on oil (d) mosquitoes fail to mate if water surface is not available

Ans. [a]

74. At constant temperature and pressure which of the following statements is true for the reaction.



- (a) $\Delta E > \Delta H$ (b) $\Delta E = \Delta H$
(c) $\Delta E < \Delta H$ (d) ΔH and ΔE are independent of each other

Ans. [a]

Sol. $\Delta H = \Delta E + \Delta n_g RT$

$$\Delta n_g = 1 - 1.5$$

$$\Delta n_g = -0.5$$

$$\Delta E > \Delta H$$

75. When a car turns on a curved road, you are pushed against one of the doors of the car because of
 (a) inertia (b) the centrifugal force
 (c) the centripetal force (d) the frictional force

Ans. [a]

Sol. Inertia

76. The distance between two spots A & B on the same bank of the river is 75km. Speed of the boat in still water is twice as much as that of the speed of the water current of the river. The boat travels in the river from A to B and returns back to the spot in 16 hour. What is the speed of the boat in still water ?
 (a) 18 kmph (b) 15 kmph (c) 16 kmph (d) 12.5 kmph

Ans. [d]

Sol. Speed of water = x

Speed of boat in still water = 2x

A \longleftrightarrow 75 km \longrightarrow B

$$t_1 + t_2 = 16 \quad \frac{75}{x} + \frac{75}{3x} = 16 \Rightarrow x = 12.5$$

77. Michael Faraday a book binder got an opportunity to work with a scientist and later succeeded him. Name of the scientist is

- (a) Humphrey Davy (b) Hans Christain Oersted
 (c) Heinrich Lenz (d) James Clerk Maxwell

Ans. [a]

78. Find the equation of the line parallel to $4x + 3y = 5$ and having x-intercept (-3)

- (a) $3x + 4y + 12 = 0$ (b) $3x + 4y = 12$
 (c) $4x + 3y + 12 = 0$ (d) $4x + 3y - 12 = 0$

Ans. [c]

Sol. line parallel to

$4x + 3y = 5$, is

$4x + 3y + k = 0$

$$\frac{x}{-k/4} + \frac{y}{-k/3} = +1$$

$$\text{given } -\frac{k}{4} = -3$$

$$k = 12$$

$$\therefore 4x + 3y + 12 = 0$$

79. The green coloured substance produced during the burning of ammonium dichromate in fireworks is

- (a) Cr_2O_3 (b) CrO_3 (c) $\text{CrO}(\text{O}_2)_2$ (d) $\text{Cr}(\text{OH})_3$

Ans. [a]

Sol. $(\text{NH}_4)_2 \text{Cr}_2\text{O}_7 \xrightarrow{\Delta} \text{N}_2 + \text{Cr}_2\text{O}_3 + 4\text{H}_2\text{O}$

80. Mud flats with mangrove plants export a lot of organic matter to waters in contact. This is primarily because:

- (a) there are fewer consumers in mangrove community
 (b) excreta of animals in mangrove community is richer in fibers
 (c) aerobic decomposers cannot survive in waterlogged mud
 (d) detritivores are lacking in mangrove community

Ans. [c]