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Examination Time: 1000 hrs to 1200 hrs

Question paper code: 51

Student's Roll No:										

INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS) 2019 – 20

Instructions to Candidates – read carefully and strictly follow each of them

1. Question paper code is given on top right corner of each page of question paper. It must be mentioned in YOUR OMR sheet (in the space provided). Otherwise your answer sheet (OMR sheet) will NOT be assessed.
2. Refer page 20: for periodic table and some useful information of mathematics.
3. Use and carrying calculators of any type is strictly prohibited.
4. Use and even carrying smart watches, phones, i-pads or any other communication devices or any other objectionable material in examination centre is strictly prohibited.
5. On the answer sheet, make all the entries correctly, carefully in the space (s) provided, in capital letters as well as by properly darkening the appropriate bubbles using blue or black ball point pen only. Incomplete/ incorrect/ carelessly filled information may disqualify your candidature. Please take care while entering.
6. Please do not make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet. Further, do not write on the back side of the answer sheet.
7. As answer sheets are evaluated using machine, change of entry is not allowed. Even scratching or overwriting may result in a wrong score.
8. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which only one is correct. Choose the correct alternative and fill the appropriate bubble, as shown:

Q. 

9. Correct answer carries 3 marks, wrong answer - 1 mark (negative 1), no attempt – zero marks.
10. Rough work should be done in the space provided in the question paper only.
11. Candidates are not permitted to leave the examination hall before the completion of the examination schedule (i.e. before 1200 Hrs).
12. Your answer sheet consists of two pages original copy and candidate's copy. Do not detach them till the end of the examination. At the end of examination, submit your answer paper (original copy) to the invigilator and take away the student's copy for your further reference.

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13. Comments regarding this question paper, if any, may be filled in Google forms only at https://goo.gl/forms/9GP03NRgUVuhWJn52 till 22nd November, 2019. The answers/solutions to this question paper will be available on our website: www.iapt.org.in by 2nd December, 2019.
14. For Certificates and awards – Please see the website of IAPT: www.iapt.org.in

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Rough work below this line:

QUESTION PAPER STARTS HERE

Q1: Let α and β be the roots of $x^2 - 5x + 3 = 0$ with $\alpha > \beta$. If $a_n = \alpha^n - \beta^n$ for $n \geq 1$ then the value of $\frac{3a_6 + a_8}{a_7}$ is

(a) 2 (b) 3 (c) 4 (d) 5

Sol. **(c)**

a & b are roots of $x^2 - 5x + 3 = 0$

so $\alpha^2 - 5\alpha + 32 = 0 \Rightarrow \alpha^2 + 3 = 5\alpha$

& $\beta^2 - 5\beta + 3 = 0 \Rightarrow \beta^2 + 3 = 5\beta$

Now $\frac{3a_6 + a_8}{a_7}$

$$\frac{3\left[\alpha^6 - \beta^6\right] + \left[\alpha^8 - \beta^8\right]}{\left[\alpha^7 - \beta^7\right]}$$

$$\frac{\alpha^6\left[3 + \alpha^2\right] + \beta^6\left[3 + \beta^2\right]}{\alpha^7 - \beta^7}$$

$$\frac{\alpha^6 \times (5\alpha) - \beta^6(5\beta)}{\alpha^7 - \beta^7} = \frac{5\left(\alpha^7 - \beta^7\right)}{\left(\alpha^7 - \beta^7\right)} = 5$$

Q2: The number of triples (x, y, z) such that any one of these numbers is added to the product of the other two, the result is 2, is

(a) 1 (b) 2 (c) 4 (d) infinitely many

Sol. **(b)**

$x + yz = 2$ … (1)

$y + xz = 2$ … (2)

$z + xy = 2$ … (3)

equation (1) - equation (2)

$(x - y) + z(y - x) = 0$

$(x - y)(1 - z) = 0$

$z = 1, x = y$

Case-I

For x = y equations are convert into

$y + yz = 2 \Rightarrow y(1 + z) = 2$ .....(4)

$z + y^2 = 2 \Rightarrow z = 2 - y^2$ .....(5)

Put z in equation (4)

$y(3 - y^2) = 2$

$3y - y^3 = 2$

$y^3 - 3y + 2 = 0$

$(y - 1)^2 (y + 2) = 0$

so y = 1 or y = – 2

Case-II

For z = 1 equations are convert into

$x + y = 2 \Rightarrow x = (2 - y)$

$xy + 1 = 2$

so $(2 - y)y = 1$

$2y - y^2 = 1$

$y^2 - 2y + 1 = 0$

$(y - 1)^2 = 0$

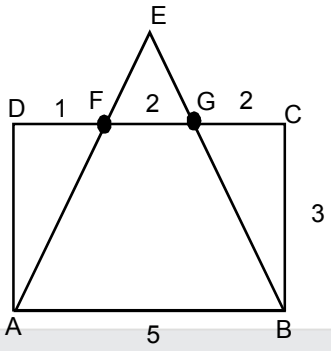
so y = 1 and x = 1

so 2 solutions (1, 1, 1) and (– 2, – 2, – 2)

Q3: In rectangle ABCD, AB = 5 and BC = 3. Points F and G are on the line segment CD so that DF = 1 and GC = 2. Lines AF and BG intersect at E. What is the area of AEB ?

(a) 10 sq. units (b) $\frac{15}{2}$ sq. units (c) $\frac{25}{2}$ sq. units (d) 20 sq. units

Sol. **(c)**



Let ar. $\Delta EFG = a$

ar FGBA = $\frac{1}{2}(2+5)3 = \frac{21}{2}$

$\Delta EFG \sim \Delta EAB$

$\frac{arEFG}{arEAB} = \left(\frac{2}{5}\right)^2$

$\frac{a}{a+\frac{21}{2}} = \frac{4}{25}$

$25a = 4a + 42$

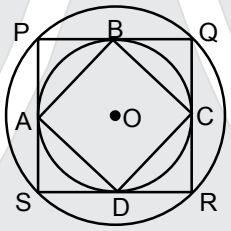
$21a = 42$

$a = 2$

So ar ΔEAB = ar ΔEFG + area ΔGBA

$= 2 + \frac{21}{2} = \frac{25}{2}$ sq. units

Q4: In the given figure, two concentric circles are shown with centre O. PQRS is a square inscribed in the outer circle. It also circumscribes the inner circle, touching it at points B, C, D and A. What is the ratio of the perimeter of the outer circle to that of quadrilateral ABCD ?



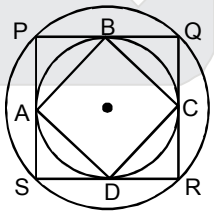
(a) $\frac{\pi}{4}$ (b) $\frac{3\pi}{2}$ (c) $\frac{\pi}{2}$ (d) π

Sol. **(c)**

Let sides of ABCD is a.

So perimeter of ABCD is 4a.

Now, diagonal of ABCD = diameter of inner circle.



$\sqrt{2}a = 2r_1$

$r_1 = \frac{a}{\sqrt{2}}$

side of PQRS = diameter of inner circle

$b = 2r_1$

$b = \sqrt{2}a$

Now diameter of outer circle = diagonal of square PQRS

$2r_2 = \sqrt{2}b$

$2r_2 = \sqrt{2} \times \sqrt{2}a$

$2r_2 = 2a$

$r_2 = a$ Perimeter of outer circle = $2\pi r_2 = 2\pi a$

required ratio = $\frac{2\pi a}{4a} = \frac{\pi}{2}$.

Q5: How many positive integers N give a remainder 8 when 2008 is divided by N.
(a) 12 (b) 13 (c) 14 (d) 15

Sol. **(d)**
2008 = 2000 + 8
$2000 = 2^4 \times 5^3$
Number of factors of 2000 = 5 × 4 = 20
In which 1, 2, 4, 5, 8 are also include but N > 8
So , Total 20 – 5= 15 values are possible.

Q6: What is the product of all the roots of equation $\sqrt{5|x|+8} = \sqrt{x^2-16}$?
(a) – 64 (b) – 24 (c) 576 (d) 24

Sol. **(a)**
$\sqrt{5|x|+8} = \sqrt{x^2-16}$
$x^2 - 16 > 0$
$(x + 4)(x - 4) > 0$
$x < -4$ & $x > 4$
Now square on both sides.
$5|x| + 8 = x^2 - 16$
$x^2 - 5|x| - 24 = 0$
$|x|^2 - 5|x| - 24 = 0$
$|x|^2 - 8|x| + 3|x| - 24 = 0$
$|x| \{|x| - 8\} + 3\{|x| - 8\} = 0$
$\{|x| - 8\} + \{|x| + 3\} = 0$
$|x| = 8$ & $|x| = 3$
$x = \pm 8$ $x = \pm 3$
But $x = \pm 3$ is not possible so
$x = +8, -8$,
Product of values is $8 \times (-8) = -64$

Q7: LCM of two numbers is 5775. What of the following cannot be their HCF ?
(a) 175 (b) 231 (c) 385 (d) 455

Sol. **(d)**
$\because$ HCF is a factor of LCM
But 5775 is not divisible by 455
so option (d) is correct.

Q8: If a, b, c are distinct real numbers such that $a + \frac{1}{b} = b + \frac{1}{c} = c + \frac{1}{a}$ evaluate abc.
(a) $\pm\sqrt{2}$ (b) $\sqrt{2}-1$ (c) $\sqrt{3}$ (d) ± 1

Sol. **(d)**
$a + \frac{1}{b} = b + \frac{1}{c} = c + \frac{1}{a}$

$a - b = \frac{1}{c} - \frac{1}{b}$

$a - b = \frac{b-c}{bc}$ .....(1)

$b - c = \frac{1}{a} - \frac{1}{c}$

$b - c = \frac{c-c}{ac}$.....(2)

$a - c = \frac{1}{a} - \frac{1}{b}$

$a - c = \frac{b-a}{ab}$ .....(3)

Equation (1) × eq (2) × eq(3)

$(a-b)(b-c)(a-c) = \frac{(b-c)(c-a)(b-a)}{a^2b^2c^2} \Rightarrow (abc)^2 = 1 \quad \Rightarrow \quad abc = \pm 1$

Q9: If the equation $(\alpha^2 - 5\alpha + 6)x^2 + (\alpha^2 - 3\alpha + 2)x + (\alpha^2 - 4) = 0$ has more than two roots, then the value of α is

(a) 2 (b) 3 (c) 1 (d) none of these

Sol. **(a)**

The equation $(\alpha^2 - 5\alpha + 6)x^2 + (\alpha^2 - 3\alpha + 2)x + (\alpha^2 - 4) = 0$ has more than two roots then it means it is an identity so $\alpha^2 - 5\alpha + 6 = 0$, $\alpha^2 - 3\alpha + 2 = 0$ and $\alpha^2 - 4 = 0$

$\alpha^2 - 5\alpha + 6 = 0$

$(\alpha - 3)(\alpha - 2) = 0$

$\alpha = 3, 2$

and

$\alpha^2 - 3\alpha + 2 = 0$

$(\alpha - 2)(\alpha - 1) = 0$

$\alpha = 2, 1$

and

$\alpha^2 - 4 = 0$

$(\alpha - 2)(\alpha + 2) = 0$

$\alpha = -2, 2$

So the value of $\alpha = 2$

Q10: Mr. X with his eight children of different ages is on a family trip. His oldest child, who is 9 years old saw a license plate with a 4-digit number in which each of two digits appear two times. "Look daddy!" she exclaims. "That number is evenly divisible by the age of each of us kids!" "That's right," replies Mr. X, "and the last two digits just happen to be my age". Which of the following is not the age of one of Mr. X's children ?

(a) 4 (b) 5 (c) 6 (d) 7

Sol. **(b)**

Lets the ages of children's 9, 8, 7, 6, 4, 3, 2, 1 (as 9 is oldest age)

L.C.M of ages = 504

We need to calculate 4 digit number which is multiple of 504 and have each digit twice.

504 × 11 = 5544.

Q11: How many numbers lie between 11 and 1111 which divided by 9 leave a remainder 6 and when divided by 21 leave a remainder 12 ?

(a) 18 (b) 28 (c) 8 (d) None of these

Sol. **(a)**

Let number is N

$N = 9x + 6$ $x,y \in I^+$

$N = 21y + 12$

$9x + 6 = 21y + 12$

$3x - 7y = 2$

x	3	10	17	....
y	1	4	7	....

So number are $9 \times 3 + 6$, $9 \times 10 + 6$, $9 \times 17 + 6$ .....

33, 96, 159 ... T_n

$T_n < 1111$

$a + (n - 1)d < 1111$

$33 + (n - 1)63 < 1111$

$n < 18.11\ldots$

$n = 18$

Q12: Two unbiased dice are rolled. What is the probability of getting a sum which is neither 7 nor 11 ?

(a) $\frac{7}{9}$ (b) $\frac{7}{18}$ (c) $\frac{2}{9}$ (d) $\frac{11}{18}$

Sol. **(a)**

Sum 7 (OR) sum 11.

Sum 7 = 3 + 4 = 7 sum 11 $\rightarrow$ 5 + 6 =11

$\Rightarrow$ 3 + 5 = 7 ` 6 + 5 = 11.

$\Rightarrow$ 1 + 6 = 7

6 + 1 = 7

5 + 2 = 7

4 + 3 = 7

Probability = $\frac{28}{36} = \frac{7}{9}$

Q13: The solution of the equation 1 + 4 + 7 + ... + x = 925 is

(a) 73 (b) 76 (c) 70 (d) 74

Sol. **(a)**

1 + 4 + 7 + …… + x = 925

This is an A.P.

a = 1

d = 3

x = 1 + (n – 1)3

$\frac{x-1}{3}$ = n –1

n = $\frac{x-1}{3}$ +1

n = $\frac{x-1+3}{3} = \frac{x+2}{3}$

sum $\frac{n}{2}[1+x]$ = 925

$\left(\frac{x+2}{3\times 2}\right)$ (x + 1) = 925

(x +2) (x +1) = 925 × 6

x^2 + x + 2x + 2 = 5550

x^2 + 3x – 5548 = 0

x^2 + 3x – 5548 = 0

(x + 76) (x –73) = 0

x = 73

Q14: If tanθ + secθ = 1.5, then value of sinθ is

(a) $\frac{5}{13}$ (b) $\frac{12}{13}$ (c) $\frac{3}{5}$ (d) $\frac{2}{3}$

Sol. **(a)**

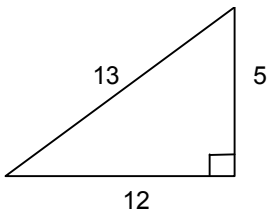
tanθ + secθ = 1.5

$Sec^2\theta - tan^2\theta$ = 1

(secθ – tanθ) (secθ + tanθ) = 1

secθ – tanθ = $\frac{1}{\sec\theta+\tan\theta}$

secθ – tanθ = $\frac{1}{1.5}$ × 10 = $\frac{2}{3}$



$\because \sec\theta + \tan\theta = \frac{3}{2}$

And $\sec\theta - \tan\theta = \frac{2}{3}$

So, $2\sec\theta = \frac{3}{2} + \frac{2}{3}$

$\sec\theta = \frac{9+4}{6} = \frac{13}{12}$

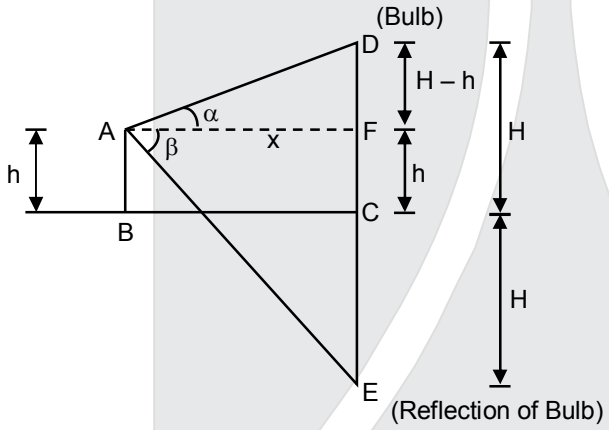
$\text{Sin}\theta = \frac{5}{13}$.

Q15: An observer standing at the top of a tower, finds that the angle of elevation of a red bulb on the top of a light house of height H is α. Further, he finds that the angle of depression of reflection of the bulb in the ocean is β. Therefore, the height of the tower is

(a) $\frac{H(\tan\beta - \tan\alpha)}{(\tan\beta + \tan\alpha)}$ (b) $\frac{H\sin(\beta-\alpha)}{\cos(\alpha+\beta)}$ (c) $\frac{H(\cos\alpha - \cos\beta)}{(\cot\alpha + \cot\beta)}$ (d) H

Sol. **(a)**

Let the height of tower is h



In ΔAFD

$\tan\alpha = \frac{DF}{AF} = \frac{H-h}{x} \Rightarrow x = \frac{H-h}{\tan\alpha}$ .....(1)

In ΔAFE

$\tan\beta = \frac{H+h}{x} \Rightarrow x = \frac{H+h}{\tan\beta}$ .....(2)

$\frac{H-h}{\tan\alpha} = \frac{H+h}{\tan\beta}$

$H\tan\beta - h\tan\beta = H\tan\alpha + h\tan\alpha$.

$\frac{H(\tan\beta - \tan\alpha)}{(\tan\beta + \tan\alpha)} = h$.

Q16: The sum of the roots of $\frac{1}{x+a} + \frac{1}{x+b} = \frac{1}{c}$ is zero. The product of roots is

(a) 0 (b) $\frac{a+b}{2}$ (c) $-\frac{1}{2}\left(a^2+b^2\right)$ (d) $2(a^2 + b^2)$

Sol **(c)**

$\frac{1}{x+a} + \frac{1}{x+b} = \frac{1}{c}$

$$\frac{x+b+x+a}{(x+a)(x+b)} = \frac{1}{c}$$

$c(2x + a + b) = x^2 + (a + b)x + ab$

$2cx + ac + bc = x^2 + (a + b)x + ab$

$x^2 + (a + b - 2c)x + ab - ac - bc = 0$

$a + b - 2c = 0$

$a + b = 2c$

Product of roots $= ab - ac - bc$

$= ab - c(a + b)$

$$= ab - \left(\frac{a+b}{2}\right)(a+b)$$

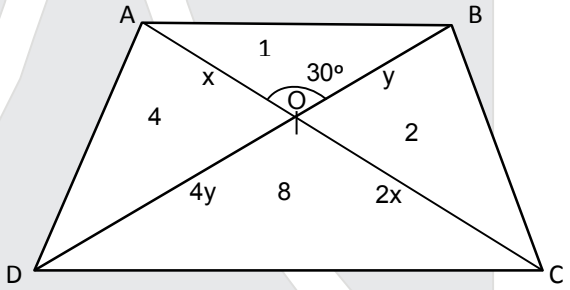
$$= \frac{2ab - a^2 - b^2 - 2ab}{2}$$

$$= -\left(\frac{a^2+b^2}{2}\right)$$

Q17: In the convex quadrilateral ABCD, the diagonals AC and BD meet at O and the measure of angle AOB is 30°. If the areas of triangle AOB, BOC, COD and AOD are 1, 2, 8 and 4 square units respectively, what is the product of the lengths of the diagonals AC and DB in sq. units ?

(a) 60 (b) 56 (c) 54 (d) 64

Sol. **(a)**



ar(AOB) =1

ar(BOC) =2

ar(COD) =8

ar(AOD) = 4

$\frac{1}{2} \times x \times y \times \sin 30^\circ = 1$

$xy = 4$

Product of diagonals $\Rightarrow 3x \times 5y$

$\Rightarrow 15 \times xy$

$\Rightarrow 15 \times 4 \Rightarrow 60$

Q18: If $\sin^2 x + \sin^2 y + \sin^2 z = 0$, then which of the following is NOT a possible value of $\cos x + \cos y + \cos z$?

(a) 3 (b) – 3 (c) – 1 (d) – 2

Sol. **(d)**

$\sin^2 x + \sin^2 y + \sin^2 z = 0$

$\Rightarrow \sin x = \sin y = \sin z = 0$

$x = y = z = 0^\circ$ or π

$\cos x + \cos y + \cos z = ?$

if $x = 0, \quad y = 0, \quad z = 0$

$\cos 0^\circ + \cos 0^\circ + \cos 0^\circ = 3$

if $x = y = z = \pi$

$\cos\pi + \cos\pi + \cos\pi = -3$

if $x = 0^\circ, \quad y = z = p$

$\cos\pi + \cos\pi + \cos 0^\circ = -1$

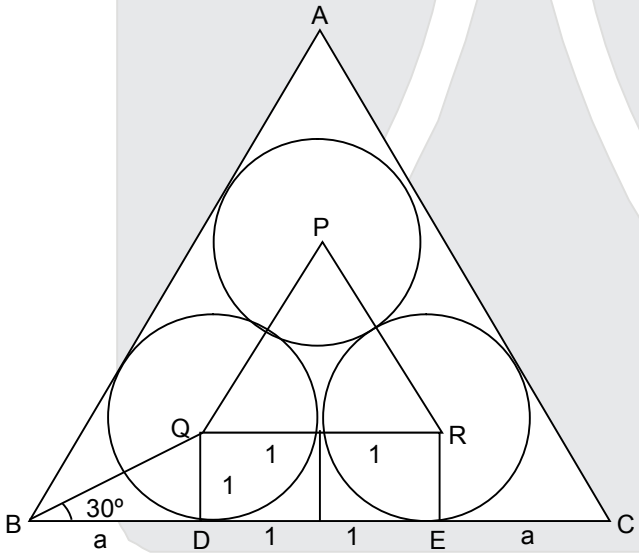
Q19: Find the remainder when x^{51} is divided by $x^2 - 3x + 2$.
(a) x (b) $(2^{51} - 2)x + 2 - 2^{51}$ (c) $(2^{51} - 1)x + 2 - 2^{51}$ (d) 0

Sol. **(c)**
$x^{51} = (x^2 - 3x + 2)\, q(x) + (ax + b)$
$x^{51} = (x - 1)(x - 2)q(x) + (ax + b)$ .....(A)
put x = 1 on both sides in equation (A)
$1 = a + b$ .....(1)
put x = 2 on both sides in equation (A)
$2^{51} = 2a + b$ .....(2)
solve (1) and (2)
$a = 2^{51} - 1$
$a + b = 1$
$2^{51} - 1 + b = 1$
$b = 2 - 2^{51}$
Remainder = ax + b
$= (2^{51} - 1)x + 2 - 2^{51}$.

Q20: In an equilateral triangle, three coins of radii 1 unit each are kept so that they touch each other and also sides of the triangle. The area of triangle ABC (in sq. units) is

(a) $4 + 2\sqrt{3}$ (b) $4\sqrt{3} + 6$ (c) $12 + \frac{7\sqrt{3}}{4}$ (d) $3 + \frac{7\sqrt{3}}{4}$

Sol. **(b)**



In ΔBQD :- $\tan 30^\circ = \frac{1}{a} = \frac{1}{\sqrt{3}} \Rightarrow a = \sqrt{3}$

Side of ΔABC = BC
= 2a + 2
$= 2\left(\sqrt{3} + 1\right)$
Area of ΔABC
$= \frac{\sqrt{3}}{4} \times \left[2\left(\sqrt{3} + 1\right)\right]^2$
$= \frac{\sqrt{3}}{4} \times 4 \times \left(\sqrt{3} + 1\right)^2$
$= \sqrt{3}\left(\sqrt{3} + 1\right)^2 \Rightarrow = \sqrt{3}\left(4 + 2\sqrt{3}\right) \Rightarrow = 6 + 4\sqrt{3}$

Q21: Gymnosperms are called 'naked seed bearing plants'because they lack :
(a) Male gamete (b) Ovule (c) Ovary (d) Seeds

Ans. (c)

Q22: In case of mice coat colour, two genes are responsible for colour of hair. Gene 'A' is responsible for distribution of pigments on shaft of hair. Wild type allele of 'A' produces a yellow band on dark hair shaft (agouti), whereas recessive allele produces no yellow band. There is another allele of A, known as A^Y, which is embryonic lethal in homozygous condition only. In an experiment, two yellow mice were crossed to obtain a progeny of 6 pups. What would be the most probable number of agouti mice among them ?
(a) 0 (b) 2 (c) 4 (d) None of these

Ans. (b)

Q23: A stain was developed by a group of scientists to stain particular cell organelle. The stain was tested on various tissues derived from an autopsy sample from a mammal. The organelles were counted. The results showed maximum number of the organelles in cells of brain, lesser in cells of heart, least in mature sperms and absent in erythrocytes. Identify the organelles from following options.
(a) Nissl bodies (b) Mitochondria (c) Golgi bodies (d) Endoplasmic reticulum

Ans. (b)

Q24: *Pinus sylvestris* grows at low temperatures in Russia. The plant survives under such freezing conditions due to the presence of :
(a) Saturated lipids in plasma membrane (b) Glycoproteins in plasma membrane
(c) Glycolipids in plasma membrane (d) Polyunsaturated lipids in plasma membrane

Ans. (d)

Q25: In a experimental setup, certain pathogen caused a disease in primates with nasal congestion, sore throat and fever being the common symptoms. The scientists injected an extract from blue-green mold as the first line action. However, the symptoms did not subside. The possible causative agents of the disease were listed out as follows.
i. a virus ii. a fungus iii. a conjugation deficient bacterium iv. a tapeworm
Choose the correct option from the following that indicate the pathogen.
(a) i, ii (b) i, iii (c) ii, iv (d) iii only

Ans. (b)

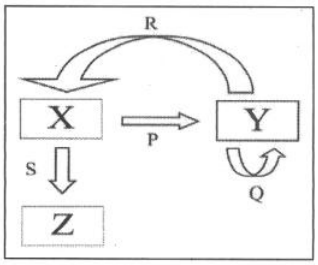
Q26: A organism has 27 pairs of homologous chromosomes. In each daughter cell after completion of mitosis and in each gamete after completion of meiosis II, _____and _____ chromosomes would be present respectively.
(a) 27 and 27 (b) 54 and 27 (c) 108 and 54 (d) 54 and 108

Ans. (b)

Q27: A group of students was studying development of an organism under controlled laboratory conditions. Following observations were made by them.
i. The larvae had a rod-like supporting structure that separated the nervous system and the gut.
ii. A prominent central cavity was present in the transverse section of the part of the nervous system of the larvae; while the adults had cerebral ganglia as the main component of the nervous system.
iii. The eyes were prominently seen in larvae.
iv. The tails were absent in the adults, which the larvae had.
v. A lot of phagocytic activity was observed before conversion of larvae into adults.
vi. The adults had a cuticular exoskeleton.
(a) Amphibia (b) Pisces (c) Protochordata (d) Arthropoda

Ans. (c)

Q28: A process is represented in the adjacent figure. The arrows indicate the flow of a biochemical reaction. The arrowhead points to the product, while the base of the arrow indicates the template biomolecule, What do P, Q, R and S represent ?



(a) P : Replication, Q : Translation, R : Transcriptions, S : Reverse Transcription
(b) P : Transcription, Q : Replication, R : Reverse Transcription, S : Translation
(c) P : Reverse Transcription, Q : Replication, R : Translation S : Transcription,
(d) P : Reverse Transcription, Q ; Replication, R : Transcription, S : Translation

Ans. (d)

Q29: The whooping cranes were on the verge of extinction with only 21 individuals in wild in1941.After conservation measures, the cranes are now included in the endangered category by IUCN. The highlight of the conservation efforts is the reintroduction of the whooping cranes in wild. This was possible due to raising of the young cranes in absence of their parents by biologists dressed in crane costumes. Aircraft Guided bird migration technique was used for teaching the captive-bred cranes to follow the scientists to learn the migratory route. What type of animal behaviour might be responsible for these captive-bred cranes to follow the crane costume dressed scientists ?
(a) Cognitive learning (b) Habituation
(c) Operant conditioning (d) Genetic Imprinting

Ans. (d)

Q30: In the baking industry, when the dough in prepared, various ingredients are mixed together with the flour, At one instance, the dough was fermented, but failed to rise sufficiently during the baking process. Choose the correct cause(s) from following possiblilites.
i. The salt was mixed before the fermentation process was completed
ii. The sugar was added in excess
iii. Yeast granules were not activated prior to mixing with the flour.
(a) i, iii (b) iii only (c) i, ii, iii (d) i, ii

Ans. (c)

Q31: Given below are four statements.
I. Prokaryotic cells are unicellular while eukaryotes are multicellular.
II. Histones are present in eukaryotes and absent in prokaryotes.
III. The nucleoid contains the genetic material in prokaryotes and eukaryotes.
IV. Prokaryotic flagellum is composed of flagellin while eukaryotic flagellum is composed of tubulin.
Identify which amongst these are false.
(a) I and II (b) III and IV (c) II and III (d) I and III

Ans. (d)

Q32: The students of a college were working on regeneration using Planaria (Platyhelminthes) and Asterias (Echinodermata). Planaria was cut in three pieces, namely, a piece with head, with tail and the middle piece. Asterias (bearing five arms) was cut in such a way that after separation, six pieces were obtained, namely, an arm with a portion of the central disc, four pieces cut from tips of each of the remaining arms and the remaining body. The animals were allowed to regenerate completely. How many Planaria and Asterias respectively will be obtained after the completion of regeneration in both?
(a) 1, 1 (b) 3, 2 (c) 3, 6 (d) 1, 2

Ans. (b)

Q33: Fecundity in animal world is the maximum possible ability of an individual to produce offsprings during its entire lifetime. Following factors were checked for their effect on fecundity of different animal models.

i. Availability of food during breeding season
ii. Mode of fertilization
iii. Population density

Which of these factor(s) can regulate fecundity?

(a) i, ii (b) ii, iii (c) i, ii, iii (d) None of the above

Ans. (c)

Q34: Rahul sprayed a chemical `X' on a plant with rosette habit. After few days, he found the internodal distances to have increased suddenly. The chemical `X' might be:

(a) Ethylene (b) Abscisic acid (c) Auxin (d) Gibberellic acid

Ans. (d)

Q35: In case of peppered moths, pale and dark moths are observed. Pale variety is known to be the wild type variety. During industrial revolution, industrial melanism led to prevalence of dark variety around the cities and pale variety continued to be in majority in areas away from the industries. After enforcement of regulations for controlling pollution, reappearance of pale moths in majority was observed around cities again. Driving force(s) for these adaptive changes is/are:

i. Increased pollution around industries
ii. A stable transposition of a gene in moths
iii. Limitations of the vision of birds to differentiate dark moths on darkened barks and pale moths in presence of lichens
iv. Ability of lichens to grow on barks in less polluted areas only.

(a) i, iv (b) i, iii, iv (c) i, ii (d) i, ii, iii and iv

Ans. (b)

Q36: Any damage or injury to a particular area causes nociceptors to release some chemicals, which carry the signal to the higher centres in the nervous system for the processing and a subsequent action. However, there is a difference in the way in which the stimulus is received which is related to the acuity of the detection. Fingertips are more sensitive as compared to the forearm. Following reasons for the observed phenomenon were suggested.

i. The receptive fields in the fingertip are smaller
ii. The number of nociceptors per receptive field in the forearm is lesser
iii. The amount of prostaglandins released by the nociceptors per receptive field is more in fingertips

The most probable reason(s) for this may be:

(a) i (b) i, iii (c) ii, iii (d) i, ii, iii

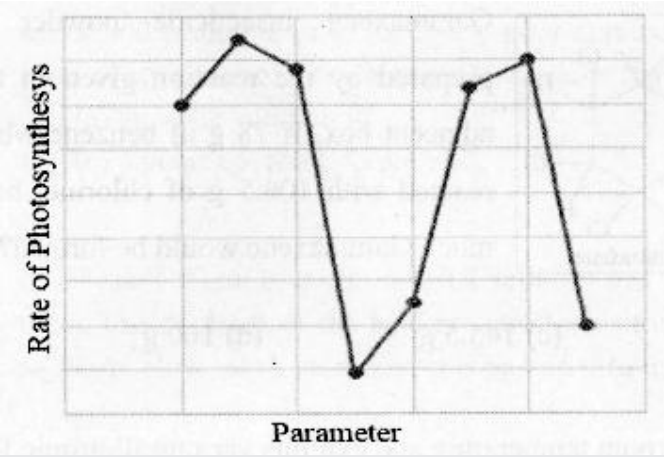
Ans. (d)

Q37: On a study tour, plants with leathery leaves with thick cuticle, vivipary, salt glands, apogeotropic roots, and stomata limited to abaxial surface were observed. The plants might be:

(a) Bromeliads (b) Cycads (c) Mangroves (d) None of the above

Ans. (b)

Q38: Rate of photosynthesis in hydrophytes depends on various parameters. The adjacent graph shows the effect of one parameter (while keeping all the others constant) on the rate of photosynthesis. Rate of photosynthesis is plotted on Y axis. Identify the parameter which is plotted along X axis:



(a) light intensity (b) wavelength (c) temperature (d) CO_2 concentration

Ans. **(b)**

Q39: A 4 μm long bacterial cell was magnified and drawn to a dimension of 6 cm. How many times has it been magnified ?
(a) 1.5×10^3 (b) 15×10^4 (c) 1.5×10^4 (d) 1.5

Ans. **(c)**

Q40: Four different human body fluid samples were subjected to quantification of hydrogen ion concentration. mEq/L is the unit of measurement for hydrogen ion concentration. The results of the experiment were as follows:
Sample A: 1.6×10^2 units Sample B: 4.5×10^{-5} units
Sample C: 1×10^{-3} units Sample D: 3×10^{-2} units
Identify the samples in sequence from A to D.
(a) Gastric HCl, Venous blood, Intracellular Fluid, Urine
(b) Venous blood, Intracellular Fluid, Gastric HCl, Urine
(c) Urine, Gastric HCl, Venous blood, Intracellular Fluid
(d) Intracellular Fluid, Urine, Gastric HCl, Venous blood

Ans. **(a)**

Q41: Four gram of mixture of calcium carbonate and sand is treated with excess of HCl and 0.880 g of carbon-di-oxide is produced. What is the percentage of calcium carbonate in original mixture ?
(a) 40% (b) 50% (c) 55% (d) 45%

Sol. **(b)**

$CaCO_3 + Sand + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
4g 0.880 g

Mol of $CO_2 = \frac{0.880g}{44} = 20 \times 10^{-3} = 0.02$ mol

Mol of $CaCO_3 = 0.02$ mol

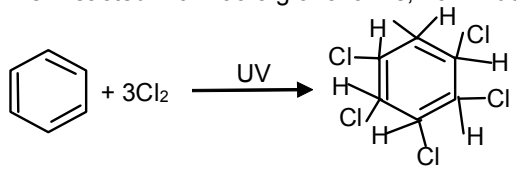
Mass of $CaCO_3 – 0.02 \times 100 = 2$ gm

% of $CaCO_3 = \frac{2}{4} = 50\%$

Q42: How many sigma bonds are present between any two carbon atoms in fullerenes ?
(a) 1 (b) 2 (c) 3 (d) 4

Sol. **(a)**

Q43: Gammaxene insecticide powder is prepared by the reaction given in the adjacent box. If 78 g of benzene when reacted with 106.5 g of chorine, how much Gammaxene would be formed ?



(a) 140 g (b) 154.5 g (c) 145.5 g (d) 160 g

Sol. **(c)**

	C_6H_6	+ $3Cl_2$ ⟶	$C_6H_6Cl_6$
	Benzene		Gammaxene
	1 mol	3 mol	1 mol
Stoichiometry	78 gm	213 gm	291 gm
Given	78 gm	106.5 gm	?

213 gm Cl_2 produce → = 291 gm $C_6H_6Cl_6$

1 gm Cl_2 → = $\frac{291}{213}$ $C_6H_6Cl_6$

106.5 gm Cl_2 → = $\frac{291}{213}$ × 106.5 gm $C_6H_6Cl_6$

= 145.5 gm $C_6H_6Cl_6$

Q44: An element Y is a white translucent solid at room temperature and exhibits various allotropic forms. Some compounds of element Y find application in agricultural industry. Y forms two solid oxides which dissolve in water to form comparatively weak acids. The element Y is :
(a) Sulphur (b) Nitrogen (c) Phosphorous (d) Carbon

Sol. **(c)**
Y → white translucent solid
→ allotropic forms
→ Used in agricultural industry
→ two solid oxides (P_2O_3 , P_2O_5)
→ Dissolved in water to form weak acid, (H_3PO_4, H_3PO_3)

Q45: A student was studying reactions of metals with dilute NaOH at room temperature. The student took dilute NaOH in four different test tubes and added copper powder to test tube A, zinc dust to test tube B, aluminium powder to test tube C and iron powder to test tube D and observed effervescence in ____.
(a) Test tubes A & B (b) Test tubes B & C (c) Test tubes C & D (d) Test tubes A & C

Sol. **(b)**
dil NaOH

Test tube A	Cu + dil. NaOH → No reaction
Test tube B	Zn + dil. NaOH → $NaZnO_2$ + H_2
Test tube C	Al + dil. NaOH → $NaAlO_2$ + H_2
Test tube D	Fe + dil. NaOH → → No reaction

Q46: Which of the following polymeric material will be ideal for remoulding ?
(a) Polythene and Melamine (b) Polyvinyl chloride and Polythene
(c) Melamine and Bakelite (d) Bakelite and Polyvinyl chloride

Sol. **(b)**

Q47: A magician performed following act : He dipped Rs. 50 note in a 50% solution of alcohol in water and held it on the burning flame, but the note did not burn. The reason behind this is :
(a) The alcohol kept on dousing the fire
(b) Air required for burning was not available
(c) The Rs. 50 note failed to reach ignition temperature
(d) The Rs. 50 note is fire proof

Sol. **(c)**

Q48: Which of the following is iso-structural with CO_2 ?
(a) NO_2 (b) N_2O_4 (c) NO (d) N_2O

Sol. **(d)**
Isostructural with CO_2
$CO_2 \rightarrow O = C = O$ linear
$N_2O \rightarrow \dot{N} \equiv N - \ddot{O}:$

Q49: Substance X is white crystalline solid which melts after 10 second on burner flame. It is soluble in water and insoluble in CCl_4 It is a poor conductor of electricity in molten state as well as in the form of aqueous solution, hence we conclude that substance X is :
(a) an ionic compound (b) a non polar covalent compound
(c) a polar covalent compound (d) a pure element

Sol. **(c)**
$X \rightarrow$ white crystalline solid
$\rightarrow$ Soluble in water and insoluble in CCl_4
$\rightarrow$ Low melting point
'X' should be polar covalent compound

Q50: In a beaker 50 ml of a normal HCl solution was taken and NH_3 gas was passed through it for some time. The contents of the beaker were then titrated, which required 60 ml of semi normal NaOH solution. How much ammonia was passed through the beaker ?
(a) 0.85 g (b) 0.34 g (c) 0.51 g (d) 0.4 g

Sol. **(b)**
HCl + $NH_3 \rightarrow$ Neutralised by
(1N 50 ml) NaOH $\rightarrow$ 60 ml, $\frac{1}{2}$ N
$HCl + NH_3 \rightarrow NH_4Cl$
$(N_1V_1)_{HCl}$ – milliequivalent of $NH_3 = (N_2V_2)_{NaOH}$
$50 \times 1 - x = \frac{1}{2} \times 60 = 30$
x = 200 meq.
equivalent of $NH_3 = 0.02$
wt. of $NH_3 = 0.02 \times 17 = 0.34$

Q51: Which is the correct order of metals with reference to their melting point in increasing order ?
(a) Hg, Ga, Li, Ca (b) Ca, Li, Ga, Hg (c) Hg, Li, Ga, Ca (d) Hg, Ga, Ca, Li

Sol. **(a)**
Correct order of melting point :
Li $\rightarrow$ 180.5°C
Ca $\rightarrow$ 842°C
Hg $\rightarrow$ –38.83°C
Ga $\rightarrow$ 29.76°C
Hg < Ga < Li < Ca

Q52: Sodium tungstate has formula Na_2WO_4 , lead phosphate has formula $Pb_3(PO_4)_2$, formula for lead tungstate should be :
(a) $PbWO_4$ (b) $Pb_2(WO_4)_3$ (c) $Pb_3(WO_4)_2$ (d) $Pb_3(WO_4)_4$

Sol. **(a)**
$Na_2WO_4 \rightarrow Na^+ + W_4^{2-}$
$Pb_3(PO_4)_2 \rightarrow Pb^{2+} + PO_4^{3-}$
Lead Tungstate = $Pb^{2+}\ WO_4^{2-} = PbWO_4$

Q53: What is the ratio of reducing agent to oxidizing agent, if the following reaction is correctly balanced ?
$NH_3 + O_2 \rightarrow NO + H_2O$
(a) 4 : 5 (b) 5 : 4 (c) 5 : 3 (d) 3 : 5

Sol. **(a)**

Reduction/oxidising agent

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

Oxidation/Reducing agent

Reducing agent $\rightarrow NH_3$ oxidising agent = O_2
Ratio of reducing agent to oxidizing agent = 4 : 5

Q54: Arrange following solution in increasing hydronium ion concentration. The solutions are :
(P) 0.1 M HCl (Q) 0.1 M H_2SO_4 (R) 0.001 M NH_4OH (S) 0.001 M $Ca(OH)_2$
The correct order will be : -
(a) P > Q > R > S (b) Q > P > S > R (c) S > R > Q > P (d) S > R > P > Q

Sol. **(b)**
order of $[H_3O^+]$
$H_2SO_4 > HCl > Ca(OH)_2 > NH_4OH$
Q > P > S > R

Q55: In one lite of pure water, 44.4 g of calcium chloride is dissolved. The number of ions in one mL of the resultant solution is :
(a) 7.23×10^{23} (b) 7.23×10^{20} (c) 4.82×10^{23} (d) 4.25×10^{20}

Sol. **(b)**

mole of $CaCl_2$ $\frac{44.4}{111} = 0.4$ mol

In 1000 mol no. of mol = 0.4

In 1 ml no. of mol $CaCl_2 = \frac{0.4}{1000} = 4 \times 10^{-4}$ mol

Total no. of ions $= 4 \times 10^{-4} \times N_A$ of $Ca^{2+} + 2 \times 4 \times 10^{-4} \times N_A$ of Cl^-
$= 3 \times 4 \times 10^{-4} \times N_A$
$= 12 \times 10^{-4} \times 6.023 \times 10^{23}$
$= 7.2276 \times 10^{20}$
$= 7.23 \times 10^{20}$

Q56: A zinc rod was dipped in 100 cm^3 of 1M copper chloride solution. After certain time the molarity of Cu^{2+} ions in the solution was found to be 0.8 M. If the weight of zinc rod is 20 g, then the molarity of chloride ions is ____ .
(a) 2 M (b) 1.5 M (c) 1 M (d) 0.5 M

Sol. **(a)**
Mili mole of $CuCl_2 = 100 \times 1 \setminus 100$ mili mole
Mili mole of Cl^- ions = 200 mili mol

Concentration of Cl^- ion $= \frac{\text{mol}}{\text{volume}} = \frac{200}{100} = 2$ M

Q57: When four dilute solutions of (I) vinegar, (II) common salt, (III) caustic soda and (IV) baking soda are tested with universal indicator which will be the correct observation
(a) I-Green, II-Violet, III-Blue, IV- Red (b) I-Green, II-Blue, III-Violet, IV-Red
(c) I-Red, II-Green, III-Violet, IV- Blue (d) I-Red, II-Violet, III-Green, IV-Blue

Sol. **(c)**
(I) vinegar (Weak acid) $\rightarrow$ Red
(II) common salt, (Salt) $\rightarrow$ Green
(III) caustic soda (Strong base) $\rightarrow$ Voilet
(IV) baking soda (Weak base) $\rightarrow$ Blue

Q58: Which of the following species is/are isoelectronic with Neon ?
(i) N^{3-} (ii) Mg^{2+} (iii) K^{+} (iv) Ca^{2+}
(a) only (iv) (b) only (ii) (c) both (i) & (ii) (d) both (i) and (iii)

Sol. **(c)**

Q59: Which of the following gases will have equal volume at STP, if the weight of gases is 14.0 g ?
(i) N_2O (ii) NO_2 (iii) N_2 (iv) CO
(a) (i) & (ii) (b) (ii) & (iii) (c) (i) & (iii) (d) (iii) & (iv)

Sol. **(d)**

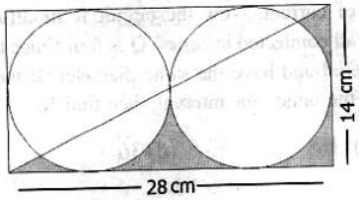
Q60: Which of the following are not ionic ?
(i) $AlCl_3$ (ii) $CaCl_2$ (iii) $MgCl_2$ (iv) LiCl
(a) (i) & (iv) (b) (i) & (ii) (c) (ii) & (iii) (d) (iii) & (iv)

Sol. **(a)**

Q61: Apple dropping from apple trees were observed by many people before Newton. But why they fall was explained by Isaac Newton postulating the law of universal gravitation. Which of the following statements best describes the situation?
(a) The force of gravity acts only on the apple
(b) The apple is attracted towards the surface of the earth
(c) Both earth and apple experience the same force of attraction towards each other
(d) Apple falls due to earth's gravity and hence only (a) is true and (c) is absurd.

Sol. **(c)**
Self gravitation

Q62: A rectangular metal plate, shown in the adjacent figure has a charge of 420 μC assumed to be uniformly distributed over it. Then how much is the charge over the shaded area? No part of metal plate is cut. (Circles and the diagonal are shown for clarity only. π = 22/7)



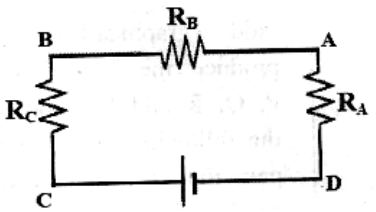
(a) 45 μC (b) 450 μC (c) 15 μC (d) 150 μC

Sol. **(a)**

Shaded area = $\frac{\text{area of rectangle} - 2(\text{area of one circle})}{2} = \frac{392 - 308}{2} = 42\ \text{cm}^2$

Now charge on shaded area = $\frac{420}{392} \times 42 = 45\mu C$

Q63: In the adjacent circuit, the voltages across AD, BD and CD are 2 V, 6V and 8 V respectively. If resistance $R_A = 1\ k\Omega$, then the values of resistances R_B and R_C are _____ and _____ respectively.



(a) 4 kΩ and 6 kΩ
(b) 2 kΩ and 1 kΩ
(c) 1 kΩ and 2 kΩ
(d) data insufficient as battery voltage is not given

Sol. **(b)**

Let i current flow through the circuit

$\therefore V_{AD} = iR_A$

$2 = i \times 1000$

$\therefore i = \frac{1}{500}$

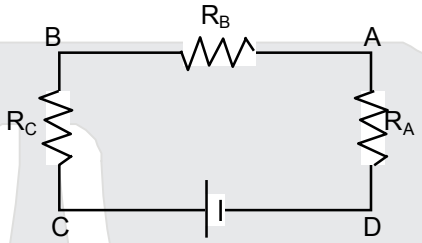
Now $V_{BD} = 6 = i[R_A + R_B]$

$\therefore R_B = 2000\ \Omega = 2\ k\Omega$

Again $V_{CD} = 8V = E = i[R_A + R_B + R_C]$

$8 = \frac{1}{500}[2000 + 1000 + x]$

$\therefore x = 1000\Omega = R_C = 1K\Omega$



Q64: A new linear scale of temperature measurement is to be designed. It is called a 'Z scale' on which the freezing and boiling points of water are 20 Z and 220 Z respectively. What will be the temperature shown on the 'Z scale' corresponding to a temperature of 20ºC on the Celsius scale?

(a) 10 Z (b) 20 Z (c) 40 Z (d) 60 Z

Sol. **(d)**

$$\frac{C-0}{100-0} = \frac{Z-20}{220-20}$$

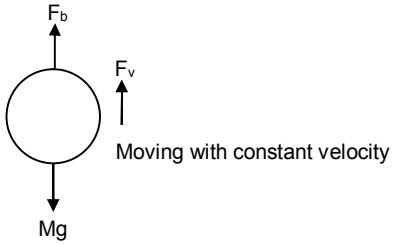
$$\frac{C}{100} = \frac{Z-20}{200} \quad \because C = 20^oC$$

$$\frac{20}{100} = \frac{Z-20}{200} \Rightarrow Z = 60$$

Q65: Consider the motion of a small spherical steel body of mass m, falling freely through a long column of a fluid that opposes its motion with a force proportional to its speed. Initially the body moves down fast, but after some time attains a constant velocity known as terminal velocity. If weight mg, opposing force (F_v) and buoyant force (F_b) act on the body then the correct equation relating these forces after the terminal velocity is reached is :

(a) $mg + F_v = F_b$ (b) $mg = F_v - F_b$ (c) $mg = F_v + F_b$ (d) none

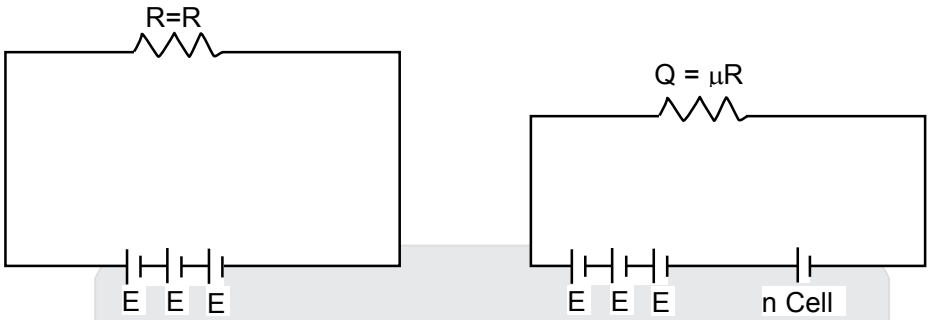
Sol. **(c)**



Q66: A piece of wire P and three identical cells are connected in series. An amount of heat is generated in a certain time interval in the wire due to passage of current. Now the circuit is modified by replacing P with another wire Q and N identical cells, all connected in series. Q is four times longer in length than P. The wire P and Q are of same material and have the same diameter. If the heat generated in second situation is also same as before in the same time interval, then find N.

(a) 4 (b) 6 (c) 16 (d) 36

Sol. **(b)**



$R_P = \rho\frac{\ell}{A}$

$R_Q = \rho\frac{4\ell}{A}$

$R_Q = 4R_p$

$H = \frac{(3E)^2}{R} \times t$

$H_P = \frac{9E^2}{R} \times t$

$\therefore R_Q = 4R_P$

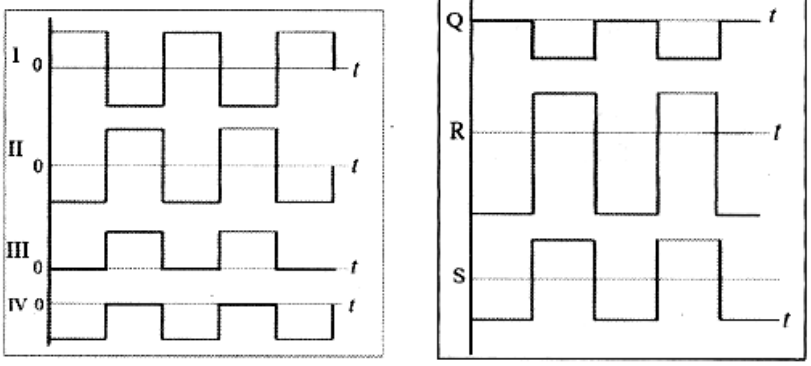
$\therefore H_Q = \frac{(nE)^2}{4R} \times t$

Now $H_P = H_Q$

$\therefore \frac{9E^2}{R} \times t = \frac{n^2E^2}{4R} \times t$

$\therefore n = 6$

Q67: Some waveforms among I, II, III and IV superpose (add graphically) to produce the waveforms P, Q, R and S. Among the following match the pairs that give the correct combinations :



Resultant	Superposition of
P	(K) III and IV
Q	(L) II and IV
R	(M) I, II and III
S	(N) I and IV
	(O) II and III

(a) P ↔ O, Q ↔N, R ↔L, S↔M (b) P ↔ M, Q ↔N, R ↔L, S↔K
(c) P ↔ M, Q ↔N, R ↔K, S↔L (d) P ↔ O, Q ↔M, R ↔L, S↔K

Sol. **(b)**
Super position of Waves

Q68: At any instant of time, the total energy (E) of a simple pendulum is equal to the sum of its kinetic energy $\left(\frac{1}{2}mv^2\right)$ and potential energy $\left(\frac{1}{2}kx^2\right)$, where m is the mass, v is the velocity x is the displacement of the bob and k is a constant for the pendulum. The amplitude of oscillation of the pendulum is 10 cm and its total energy is 4 mJ. Find k.
(a) $1.8Nm^{-1}$ (b) $0.8\ Nm^{-1}$ (c) $0.5\ Nm^{-1}$ (d) data insufficient

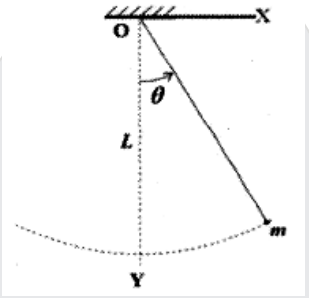
Sol. **(b)**
Total energy

$E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$ when x is maximum that is

x = A then v = 0

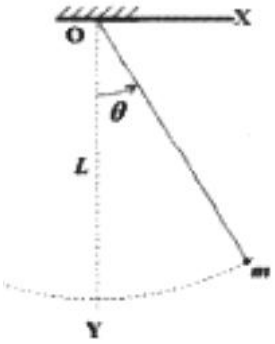
$4\times10^{-3} = \frac{1}{2}kA^2 \Rightarrow 4\times10^{-3} = \frac{1}{2}k\,(0.10)^2 \Rightarrow K = 8\times10^{-2}$ N/m.

Q69: A rigid body of mass m is suspended from point O using an inextensible string of length L. When it is displaced through an angle θ, what is the change in the potential energy of the mass? (Refer adjacent figure.)



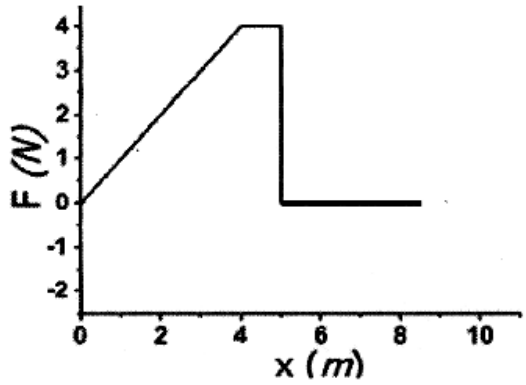
(a) mg L (1 – cos θ) (b) mg L (cos θ – 1) (c) mg L cos θ (d) mg L(1 – sin θ)

Sol. **(a)**



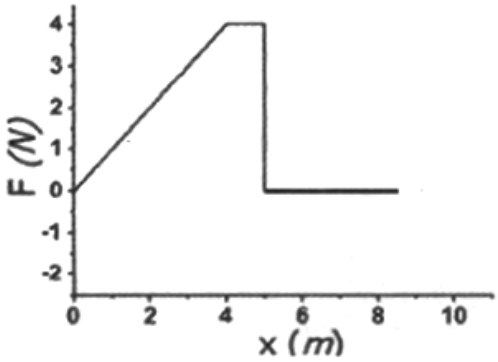
$U_A - U_B = -mgl\cos\theta - (-mgl) \Rightarrow = mgl\,(1 - \cos\theta)$

Q70: Refer to the adjacent figure. A variable force F is applied to a body of mass 6 Kg at rest. The body moves along x – axis as show. The speed of the body at x = 5 m and x= 6 is _____ and _____ respectively.



(a) 0 m/s, 0 m/s (b) 0 m/s, 2 m/s (c) 2 m/s, 2m/s (d) 2 m/s, 4 m/s

Sol. **(c)**



F = 0 from x = 5 to x = 6
Velocity will be same
from work energy theorem
Area of f-x curve = ΔKE

$$\frac{1}{2}(1+5)u = \frac{1}{2}\times 6\,(v^2 - 0)$$

v = 2m/s
Answer is (2m/s , 2m/s) at t = 5 and t = 6

Q71: When a charged particle with charge q and mass m enters uniform magnetic field B with velocity v at right angles to B, the force on the moving particle is given by qvB. This force acts as the centripetal force making the charged particle go in a uniform circular motion with radius $r = \frac{mv}{Bq}$. Now if a hydrogen ion and a deuterium ion enter the magnetic field with velocities in the ratio 2 : 1 respectively, then the ratio of their radii will be _____ .

(a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 1 : 1

Sol. **(d)**

$$\frac{r_1}{r_2} = \frac{m_1 v_1}{Bq_1} \times \frac{Bq_2}{m_2 v_2} \qquad \because \frac{m_1}{m_2} = \frac{1}{2},\ \frac{v_1}{v_2} = \frac{2}{1},\ \frac{q_1}{q_2} = \frac{1}{1}$$

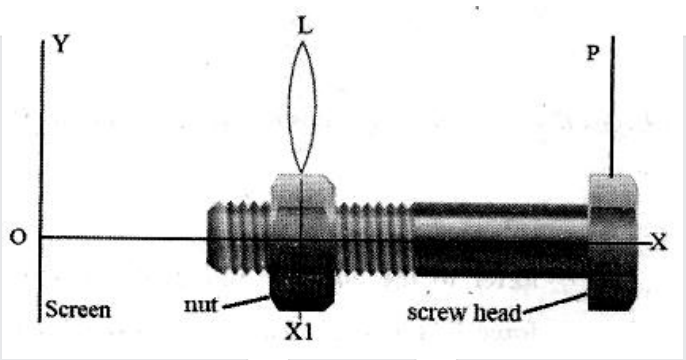
$$= \frac{1}{2}\times\frac{2}{1} = \frac{1}{1}$$

Q72: A piece of ice is floating in water at 4ºC in a beaker. When the ice melts completely, the water level in the beaker will
(a) rise (b) fall (c) remains unchanged (d) unpredictable

Sol. **(a)**
Finally the temperature of water will be less than 4 ºC, so level will rise.

.

Q73: In a screw-nut assembly (shown below) the nut is held fixed in its position and the screw is allowed to rotate inside it. A convex lens (L) of focal length 6.0 cm is fixed on the nut. An object pin (P) is attached to the screw head. The image of the object is observed on a screen Y. When the screw head is rotated through one rotation, the linear distance moved by the screw tip is 1.0 mm. The observations are made only when the image is obtained in the same orientation on the screen. At a certain position of P, the image formed is three times magnified as that of the pin height. Through how many turns should the screw head be rotated so that the image is two times magnified?



(a) 8 (b) 10 (c) 12 (d) 14

Sol. **(b)**

$\frac{v}{u} = -3$ $\quad v = -3u$

Now $\frac{1}{6} = -\frac{1}{3} - \frac{1}{u}$

$3u = -24$

$u = -8$ cm

in second case

$\frac{v}{u'} = -2 \Rightarrow v = -2u'$

$\frac{1}{6} = -\frac{1}{2u'} - \frac{1}{u'}$

$-18 = 2u'$

$u' = -9$ cm

so $u - u' = 1$ cm

in one rotation it shift by 1 mm

so total number revoluation = 10

Q74: A school is located between two cliffs. When the metal bell is struck by school attendant, first echo is heard by him after 2.4 s and second echo follows after 2.0 s for him at the same position near the bell. If the velocity of sound in air is 340 ms^{-1} at the temperature of the surroundings, then the distance between the cliffs is approximately _____.
(a) 0.488 km (b) 0.751 km (c) 1.16 km (d) 1.41 km

Sol. **(c)**

Total time = $\frac{2.4+4.4}{2}$ = 3.4 sec

V = 340 m/s

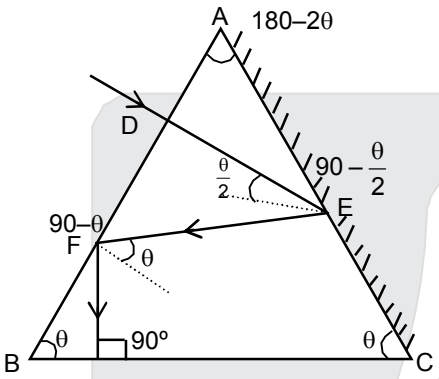
So distance = V × t = 340 × 3.4 = 1156 m

= 1.156 km = 1.16 km approx..

Q75: The triangular face of a crown glass prism ABC isosceles. Length AB = length AC and the rectangular face with edge AC is silvered. A ray of light is incident normally on rectangular face with edge AB. It undergoes reflections at AC and AB internally and it emerges normally through the rectangular base with edge BC. Then angle BAC of the prism is _____.

(a) 24° (b) 30° (c) 36° (d) 42°

Sol. **(c)**



In ΔADE

$180 - 20 + 90 - \frac{\theta}{2} + 90 = 180$

$\theta = 72°$

$\angle BAC = 180 - 2\theta = 180 - 2(72) = 36°$

Q76: The radius of curvature of a convex mirror is 'x'. The distance of an object from focus of this mirror is 'y'. Then what is the distance of image from the focus?

(a) $y^2/4x$ (b) x^2/y (c) $x^2/4y$ (d) $4y^2/x$

Sol. **(c)**

$f^2 = U_f V_f$

Here $f = \frac{x}{2}$

$U_f = y$

$\left(\frac{x}{2}\right)^2 = yV_f$

$V_f = \frac{x^2}{4y}$

Q77: A physics teacher and his family are travelling in a car on a highway during a severe lightning storm. Choose the correct option :

(a) Safest place will be inside the car as the charges due to lightning tend to remain on the metal sheet/ skin of the vehicle if struck by lightning.

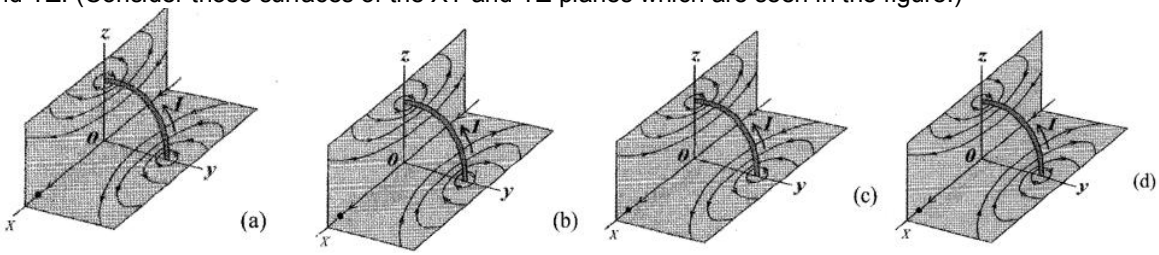
(b) It's too dangerous to be inside the car. As the car has a metal body the charges tend to accumulate on the surface and will generate a strong electric field inside the car.

(c) Safest place is under a tree. It's better to get drenched under a tree as the wet tree will provide a path to the charges for earthing.

(d) It is safer to exit the car and stand on open ground.

Sol. **(a)**

Q78: A conductor in the form of a circular loop is carrying current I. The direction of the current is as shown. Then which figure represents the correct direction of magnetic field lines on the surface of the planes XY and YZ. (Consider those surfaces of the XY and YZ planes which are seen in the figure.)



Sol. **(a)**
According to right handed thumb rule or clock rule

Q79: A particle experiences constant acceleration for 20 s after starting from rest. If it travels a distance S_1 in the first 10 s and distance S_2 in the next 10 s, the relation between S_1 and S_2 is :
(a) $S_2 = 3S_1$ (b) $S_1 = 3S_2$ (c) $S_2 = 2S_1$ (d) $S_1 = 10S_2$

Sol. **(a)**
Let acceleration of body = a

$S_1 = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}a10^2 = 50a$

Now velocity after 10 sec = initial velocity of next journey
$V = 0 + 10a$

$\therefore S_2 = ut + \frac{1}{2}at^2 = 10a \times 10 + \frac{1}{2}a10^2 = 150a$

$\therefore S_2 = 3S_1$

Q80: A sound wave is produced by a vibrating metallic string stretched between its ends.
Four statements are given below. Some of them are correct.
(P) Sound wave is produced inside the string.
(Q) Sound wave in the string is tranvese.
(R) Wavelength of the sound wave in surrounding air is equal to the wavelength of the transverse wave on the string.
(S) Loudness of sound is proportional to the square of the amplitude of the vibrating string.
Choose the correct option.
(a) P (b) R and S (c) P and Q (d) S

Sol. **(d)**

NOTE: FOLLOWING INFORMATION MAY BE USEFUL TO YOU:

1. Trigonometric ratios are defined for angles greater than 90° also.

2. The following identities may be useful:
$$\sin(180^\circ - \theta) = \sin\theta; \quad \cos(180^\circ - \theta) = -\cos\theta$$

3. Periodic Table of elements

PERIODIC TABLE OF THE ELEMENTS

1																		2
H																		He
1.008																		4.00
3	4											5	6	7	8	9		10
Li	Be											B	C	N	O	F		Ne
6.94	9.01											10.81	12.01	14.01	16.00	19.00		20.18
11	12											13	14	15	16	17		18
Na	Mg											Al	Si	P	S	Cl		Ar
22.99	24.30											26.98	28.09	30.97	32.06	35.45		39.95
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br		Kr
39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.59	74.92	78.96	79.90		83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53		54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I		Xe
85.47	87.62	88.91	91.22	92.91	95.94	(98)	101.1	102.91	106.42	107.87	112.41	114.82	118.71	121.75	127.60	126.91		131.29
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85		86
Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At		Rn
132.91	137.33	138.91	178.49	180.95	183.85	186.21	190.2	192.2	195.08	196.97	200.59	204.38	207.2	208.98	(209)	(210)		(222)
87	88	89	104	105	106	107	108	109	110	111								
Fr	Ra	†Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg								
(223)	226.02	227.03	(261)	(262)	(266)	(264)	(277)	(268)	(271)	(272)								

*Lanthanide Series	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	140.12	140.91	144.24	(145)	150.4	151.97	157.25	158.93	162.50	164.93	167.26	168.93	173.04	174.97
†Actinide Series	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)

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