

TEST PAPER

KVPY-2019

Date : 03-11-2019

Time Allowed: 3 Hrs.

Maximum Marks: 100

KISHORE VAIGYANIK PRO TSAHAN YOJANA STREAM (SA)

INSTRUCTIONS FOR MARKING ON ANSWER SHEET

1. Immediately fill the particulars on this page of the Test Booklet with Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The Test Booklet consists of **80** questions.
3. There are Two parts in the question paper. The distribution of marks subjectwise in each part is as under for each correct response.

MARKING SCHEME :

PART-I

MATHEMATICS

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

PHYSICS

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

CHEMISTRY

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

BIOLOGY

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

PART-II

MATHEMATICS

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

PHYSICS

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

CHEMISTRY

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

BIOLOGY

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

4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. for Part-I **0.25** marks will be deducted for indicating incorrect response of each question and for Part-II **0.50** marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the Answer sheet.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, paper, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page.
7. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
8. Do not fold or make any stray marks on the Answer Sheet.

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PART-I

One Mark Questions

MATHEMATICS

Choose the correct (✓) answer:

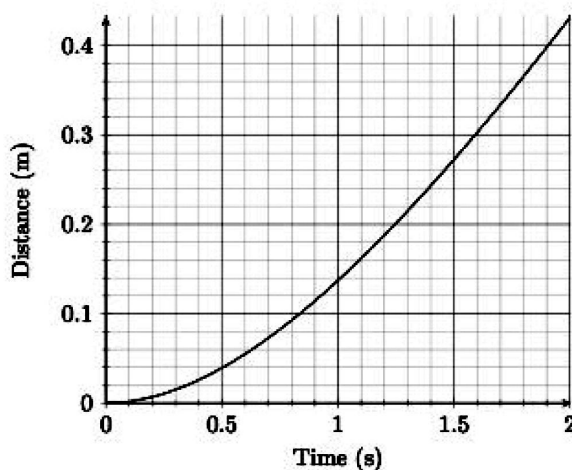
1. Let ABC be an equilateral triangle with side length a. Let R and r denote the radii of the circumcircle and the incircle of triangle ABC respectively. Then, as a function of a, the ratio $\frac{R}{r}$
 - (1) strictly increases
 - (2) strictly decreases
 - (3) remains constant
 - (4) strictly increases for $a < 1$ and strictly decreases for $a > 1$
2. Let b be a non-zero real number. Suppose the quadratic equation $2x^2 + bx + \frac{1}{b} = 0$ has two distinct real roots. Then
 - (1) $b + \frac{1}{b} > \frac{5}{2}$
 - (2) $b + \frac{1}{b} < \frac{5}{2}$
 - (3) $b^2 - 3b > -2$
 - (4) $b^2 + \frac{1}{b^2} < 4$
3. Let $p(x) = x^2 + ax + b$ have two distinct real roots, where a, b are real numbers. Define $g(x) = p(x^3)$ for all real number x. Then which of the following statements are true?
 - I. g has exactly two distinct real roots
 - II. g can have more than two distinct real roots
 - III. There exists a real number α such that $g(x) \geq \alpha$ for all real x
 - (1) Only I
 - (2) Only I and III
 - (3) Only II
 - (4) Only II and III
4. Let $a_n, n \geq 1$, be an arithmetic progression with first term 2 and common difference 4. Let M_n be the average of the first n terms. Then the sum $\sum_{n=1}^{10} M_n$ is :
 - (1) 110
 - (2) 335
 - (3) 770
 - (4) 1100
5. In a triangle ABC, $\angle BAC = 90^\circ$; AD is the altitude from A on to BC. Draw DE perpendicular to AC and DF perpendicular to AB. Suppose AB = 15 and BC = 25. Then the length of EF is
 - (1) 12
 - (2) 10
 - (3) $5\sqrt{3}$
 - (4) $5\sqrt{5}$
6. The sides a, b, c of a triangle satisfy the relations $c^2 = 2ab$ and $a^2 + c^2 = 3b^2$. Then the measure of $\angle BAC$, in degrees, is :
 - (1) 30
 - (2) 45
 - (3) 60
 - (4) 90
7. Let N be the least positive integer such that whenever a non-zero digit c is written after the last digit of N, the resulting number is divisible by c. The sum of the digits of N is :
 - (1) 9
 - (2) 18
 - (3) 27
 - (4) 36
8. Let x_1, x_2, \dots, x_{11} be 11 distinct positive integers. If we replace the largest of these integers by the median of the other 10 integers, then
 - (1) the median remains the same
 - (2) the mean increases
 - (3) the median decreases
 - (4) the mean remains the same
9. The number of cubic polynomials P(x) satisfying $P(1) = 2, P(2) = 4, P(3) = 6, P(4) = 8$ is :
 - (1) 0
 - (2) 1
 - (3) More than one but finitely many
 - (4) infinitely many

Space For Rough Work

10. A two-digit number \overline{ab} is called almost prime if one obtains a two-digit prime number by changing at most one of its digits a and b . (For example, 18 is an almost prime number because 13 is a prime number). Then the number of almost prime two-digit numbers is :
- (1) 56 (2) 75
(3) 87 (4) 90
11. Let P be an interior point of a convex quadrilateral $ABCD$ and K, L, M, N be the midpoints of AB, BC, CD, DA respectively. If $\text{area}(PKAN) = 25$, $\text{area}(PLBK) = 36$, and $\text{area}(PMDN) = 41$ then $\text{area}(PLCM)$ is :
- (1) 20 (2) 29
(3) 52 (4) 54
12. The number of non-negative integer solutions of the equations $6x + 4y + z = 200$ and $x + y + z = 100$ is :
- (1) 3 (2) 5
(3) 7 (4) Infinite
13. Let $N_1 = 2^{55} + 1$ and $N_2 = 165$. Then
- (1) N_1 and N_2 are coprime
(2) the HCF (Highest Common Factor) of N_1 & N_2 is 55
(3) the HCF of N_1 and N_2 is 11
(4) the HCF of N_1 and N_2 is 33
14. Let $\ell > 0$ be a real number, C denote a circle with circumference ℓ , and T denote a triangle with perimeter ℓ . Then
- (1) given any positive real number α , we can choose C and T as above such that the ratio $\frac{\text{Area}(C)}{\text{Area}(T)}$ is greater than α
(2) given any positive real number α , we can choose C and T as above such that the ratio $\frac{\text{Area}(C)}{\text{Area}(T)}$ is less than α
(3) given any C and T as above, the ratio $\frac{\text{Area}(C)}{\text{Area}(T)}$ is independent of C and T
(4) there exist real numbers a and b such that for any circle C and triangle T as above, we must have $a < \frac{\text{Area}(C)}{\text{Area}(T)} < b$
15. The number of three digit numbers abc such that the arithmetic mean of b and c and the square of their geometric mean area equal is :
- (1) 9 (2) 18
(3) 36 (4) 54

PHYSICS

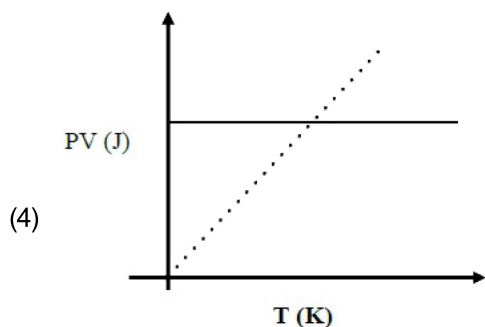
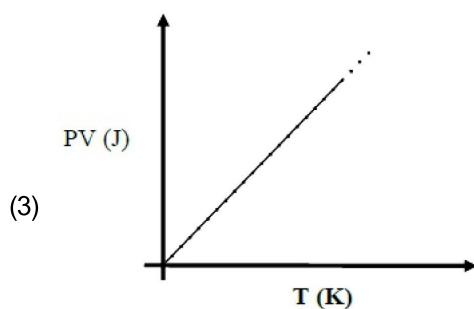
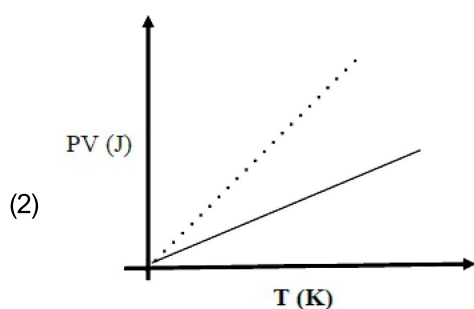
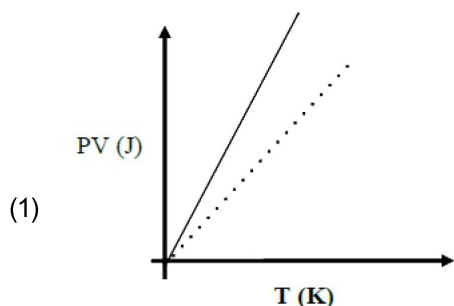
16. Various optical processes are involved in the formation of a rainbow. Which of the following provides the correct order in time in which these processes occur ?
- (1) Refraction, total internal reflection, refraction.
(2) Total internal reflection, refraction, total internal reflection.
(3) Total internal reflection, refraction, refraction.
(4) Refraction, total internal reflection, total internal reflection.
17. A specially designed Vernier caliper has the main scale least count of 1 mm. On the Vernier scale there are 10 equal divisions and they match with 11 main scale divisions. Then, the least count of the Vernier caliper is :
- (1) 0.1 mm (2) 0.909 mm
(3) 1.1 mm (4) 0.09 mm
18. A steel ball is dropped in viscous liquid. The distance of the steel ball from the top of the liquid is shown below. The terminal velocity of the ball is closest to :



- (1) 0.26 m/s (2) 0.33 m/s
(3) 0.45 m/s (4) 0.21 m/s

Space For Rough Work

27. Which one of the following schematic graphs best represents the variation of PV (in Joules) versus T (in Kelvin) of one mole of an ideal gas? (the dotted line represents $PV = T$)



28. Mumbai needs 1.4×10^{12} litres of water annually. Its effective surface area is 600 km^2 and it receives an average rainfall of 2.4 m annually. If 10% of this rain water is conserved it will meet approximately :

- (1) 1% of Mumbai's water needs
- (2) 10% of Mumbai's water needs
- (3) 50% of Mumbai's water needs
- (4) 100% of Mumbai's water needs

29. A Mass M moving with a certain speed V collides elastically with another stationary mass m . After the collision the masses M and m move with speeds V' and v respectively. All motion is in one dimension. then:

- (1) $V = V' + v$
- (2) $V' = V + v$
- (3) $V' = (V + v)/2$
- (4) $v = V + V'$

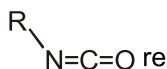
30. Four rays, 1, 2, 3 and 4 are incident normally on the face PQ of an isosceles prism PQR with apex angle $\angle Q = 120^\circ$. The refractive indices of the material of the prism for the above rays 1, 2, 3 and 4 are 1.85, 1.95, 2.05 and 2.15, respectively and the surrounding medium is air. Then the rays emerging from the face QR are :

- (1) 4 only
- (2) 1 and 2 only.
- (3) 3 and 4 only
- (4) 1, 2, 3 and 4

Space For Rough Work

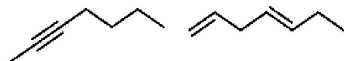
CHEMISTRY

31. The hybridization of N, C and O shown in the following

compound  respectively, are.

- (1) sp^2 , sp , sp^2 (2) sp^2 , sp^2 , sp^2
 (3) sp^2 , sp , sp (4) sp , sp , sp^2

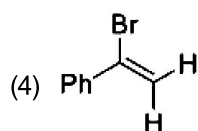
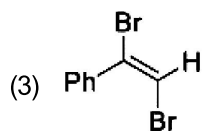
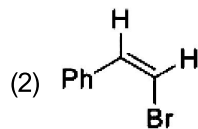
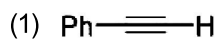
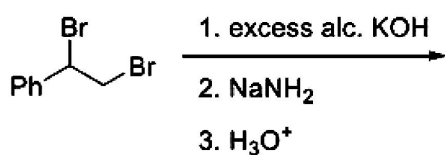
32. The following compounds



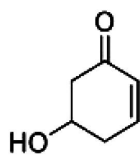
are :

- (1) geometrical isomers (2) positional isomers
 (3) optical isomers (4) functional group isomers

33. The major product of the following reaction



34. IUPAC name of the following compound



is :

- (1) 1-hydroxycyclohex-4-en-3-one
 (2) 1-hydroxycyclohex-3-en-5-one
 (3) 3-hydroxycyclohex-5-en-1-one
 (4) 5-hydroxycyclohex-2-en-1-one

35. In water-gas shift reaction, hydrocarbon gas is produced from the reaction of steam with

- (1) methane (2) coke
 (3) carbon monoxide (4) carbon dioxide

36. Treatment with lime can remove hardness of water caused by

- (1) $CaCl_2$ (2) $CaSO_4$
 (3) $Ca(HCO_3)_2$ (4) $CaCO_3$

37. The most polarizable ion among the following is

- (1) F^- (2) I^-
 (3) Na^+ (4) Cl^-

38. For a multi-electron atom, the highest energy level among the following is

- (1) $n = 5, l = 0, m = 0, s = +\frac{1}{2}$
 (2) $n = 4, l = 2, m = 0, s = +\frac{1}{2}$
 (3) $n = 4, l = 1, m = 0, s = +\frac{1}{2}$
 (4) $n = 5, l = 1, m = 0, s = +\frac{1}{2}$

39. The oxide which is neither acidic nor basic is:

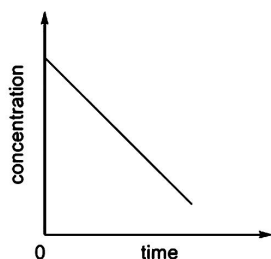
- (1) As_2O_3
 (2) Sb_4O_{10}
 (3) N_2O
 (4) Na_2O

40. The element whose salts cannot be detected by flame test is

- (1) Mg (2) Na
 (3) Cu (4) Sr

Space For Rough Work

41. The plot of concentration of a reactant vs. time for a chemical reaction is shown below :



The order of this reaction with respect to the reactant is

- (1) 0
 (2) 1
 (3) 2
 (4) not possible to determine from this plot
42. During the free expansion of an ideal gas in an isolated chamber,
- (1) Internal energy remains constant
 (2) Internal energy decreases
 (3) Work done on the system is negative
 (4) Temperature increases

43. The number of moles of water present in a spherical water droplet of radius 1.0 cm is :

[Given: density of water in the droplet = 1.0 g cm^{-3}]

- (1) $\frac{\pi}{18}$ (2) $\frac{2\pi}{27}$
 (3) 24π (4) $\frac{2\pi}{9}$
44. Among the following, the correct statement about cathode ray discharge tube is
- (1) the electrical discharge can only be observed at high pressure and at low voltages
 (2) in the absence of external electrical or magnetic field, cathode rays travel in straight lines
 (3) the characteristics of cathode rays depend upon the material of electrodes
 (4) the characteristics of cathode rays depend upon the gas present in the cathode ray tube
45. For a spontaneous process
- (1) enthalpy change of the system must be negative
 (2) entropy change of the system must be positive
 (3) entropy change of the surrounding must be positive
 (4) entropy change of the system plus surrounding must be positive

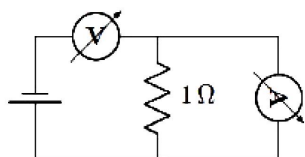
BIOLOGY

46. Which one of the following is a CORRECT statement about primate evolution ?
- (1) Chimpanzees and gorillas evolved from macaques
 (2) Humans and chimpanzees evolved from gorillas
 (3) Humans, chimpanzees and gorillas evolved from a common ancestor
 (4) Humans and gorillas evolved from chimpanzees
47. The crypts of Lieberkühn are found in which one of the following parts of the human digestive tract?
- (1) Oesophagus (2) Small intestine
 (3) Stomach (4) Rectum
48. Removal of the pancreas impairs the breakdown of
- (1) lipids and carbohydrates only
 (2) lipids and proteins only
 (3) lipids, proteins and carbohydrates
 (4) proteins and carbohydrates only
49. Microscopic examination of a blood smear reveals an abnormal increase in the number of granular with multiple nuclear lobes. Which one of the following cell types has increased in number ?
- (1) Lymphocytes (2) Monocytes
 (3) Neutrophils (4) Thrombocytes

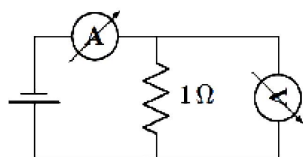
Space For Rough Work

- 50.** Which one of the following genetic phenomena is represented by the blood group AB ?
- (1) Codominance (2) Dominance
(3) Overdominance (4) Semidominance
- 51.** The mode of speciation mediated by geographical isolation is referred to as
- (1) adaptive radiation (2) allopatric speciation
(3) parapatric speciation (4) sympatric speciation
- 52.** Which one of the following metabolic conversion requires oxygen?
- (1) Glucose to pyruvate
(2) Glucose to CO₂ and ethanol
(3) Glucose to lactate
(4) Glucose to CO₂ and H₂O
- 53.** Where are the proximal and distal convoluted tubules located within the human body?
- (1) Adrenal cortex (2) Adrenal medulla
(3) Renal cortex (4) Renal medulla
- 54.** In a diploid organism, when the locus X is inactivated, transcription of the locus Y is triggered. Based on observation. Which one of the following statements is CORRECT?
- (1) X is dominant over Y (2) X is epistatic to Y
(3) Y is dominant over X (4) Y is epistatic to X
- 55.** Which one of the following sequences represents the CORRECT taxonomical hierarchy?
- (1) Species, genus, family, order
(2) Order, genus, family, species
(3) Species, order, genus family
(4) Species, genus, order, family
- 56.** Which one of the following organs is NOT a site for the production of white blood cells?
- (1) Bone marrow (2) Kidney
(3) Liver (4) Spleen
- 57.** Which one of the following anatomical structures is involved in guttation?
- (1) Cuticle (2) Hydathodes
(3) Lenticels (4) Stomata
- 58.** Which one of the following parts of the eye is affected in cataract ?
- (1) Cornea (2) Conjunctiva
(3) Retina (4) Lens
- 59.** Which one of the following organism is a bryophyte ?
- (1) Liverwort (2) Volvox
(3) Chlamydomonas (4) Fern
- 60.** During oogenesis in mammals, the second meiotic division occurs
- (1) Before fertilization (2) After implantation
(3) Before ovulation (4) After fertilization

68. A student uses the resistance of a known resistor (1Ω) to calibrate a voltmeter and an ammeter using the circuits shown below. The student measures the ratio of the voltage to current to be $1 \times 10^3 \Omega$ in circuit (a) and 0.999Ω in circuit (b). From these measurements, the resistances (in Ω) of the voltmeter and ammeter are found to be close to :



(a)



(b)

- (1) 10^2 and 10^{-2} (2) 10^3 and 10^{-3}
 (3) 10^{-2} and 10^2 (4) 10^{-3} and 10^3

69. A hot air balloon with a payload rises in the air. Assume that the balloon is spherical in shape with diameter of 11.7 m and the mass of the balloon and the payload (without the hot air inside) is 210 kg. Temperature and pressure of outside air are 27°C and $1\text{ atm} = 10^5\text{ N/m}^2$ respectively. Molar mass of dry air is 30 g. The temperature of the hot air inside is close to, [The gas constant $R = 8.31\text{ J/K/mol}$]

- (1) 27°C (2) 52°C
 (3) 105°C (4) 171°C

70. A healthy adult of height 1.7 m has an average blood pressure (BP) of 100 mm of Hg. The heart is typically at a height of 1.3 m from the foot. Take the density of blood to be 10^3 kg/m^3 and note that 100 mm of Hg is equivalent to 13.3 kPa (kilo Pascals). The ratio of BP in the foot region to that in the head region is close to:

- (1) one (2) two
 (3) three (4) four

CHEMISTRY

71. PbO_2 is obtained from

- (1) the reaction of PbO with HCl
 (2) thermal decomposition of $\text{Pb}(\text{NO}_3)_2$ at 200°C
 (3) the reaction of Pb_3O_4 with HNO_3
 (4) the reaction of Pb with air at room temperature

72. For one mole of van der Waals gas, the compressibility

factor $Z = \left(\frac{PV}{RT}\right)$ at a fixed volume will certainly decrease if

[Given: "a", "b" are standard parameters for van der Waals gas]

- (1) "b" increases and "a" decreases at constant temperature
 (2) "b" decreases and "a" increases at constant temperature
 (3) temperature increases at constant "a" and "b" values
 (4) "b" increases at constant "a" and temperature

73. The correct statement among the following

- (i) $E_{2s}(\text{H}) > E_{2s}(\text{Li}) > E_{2s}(\text{Na}) > E_{2s}(\text{K})$
 (ii) The maximum number of electrons in the shell with principal quantum number n is equal to $2n^2$
 (iii) Extra stability of half-filled subshell is due to smaller exchange energy
 (iv) Only two electrons, irrespective of their spin, may exist in the same orbital are
- (1) (i) and (ii) (2) (ii) and (iii)
 (3) (iii) and (iv) (4) (i) and (iv)

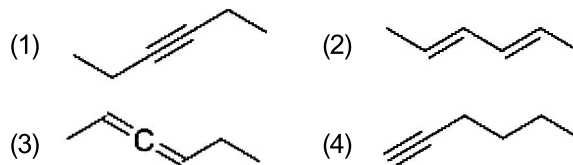
74. An organic compound contains 46.78% of a halogen X. When 2.00 g of this compound is heated with fuming HNO_3 in the presence of AgNO_3 , 2.21 g AgX was formed. The halogen X is

[Given: atomic weight of $\text{Ag} = 108$, $\text{F} = 19$, $\text{Cl} = 35.5$, $\text{Br} = 80$, $\text{I} = 127$]

- (1) F (2) Cl
 (3) Br (4) I

Space For Rough Work

75. An organic compound X with molecular formula C_6H_{10} , when treated with HBr, forms a gem dibromide. The compound X upon warming with $HgSO_4$ and dil. H_2SO_4 , produces a ketone which gives a positive iodoform test. The compound X is:



BIOLOGY

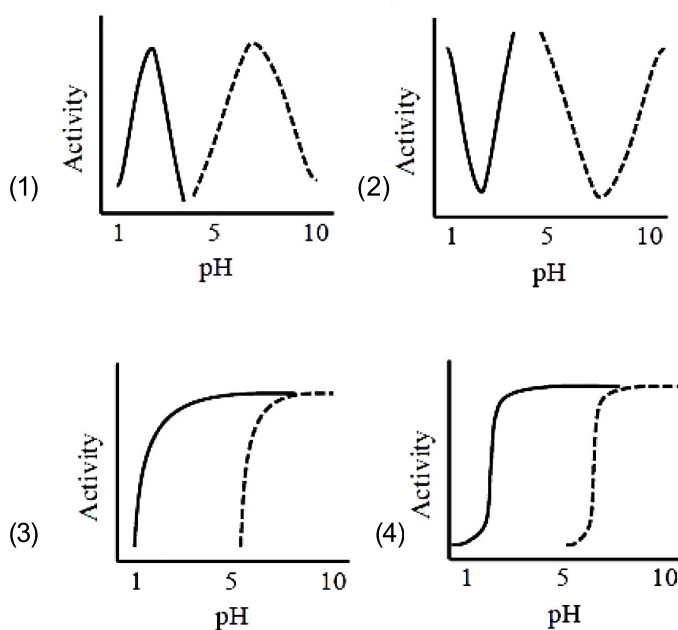
76. A cell weighing 1 mg grows to double its initial mass before dividing into two daughter cells of equal mass. Assuming no death, at the end of 100 divisions what will be the ratio of the mass of the entire population of these cells to that of the mass of the Earth? Assume that mass of the Earth is 10^{24} kg and 2^{10} is approximately equal to 1000.

- (1) 10^{-28} (2) 10^{-3}
 (3) 1 (4) 10^3

77. Papaya is a dioecious species with XY sexual genotype for male and XX for female. What will be the genotype of the embryos and endosperm nuclei after double fertilization?

- (1) 50% ovules would have XXX endosperm and XY embryo, while the other 50% would have XXY endosperm and XX embryo
 (2) 100% ovules would have XXX endosperm and XY embryo
 (3) 100% ovules would have XXY endosperm and XX embryo
 (4) 50% ovules would have XXX endosperm and XX embryo, while the other 50% ovules would have XXY endosperm and XY embryo

78. Solid and dotted lines represent the activities of pepsin and salivary amylase enzymes of the digestive tract, respectively. Which of the following graphs best represents their activity vs pH?



79. If the gene pool of the locus X in the human genome is 4, then what would be the highest possible number of genotypes in a large population?

- (1) 6 (2) 8 (3) 10 (4) 16

80. Match the plant hormones in Column I with their primary function in column II :

Column I	Column II
P. Abscisic acid	i) Promotes disease resistance
Q. Ethylene	ii) Maintains seed dormancy
R. Cytokinin	iii) Promotes seed germination
S. Gibberellin	iv) Promotes fruit ripening
	v) Inhibits leaf senescence
(1) P-iii, Q-iv, R-i, S-ii	(2) P-ii, Q-iv, R-v, S-iii
(3) P-v, Q-iii, R-ii, S-i	(4) P-iv, Q-ii, R-iii, S-v

Space For Rough Work

ANSWERS
KVPY-SA-2019

1. (3)	14. (1)	27. (1)	40. (1)	53. (3)	66. (3)	79. (3)
2. (3)	15. (2)	28. (2)	41. (1)	54. (4)	67. (1)	80. (2)
3. (2)	16. (1)	29. (4)	42. (1)	55. (1)	68. (2)	
4. (1)	17. (1)	30. (3)	43. (2)	56. (2)	69. (3)	
5. (1)	18. (2)	31. (1)	44. (2)	57. (2)	70. (3)	
6. (2)	19. (3)	32. (4)	45. (4)	58. (4)	71. (3)	
7. (1)	20. (3)	33. (1)	46. (3)	59. (1)	72. (2)	
8. (3)	21. (4)	34. (4)	47. (2)	60. (4)	73. (1)	
9. (1)	22. (4)	35. (3)	48. (3)	61. (3)	74. (3)	
10. (4)	23. (1)	36. (3)	49. (3)	62. (1)	75. (4)	
11. (3)	24. (3)	37. (2)	50. (1)	63. (1)	76. (3)	
12. (3)	25. (1)	38. (4)	51. (2)	64. (2)	77. (4)	
13. (4)	26. (4)	39. (3)	52. (4)	65. (2)	78. (1)	