Examination Time: 1000 to 1200 Hrs. Question paper code: JS511

INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (**NSEJS**)

Instructions to candidates – Read carefully and strictly follow each of them

1. **Use and carrying calculators of any type is strictly prohibited.**
2. 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.
3. **Write the question paper code in your answer sheet in the appropriate space provided**, otherwise your answer sheet will **not be assessed**.
4. 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.**
5. 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.
6. As answer sheets are evaluated using machine, **change of entry is not allowed.** Even scratching or overwriting may result in a wrong score.
7. 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. 

8. Correct answer carries 3 marks, wrong answer -1 mark (negative 1), no attempt – zero marks.
9. Rough work should be done in the space provided in the question paper only.
10. Candidates are not permitted to leave the examination hall before the completion of the examination schedule (i.e. before 1200 Hrs).
11. 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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12. Comments or queries (if any) regarding this question paper, may be sent by **email only** to iapt.nse@gmail.com till 2359 Hrs. of 23 Nov. 2018. The answers to this question paper will be available at – www.iapt.org.in by 02 Dec. 2018 after 1700 Hrs.
13. For certificates and awards – Please see the website of IAPT: www.iapt.org.in

PERIODIC TABLE OF THE ELEMENTS

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

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

QUESTION PAPER STARTS HERE

Q1. A tiny ball of mass m is initially at rest at height H above a cake of uniform thickness h. At some moment the particle falls freely, touches the cake surface and then penetrates in it at such a constant rate that its speed becomes zero on just reaching the ground (bottom of the cake). Speed of the ball at the instant it touches the cake surface and its retardation inside the cake are respectively

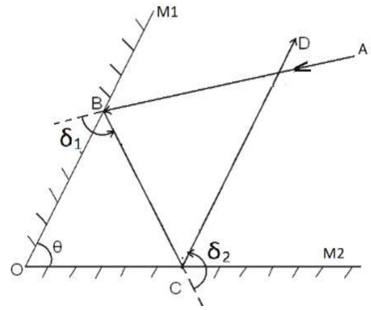
(a) $\sqrt{2gh}$ and $g\left(\frac{H}{h}-1\right)$ (b) $\sqrt{2g(H-h)}$ and $g\left(\frac{H}{h}-1\right)$

(c) $\sqrt{2gh}$ and $g\left(\frac{h}{H}-1\right)$ (d) $\sqrt{2g(H-h)}$ and $g\left(\frac{h}{H}-1\right)$

Q 2. Two sound waves in air have wavelengths differing by 2 m at a certain temperature T. Their notes have musical interval 1.4. Period of the lower pitch note is 20 ms. Then, speed of sound in air at this temperature (T) is

(a) 350 m/s (b) 342 m/s (c) 333 m/s (d) 330 m/s

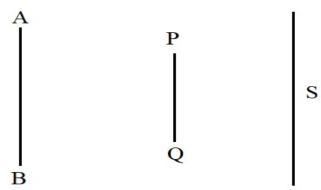
Q 3.



Two plane mirrors M_1 & M_2 have their reflecting faces inclined at θ. Mirror M_1 receives a ray AB, reflects it at B and sends it as BC. It is now reflected by mirror M_2 along CD, as shown in the figure. Total angular deviation δ suffered by the incident ray AB is:

(a) $\delta = 90^o + 2\theta$ (b) $\delta = 180^o + 2\theta$ (c) $\delta = 270^o - 2\theta$ (d) $\delta = 360^o - 2\theta$

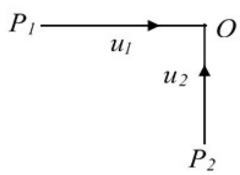
Q4.



In the adjacent figure, line AB is parallel to screen S. A linear obstacle PQ between the two is also parallel to both. AB, PQ and screen S are coplanar. A point source is carried from A to B, along the line AB. What will happen to the size of the shadow of PQ (cast due to the point source) on the screen S?

(a) It will first increase and then decrease.
(b) It will first decrease and then increase.
(c) It will be of the same size for any position of the point source on the line AB.
(d) Umbra will increase and penumbra will decrease till central position.

Q5.



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Two particles P_1 and P_2 move towards origin O, along X and Y-axes at constant speeds u_1 and u_2 respectively as shown in the figure. At $t = 0$, the particles P_1 and P_2 are at distances a and b respectively from O. Then the instantaneous distance s between the two particles is given by the relation:

(a) $s = [a^2 + b^2 + (u_1^2 + u_2^2)t^2 - 2t(au_1 + bu_2)]^{1/2}$
(b) $s = [a^2 + b^2 + (u_1^2 + u_2^2)t^2 - 2t(bu_1 + au_2)]^{1/2}$
(c) $s = [a^2 + b^2 + (u_1^2 + u_2^2)t^2 + 2t(au_1 + bu_2)]^{1/2}$
(d) $s = [a^2 - b^2 + (u_1^2 + u_2^2)t^2 - 2t(au_1 + bu_2)]^{1/2}$

Q6. An electric generator consumes some oil fuel and generates output of 25 kW. Calorific value (amount of heat released per unit mass) of the oil fuel is 17200 kcal/kg and efficiency (output to input ratio) of the generator is 0.25. Then, mass of the fuel consumed per hour and electric energy generated per ton of fuel burnt are respectively

(a) 0.5 kg, 20000 kWh (b) 0.5 kg, 5000 kWh
(c) 5 kg, 5000 kWh (d) 5 kg, 20000 kWh

Q 7. Image is obtained on a screen by keeping an object at 25 cm and at 40 cm in front of a concave mirror. Image in the former case is four times bigger than in the latter. Focal length of the mirror must be____.

(a) 12 cm. (b) 20 cm. (c) 24 cm. (d) 36 cm.

Q 8. A glass cube of refractive index 1.5 and edge 1 cm has a tiny black spot at its center. A circular dark sheet is to be kept symmetrically on the top surface so that the central spot is not visible from the top. Minimum radius of the circular sheet should be $\left(\text{Given: } \frac{1}{\sqrt{2}} = 0.707,\ \frac{1}{\sqrt{3}} = 0.577,\ \frac{1}{\sqrt{5}} = 0.447\right)$

(a) 0.994 cm (b) 0.447 cm (c) 0.553 cm (d) 0.577 cm

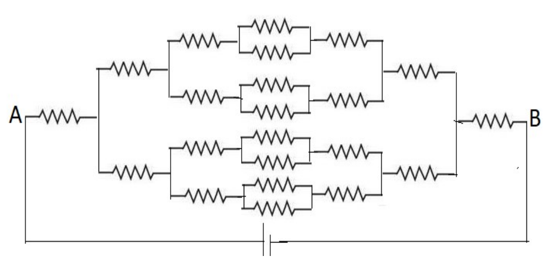
Q9. A metal rod of length L at temperature T, when heated to temperature T', expands to new length L'. These quantities are related as $L' = L(1 + \alpha[T' - T])$ where α is a constant for that material and called as coefficient of linear expansion. Correct SI unit of α is___.

(a) m-K^{-1} (b) m-K (c) K^{-1} (d) α is a pure number

Q 10. A paramedical staff nurse improvises a second's pendulum (time period 2 s) by fixing one end of a string of length L to a ceiling and the other end to a heavy object of negligible size. Within 60 oscillations of this pendulum, she finds that the pulse of a wounded soldier beats 110 times. A symptom of bradycardia is pulse < 60 per minute and that of tachycardia is > 100 per minute. Then the length of the string is nearly ________ and soldier has symptoms of _________.

(a) 1 m, bradycardia (b) 4 m, bradycardia
(c) 1 m, tachycardia (d) 4 m, tachycardia

Q11.



Each resistance in the adjacent circuit is $R\ \Omega$. In order to have an integral value for equivalent resistance between A & B, the minimum value of R must be:

(a) 4 Ω (b) 8 Ω (c) 16 Ω (d) 29 Ω

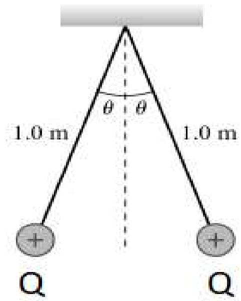
Q 12. A block of wood floats on water with $\left(\frac{3}{8}\right)^{th}$ of its volume above water. It is now made to float on a salt solution of relative density 1.12. The fraction of its volume that remains above the salt solution now, is nearly______.

(a) 0.33 (b) 0.44 (c) 0.67 (d) 0.56

Q13. Suppose our scientific community had chosen force, speed and time as the fundamental mechanical quantities instead of length, mass and time respectively and they chose the respective units of magnitudes 10 N, 100 m/s and $\frac{1}{100}$ s. Then the unit of mass in their system is equivalent to _______in our system.

(a) 10^3 kg (b) 10^{-3} kg (c) 10 kg (d) 10^{-1} kg

Q 14.



Two equally charged identical pith balls are suspended by identical massless strings as shown in the adjacent figure. If this set up is on Mercury ($g = 3.7$ m/s^2), Earth ($g = 9.8$ m/s^2) and Jupiter (g = 24.5 m/s^2), then angle 2θ will be________.

(a) maximum on Mercury (b) maximum on Earth, as it has atmosphere
(c) maximum on Jupiter
(d) the same on any planet as Coulomb force is independent of gravity

Q15. Three objects of the same material coloured white, blue and black can withstand temperatures up to 2000°C. All these are heated to 1500°C and viewed in dark. Which option is correct?

(a) White object will appear brightest (b) Blue object will appear brightest
(c) Black object will appear brightest
(d) Being at the same temperature, all will look equally bright

Q 16. A car running with a velocity of 30 m/s reaches midway between two vertical parallel walls separated by 360 m, when the driver sounds the horn for a moment. Speed of sound in air is 330 m/s. After blowing horn, the first three echoes will be heard by the driver respectively at______.

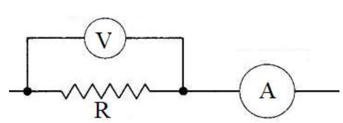
(a) 1.2 s, 2.4 s, 3.0 s (b) 1.0 s, 2.4 s, 3.0 s
(c) 1.0 s, 2.0 s, 3.0 s (d) 1.2 s, 2.4 s, 3.6 s

Q 17. Choose correct option from the following statements from electrostatics:

(I) If two copper spheres of same radii, one hollow and the other solid are charged to the same electrical potential, the solid sphere will have more charge.
(II) A charged body can attract another uncharged body.
(III) Electrical lines of force originating from like charges will exert a lateral force on each other, while those originating from opposite charges can intersect each other.

(a) Only (I) is correct. (b) Only (II) is correct.
(c) Only (I) & (II) are correct. (d) All (I), (II) & (III) are correct.

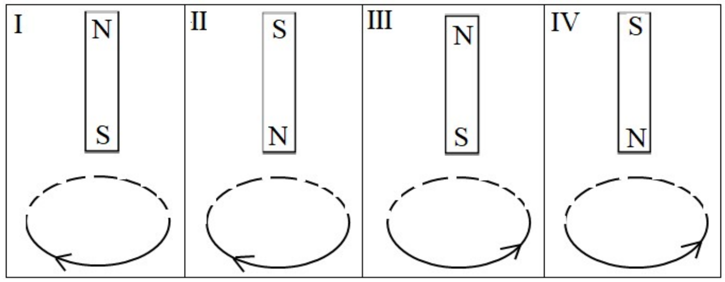
Q18.



Refer the adjacent circuit. The voltmeter reads 117 V and ammeter reads 0.13A. If the resistance of voltmeter and ammeter are 9 kΩ and 0.015Ω respectively, the value of R is___.

(a) 500 Ω (b) 1kΩ (c) 1.5kΩ (d) 2 kΩ

Q19. A bar magnet is allowed to fall freely from the same height towards a current carrying loop along its axis, as shown in the four situations I to IV. Arrows show direction of conventional current. Choose the situations in which the potential energy of the magnet coil interaction is maximum_____.



(a) I, III (b) I, IV (c) II, IV (d) II, III

Q20. A beaker is completely filled with water at 4°C. Consider the following statements:

(I) Water will overflow if the beaker is cooled for some time.

(II) Water will overflow if the beaker is heated for some time.

Select correct option regarding (I) and (II).

(a) Only (I) is correct (b) Only (II) is correct

(c) Both (I) and (II) are correct (d) Neither (I) nor (II) is correct

Q21. P^{3-} has a larger radius than atom of P because

(a) There is greater coulombic attraction between the nucleus and electrons in the P^{3-} ion.

(b) The core electrons in P^{3-} exert a weaker shielding force than those of a neutral atom.

(c) The nuclear charge is weaker in P^{3-} than it is in P.

(d) The electrons in P^{3-} have a greater coulombic repulsion than those in P atom.

Q22. A substance is dissolved in water, forming a 0.5 molar solution. If 4.0 L of solution contains 240g of the substance, what is the molecular mass of the substance?

(a) 60g/mole (b) 120g/mole (c) 240g/mole (d) 480g/mole

Q23. A car battery was kept for charging and after getting fully charged density of the battery acid (H_2SO_4) was measured and found to be1.28 g cm^{-3}. If Initial molarity of battery acid was 4.2 M then mass percentage will be around___.

(a) 28% (b) 30% (c) 32% (d) 34%

Q24. Element "X" with atomic mass 10 was allowed to react completely with element "Y" of atomic mass 20 to form a compound. When this compound was analysed it was found that it contains 60% of X and 40 % of Y by weight. The simplest formula of this compound will be_____.

(a) X_3Y (b) X_2Y_3 (c) Y_3X (d) X_6Y_4

Q25. 4.095 X 10^{24} nitrogen atoms are filled in an enclosed gas cylinder of capacity two litre. The number of moles of nitrogen gas in the cylinder is___.

(a) 14.7 (b) 6.8 (c) 3.4 (d) 2.9

Q26. When a surface tension experiment with capillary tube is performed, water rises up to 0.1m. If the experiment is carried out in space, water will rise in capillary tube____.

(a) up to height of 0.1m
(b) up to height of 0.2m
(c) up to height of 0.98m
(d) along its full length

Q27. Deepa was studying properties of gases. She took a flask and filled it with sulphur di-oxide gas, and weighed it at temperature T and pressure P. The weight of the flask containing the gas was found to be W_1. She then flushed the flask, cleaned and filled it with methane at the same temperature and pressure. The weight of the flask containing oxygen was found to be W_2. She repeated the process with oxygen under the same conditions and found the weight to be W_3. The ratio of the weights $W_1 : W_2 : W_3$ is

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

Q28. Four gas jars filled with sulphur dioxide gas were inverted into troughs of water by four students P, Q, R, S. The following observations and inference were reported by them.

P: Water did not enter the gas jar and sulphur dioxide is soluble in water.
Q: Water rushed into the gas jar and sulphur dioxide is soluble in water.
R: Water did not enter in the gas jar and sulphur dioxide is insoluble in water.
S: A small amount of water entered the gas jar slowly and sulphur dioxide is sparingly soluble in water.

Then the correct set of observations and inference is reported by,

(a) P (b) Q (c) R (d) S

Q29. A solution of pure aluminium sulphate containing 0.170g of aluminium ions is treated with excess of barium hydroxide solution. Total weight of the precipitate will be:

(a) 0.5g (b) 2.7g (c) 1.7 g (d) 0.54g

Q30. A region of one square meter area was given to each Suhas, Bobby, Sandy and Kimi in a garden. The daffodil plants grow best in the soil having a pH range of 6.0 to 6.5. If the soil has a pH 4.5, to grow daffodils, Suhas added common salt, Bobby added sodium phosphate, Sandy added aluminium sulphate and Kimi added ammonium chloride in their allotted area. Who was successful in growing daffodil?

(a) Suhas (b) Bobby (c) Sandy (d) Kimi

Q31. Electrons in the last shell of X, Y, W and Z are 2, 6, 4 and 1 respectively. Which of the following statement is correct?

(a) melting point of compound formed by X and Y is more than that of by W and Z.
(b) compound formed by X and Y is more volatile than that of by W and Z.
(c) melting point of compound formed by X and Z is more than that of by W and Y.
(d) Incomplete information so inference cannot be drawn.

Q32. W g of pure coal was combusted in pure dry oxygen. The carbon dioxide gas obtained was absorbed in 0.1M KOH solution. The complete absorption of CO_2 required 5cm^3 of 0.1M KOH. The amount of coal combusted is

(a) 3mg (b) 6mg (c) 11mg (d) 12mg

Q33. Sulphur di-oxide gas and ammonia gas were mixed in different proportions. The pair of gases containing same number of molecules at NTP is ________.

(a) 1120 cm^{3}of SO_2+ 0.85 g of ammonia (b) 0.25g mole of SO_2 + 2240 cm^3 of ammonia
(c) 1680 cm^3 of SO_2 + 1.7 g of ammonia (d) 0.25 g mole of SO_2 + 0.85 g of ammonia

Q34. A strip of iron with mass 15.5 g is placed in a solution containing 21.0 g copper sulphate. After some time the reaction stops. Iron strip was found to have mass 8.5 g. The mass of copper formed was found to be 8.60g. Find the mass of ferrous sulphate formed in this reaction.

(a) 19.40 g (b) 18.40 g (c) 17.40 g (d) 16.40 g

Q35. Sonu has N/2 HCl solution and Monu has N/10 HCl solution. They are asked to prepare 2 litres of N/5 HCl solution. What volume of two solutions be mixed?

(a) (0.5 +1.5) litre (b) (1.0 +1.0) litre (c) (0.3 +1.7) litre (d) (0.2 +1.8) litre

Q36. A solution (P) was prepared by dissolving 6.3 g of oxalic acid in 100 ml water. 25 ml of this solution was taken and was further diluted to 250 ml to prepare solution (Q). What weight of NaOH in ppm will be required to neutralize 10 ml of solution (Q)?

(a) 10 ppm (b) 20 ppm (c) 40 ppm (d) 80 ppm

Q37. Which of the following can improve the quality of petrol?

(a) n heptane (b) benzene (c) n hexadecane (d) iso-octane

Q38. $2KBrO_3 + 12H^+ + 10e^- \rightarrow Br_2 + 6H_2O + 2K^+$

From above reaction the equivalent weight of $KBrO_3$ can be calculated as (M is molecular weight of $KBrO_3$)

(a) M/5 (b) M/10 (c) M/12 (d) M/2

Q39. Shaila took about 10 cm^3 of a diluted Potassium hydrogen carbonate solution in a test tube. To this solution she added few drops of universal indicator. The colour of the solution turned:

(a) orange (b) green (c) blue (d) yellow

Q40. Which of the following is incorrect?

(a) Chalcocite - Copper (b) Magnetite - Iron
(c) Calamine - Aluminium (d) Galena - Lead

Q41. Let AB be a diameter of a circle C_1 of radius 30 cm and with center O. Two circles C_2 and C_3 of radii 15 cm and 10 cm touch C_1 internally at A and B respectively. A fourth circle C_4 touches C_1, C_2 and C_3. What is the largest possible radius of C_4?

(a) 12 cm (b) 15 cm (c) 20 cm (d) 30 cm

Q42. A 5 x 5 x 5 cube is built using unit cubes. How many different cuboids (that differ in at least one unit cube) can be formed using the same number of unit cubes?

(a) 1000 (b) 1728 (c) 2730 (d) 3375

Q43. What is the largest value of the positive integer k such that k divides $n^2(n^2-1)(n^2-n-2)$ for every natural number n?

(a) 6 (b) 12 (c) 24 (d) 48

Q44. A person kept rolling a regular (six faced) die until one of the numbers appeared third time on the top. This happened in 12^{th} throw and the sum of all the numbers in 12 throws was 46. Which number appeared least number of times?

(a) 6 (b) 4 (c) 2 (d) 1

Q45. In a square ABCD, a point P is inside the square such that ABP is an equilateral triangle. The segment AP cuts the diagonal BD in E. Suppose AE = 2. The area of ABCD is

(a) $4+2\sqrt{3}$ (b) $5+2\sqrt{3}$ (c) $4+4\sqrt{3}$ (d) $5+4\sqrt{3}$

Q46. Let n be a positive integer not divisible by 6. Suppose n has 6 positive divisors. The number of positive divisors of $9n$ is

(a) 54 (b) 36 (c) 18 (d) 12

Q47. The value of $\frac{\sqrt{a+x}-\sqrt{a-x}}{\sqrt{a+x}+\sqrt{a-x}}$, when $x = \frac{2a}{b^2+1}$ is:

(a) a (b) b (c) x (d) 0

Q48. Two regular polygons of different number of sides are taken. In one of them, its sides are coloured red and diagonals are coloured green; in the other, sides are coloured green and diagonals are coloured red. Suppose there are 103 red lines and 80 green lines. The total number of sides the two polygons together have is:

(a) 23 (b) 28 (c) 33 (d) 38

Q49. A box contains some red and some yellow balls. If one red ball is removed, one seventh of the remaining balls would be red; if one yellow ball is removed, one-sixth of the remaining balls would be red. If n denotes the total number of balls in the box, then the sum of the digits of n is

(a) 6 (b) 7 (c) 8 (d) 9

Q50. Let ABCD be a rectangle. Let X and Y be points respectively on AB and CD such that AX:XB = 1:2 = CY:YD. Join AY and CX; let BY intersect CX in K; let DX intersect AY in L. If m/n denotes the ratio of the area of XKYL to that of ABCD, then $m + n$ equals

(a) 9 (b) 11 (c)13 (d) 15

Q51. Let ABC be an equilateral triangle. The bisector of $\angle$ BAC meets the circumcircle of ABC in D. Suppose DB + DC = 4. The diameter of the circumcircle of ABC is

(a) 4 (b) $3\sqrt{3}$ (c) $2\sqrt{3}$ (d) 2

Q52. Let T_k denote the k-th term of an arithmetic progression. Suppose there are positive integers $m \neq n$ such that $T_m = 1/n$ and $T_n = 1/m$. Then T_{mn} equals

(a) $\frac{1}{mn}$ (b) $\frac{1}{m}+\frac{1}{n}$ (c) 1 (d) 0

Q53. In a triangle ABC, let AD be the median from A; let E be a point on AD such that AE : ED = 1 : 2; and let BE extended meets AC in F. The ratio of AF/FC is

(a) 1/6 (b) 1/5 (c) 1/4 (d) 1/3

Q54. If sin θ and cos θ are roots of the equation $px^2 + qx + r = 0$, then:

(a) $p^2 - q^2 + 2pr = 0$ (b) $(p + r)^2 = q^2 - r^2$
(c) $p^2 + q^2 - 2pr = 0$ (d) $(p - r)^2 = q^2 + r^2$

Q55. For a regular k-sided polygon, let $\alpha(k)$ denotes its interior angle. Suppose n > 4 is such that $\alpha(n-2)$, $\alpha(n)$, $\alpha(n+3)$ forms an arithmetic progression. The sum of digits of n is

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

Q56. The sum of 5 numbers in geometric progression is 24.
The sum of their reciprocals is 6. The product of the terms of the geometric progression is

(a) 36 (b) 32 (c) 24 (d) 18

Q57. Digits *a* and *b* are such that the product $\overline{4a1}$ x $\overline{25b}$ is divisible by 36 (in base 10). The number of ordered pairs (*a*, *b*) is

(a) 15 (b) 8 (c) 6 (d) 4

Q58. The integer closest to $\sqrt{111\ldots1 - 222\ldots2}$, where there are 2018 ones and 1009 twos, is

(a) $\frac{10^{1009}-1}{3}$ (b) $\frac{10^{1009}-1}{9}$ (c) $\frac{10^{2018}-1}{3}$ (d) $\frac{10^{2018}-1}{9}$

Q59. In a triangle ABC, a point D on AB is such that AD : AB = 1 : 4 and DE is parallel to BC with E on AC. Let M and N be the mid points of DE and BC respectively. What is the ratio of the area of the quadrilateral BNMD to that of triangle ABC?

(a) 1/4 (b) 9/32 (c) 7/32 (d) 15/32

Q60. The number of distinct integers in the collection $\left[\frac{10^2}{1}\right], \left[\frac{10^2}{2}\right], \left[\frac{10^2}{3}\right], \ldots, \left[\frac{10^2}{20}\right]$,

where $[x]$ denotes the largest integer not exceeding x, is

(a) 20 (b) 18 (c) 17 (d) 15

Q61. True coelom is not present in animals of:

(a) Platyhelminthes (b) Annelida (c) Echinodermata (d) Arthropoda

Q62. The intracellular organelle that is responsible for formation of acrosomal vesicle is:

(a) endoplasmic reticulum (b) Golgi apparatus
(c) mitochondrion (d) none of the above

Q63. The genetically modified (GM) brinjal in India has been developed for:

(a) enhancing shelf life (b) insect-resistance
(c) drought-resistance (d) enhancing mineral content

Q64. A scientist observed few cells under a microscope with following characters:

i. Cells divided by binary fission or fragmentation, or budding
ii. Cells moved with the help of flagella
iii. Ether lipids were observed in cell membranes
iv. Peptidoglycans were noted in the cell walls

Which of the following category do the cells belong to?

(a) Archaea (b) Plant cells (c) Unicellular eukaryotes (d) Cyanobacteria

Q65. Character(s) of acquired immunity is (are):

(a) differentiation between self and non-self (b) specificity of antigen
(c) retains memory (d) all the above

Q66. Instead of using chemical fertilizers in a paddy field, a farmer thought of employing nitrogen fixation technique. Amongst the following which would be beneficial for his cause?

(a) *Glycine max - Rhizobium* (b) *Cycas – Nostoc*
(c) *Casuarina – Frankia* (d) *Azolla-Anabaena*

Q67. An action potential in the nerve fibre is produced when positive and negative charges on outside and inside of the axon membrane are reversed because:

(a) all potassium ions leave the axon
(b) more potassium ions enter the axon as compared to sodium ions leaving it
(c) more sodium ions enter the axon as compared to potassium ions leaving it
(d) all sodium ions enter the axon

Q68. A geneticist was studying the pathway of synthesis of an amino acid 'X' in an organism. The presence (either synthesized *de novo* or externally added) of 'X' is a must for the survival of that organism. She isolated several mutants that require 'X' to grow. She tested whether each mutant would grow when different additives, P, Q, R, S and T were used. '+' indicates growth and '-' indicates the inability to grow in the mutants tested. Find out the correct sequence of additives in the biosynthetic pathway of 'X'.

Organisms	Additives				
	P	Q	R	S	T
Wild-type	+	+	+	+	+
Mutant 1	-	-	-	-	+
Mutant 2	-	+	+	+	+
Mutant 3	-	-	+	-	+
Mutant 4	-	+	+	-	+

(a) $P \rightarrow Q \rightarrow R \rightarrow S \rightarrow T$ (b) $P \rightarrow R \rightarrow S \rightarrow Q \rightarrow T$
(c) $T \rightarrow P \rightarrow Q \rightarrow S \rightarrow R$ (d) $P \rightarrow S \rightarrow Q \rightarrow R \rightarrow T$

Q69. In a case of mammalian coat color, the principal gene identified is 'C' which codes for a tyrosinase enzyme. In case of rabbits four different phenotypes are observed *Full Color>Chinchilla>Himalayan>Albino* (in order of the expression of gene 'C' and its alleles). In a progeny obtained after crossing two rabbits, the percentages of *Chinchilla, Himalayan* and *Albino* rabbits were 50, 25 and 25 respectively. What must have been the genotypes of the parent rabbits?

(a) $C^{ch}C^{ch}$ X $C^{ch}c$ (b) $C^{ch}C^{h}$ X $C^{ch}c$ (c) $C^{ch}c$ X $C^{h}c$ (d) $C^{h}C^{h}$ X $C^{ch}C^{ch}$

Q70. It was observed in a group of tadpoles of a mutant frog reared in a laboratory that their development was arrested at a particular stage. The exact tissue that was affected by the mutation is unknown. The development was then resumed and accelerated by injecting the tadpoles with the extracts prepared from various tissues of the wild type frogs. The observations of the experiment are given below.

Experiment No.	Tissue Extract	Observations
1	Anterior lobe of pituitary	Development resumed
2	Posterior lobe of pituitary	Development did not resume
3	Thyroid gland	Development resumed
4	Anterior lobe of pituitary + Thyroid gland	Development resumed
5	Anterior + posterior lobe of pituitary	Development resumed
6	Posterior lobe of pituitary + Thyroid gland	Development did not resume

From the above observations, find out the tissue that is affected by the mutation.

(a) Anterior lobe of pituitary
(b) Posterior lobe of pituitary
(c) Thyroid gland
(d) Both pituitary and thyroid gland

Q71.

Group A	**Group B**
Salmon	Alpine salamander
Bullfrog	Spiny anteater
Platypus	Common toad
Bull shark	Crocodile

Identify the odd ones from each group (A and B) based on same criterion.

(a) Platypus, Alpine Salamander
(b) Bull shark, Alpine salamander
(c) Bullfrog, Crocodile
(d) Platypus, Common toad

Q72. A patient was administered a chemical agent called Guanfacine hydrochloride after the patient showed the symptoms like shortness of breath and headache. Guanfacine hydrochloride is a known stimulant of central α_2-adrenergic receptors of the medulla regulating the sympathetic nervous system. The patient in this case must be suffering from__.

(a) Hypertension
(b) Hyperstimulation
(c) Hyperpolarization
(d) None of the above

Q73. A bacterial dsDNA molecule, 2988 bp in length, was found to have the following composition:

	T	C	A	G
Strand I	348	X		1400
Strand II	650			Y

The respective values of X and Y are:

(a) 1400 and 590 (b) 590 and 1400 (c) 590 and 590 (d) None of the above

Q74. What would be the length of a polypeptide translated from mRNA which is encoded by 2988 bp of a bacterial gene?

(a) 989 (b) 992 (c) 995 (d) 998

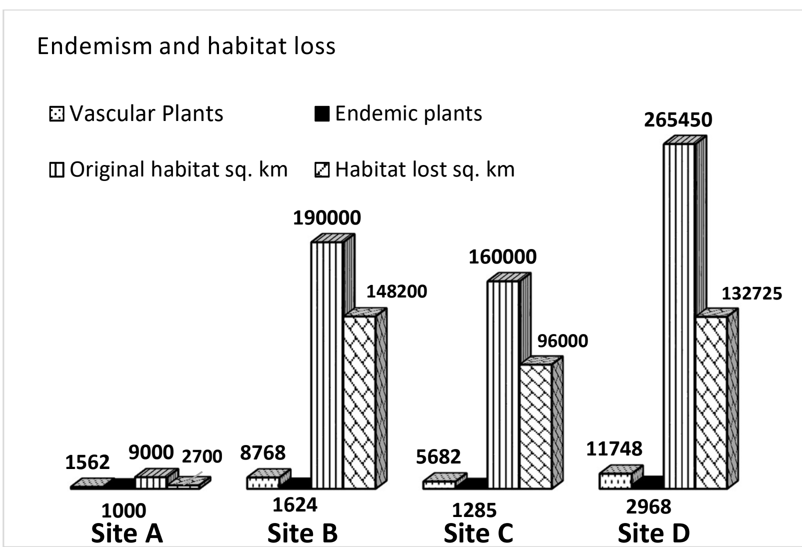
Q75. A student recorded the data for five types of cells as given below:

Character	P	Q	R	S	T
Cell wall	+	+	-	-	+
Centrioles	-	-	-	+	-
Chloroplast	-	+	-	-	-
Mitochondrion	-	+	-	+	+
Nucleus	-	+	-	+	+
Plasma membrane	+	+	-	+	+
RNA / DNA	+	+	+	+	+
Vacuoles	+	+	-	+	+

The five cell types P, Q, R, S and T are:

(a) P- Bacterium, Q- Plant, R- Virus, S- Animal, T- Fungus
(b) P- Bacterium, Q- Plant, R- Virus, S- Fungus, T- Animal
(c) P- Fungus, Q- Plant, R- Bacterium, S- Animal, T- Virus
(d) P- Plant, Q- Bacterium, R- Virus, S- Animal, T- Fungus

Q76. An environment conservation group performed a survey of some diverse locations in the country and represented it as under:



Which amongst these sites should be included as a biodiversity hotspot?

(a) Site A (b) Site B (c) Site C (d) Site D

Q77. A bacterium has a generation time of 50 minutes. A culture containing 10^8 cells per mL is incubated for 300 minutes. What will be the number of cells after 300 minutes?

(a) 64 x 10^3 cells (b) 6.4 x 10^8 cells (c) 64 x 10^9 cells (d) 6.4 x 10^9 cells

Q78. The blood grouping system is an example of 'multiple allelism'. In order to find out the gene products of various gene variants, different enzymes (codes used for the purpose of experimentation are X and Y) from four blood samples were assayed. The enzymes were quantified and the information obtained from these experiments is given in percentages in the following table. '+' indicates presence of an enzyme and '-' indicates the absence of that enzyme from the blood sample. The standard codes for dominant and recessive alleles are considered. Identify the blood groups of subjects and choose the correct option of their genotypes from given options. (In table: P means present, A means absent)

Subjects →	Ramesh		Ali		Sophia		Balwinder	
Enzymes ↓	P / A	%	P / A	%	P / A	%	P / A	%
X	+	50	+	50	+	100	-	-
Y	-	-	+	50	-	-	+	100

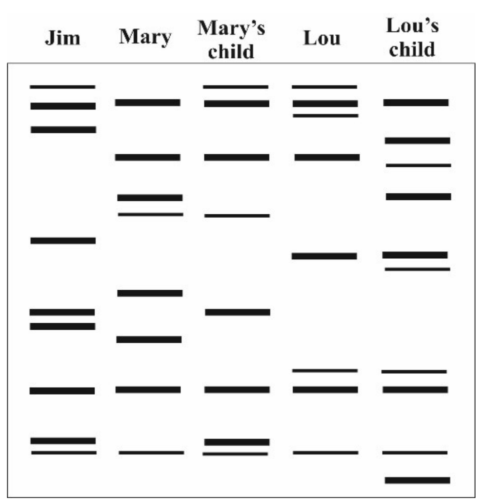
(a) I^Ai, ii, I^Bi, I^AI^B (b) I^Ai, I^AI^B, I^AI^A, I^BI^B

(c) I^Bi, I^AI^B, ii, I^Bi (d) I^Bi, ii, I^AI^B, I^Ai

Q79. In an experiment, a scientist discovered a darkly stained chromatin body on the periphery of nucleus of epithelial cells obtained from an eight year old boy. This is indicative of a particular syndrome. Find out the best possible chromosome combination of their parents from the options given below; which have the highest probability of producing the child under investigation. 'A' indicates autosome. 'X' and 'Y' represent the sex chromosomes.

(a) 22AA+XY, 22AA+XXX (b) 22AA+XXY, 22AA+XXX
(c) 22AA+XY, 22AA+XX (d) 22AA+XXY, 22AA+XX

Q80.



A millionaire Mr. Jim, died recently. Two women, Mary and Lou, claiming to have a child by Jim approached the police demanding a share in his wealth. Fortunately Jim's semen sample was cryopreserved. The scientists used DNA fingerprinting technique to study the three highly variable chromosome regions. The results obtained are shown in the adjoining figure:

After studying the DNA profile, which of the alleged heirs are children of Jim?

(a) Mary's child (b) both are children of Jim
(c) Lou's child (d) none are children of Jim

QUESTION PAPER ENDS HERE

ROUGH WORK BELOW THIS LINE