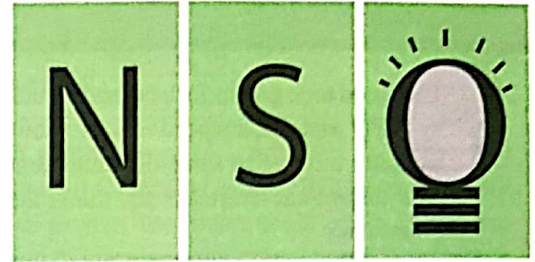# CLASS 11

LEVEL 2

NSO

SOF NATIONAL SCIENCE OLYMPIAD 2019-20

DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Total Questions: 50 | Time: 1 hr.

Guidelines for the Candidate

1. You will get additional ten minutes to fill up information about yourself on the OMR Sheet, before the start of the exam.
2. Write your **Name, School Code, Class, Section, Roll No.** and **Mobile Number** clearly on the **OMR Sheet** and do not forget to sign it. We will share your marks / result and other information related to SOF exams on your mobile number.
3. In the school code column in the OMR Sheet, please fill in code allocated to your school and not the exam center code.
4. The Question Paper comprises three sections :
   Section - 1: **Physics & Chemistry** (25 Questions)
   Section - 2: **Achievers Section** (5 Questions)
   Section - 3 : **Mathematics** (20 Questions) or **Biology** (20 Questions)
5. **Section-1 and 2 are compulsory for all.** In Section-3 opt for Mathematics OR Biology and mark the same on the OMR Sheet.
   Each question in Achievers Section carries 3 marks, whereas all other questions carry one mark each.
6. All questions are compulsory. There is no negative marking. Use of calculator / smart phone is not permitted.
7. There is only ONE correct answer. Choose only ONE option for an answer.
8. To mark your choice of answers by darkening the circles on the OMR Sheet, use **HB Pencil** or **Blue / Black ball point pen** only. E.g.

   Q.16: In the water cycle, condensation is the process of
   A. Water vapour cooling down and turning into a liquid
   B. Ice warming up and turning into a liquid
   C. Liquid cooling down and turning into ice
   D. Liquid warming up and turning into water vapour

   As the correct answer is option A, you must darken the circle corresponding to option A in the OMR Sheet. | 16. ● Ⓑ Ⓒ Ⓓ |
9. Rough work should be done in the blank space provided in this booklet.
10. Please fill in your personal details in the space provided on this page before attempting the paper.
11. **RETURN THE OMR SHEET AND QUESTION PAPER TO THE INVIGILATOR AT THE END OF THE EXAM.**

SOF

SCIENCE OLYMPIAD FOUNDATION
Inspiring Young Minds Through Knowledge Olympiads

Name:...

Section:.......... SOF Olympiad Roll No.:.. Contact No.:...

1. The speed time graphs for a car and a truck are represented by OPQ and RS, respectively as shown in the figure. Both are moving in same direction along straight path. At a instant car overtakes the truck, then
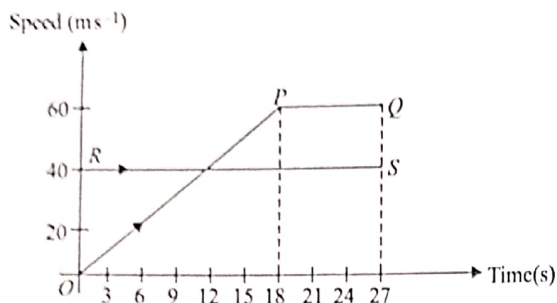
A. At $t = 18$ s, the car and truck are 180 m apart
B. At $t = 18$ s, the car and truck are 360 m apart
C. The relative distance between car and truck reduces to zero at $t = 27$ s and both are 1080 m far from origin
D. Both A and C.

2. A ball is thrown into the air and it moves along the path shown here. Ignore air resistance in this question. At point P the ball is at the highest point in its path and point Q is its position just before it hits the ground. Which of the following statements is true?
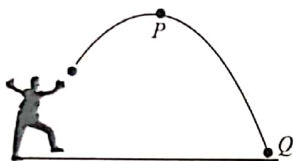
A. The speed of the ball at P is zero and the acceleration of the ball at Q is the same as that at P.
B. The speed of the ball at P is the same as the speed at Q and the acceleration at Q is higher than that at P.
C. The speed at P is lower than the speed at Q and the acceleration at P is higher than the acceleration at Q.
D. The speed at P is lower than the speed at Q and the acceleration at P is the same as the acceleration at Q.

3. Find the minimum vertical force F required to pull a thin wire ring up as shown in the figure, which is initially resting on a horizontal water surface. The circumference of the ring is 30 cm and its weight is 0.2 N. The surface tension of water is 70 dyne cm^{-1}.
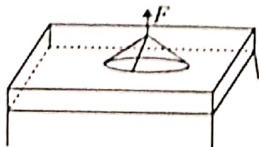
A. 0.325 N
B. 0.293 N
C. 0.30 N
D. None of these

4. A wedge of mass $M = 4m$ lies on a frictionless plane. A particle of mass m approaches the wedge with speed 2.5 m s^{-1} from the inclined side. There is no friction between the particle and the plane or between the particle and the wedge. The maximum height climbed by the particle on the wedge is given by (Take $g = 10$ m s^{-2})

A. 0.625 m
B. 0.250 m
C. 0.312 m
D. 0.18 m

5. One end of a taut string of length 3 m along the x-axis is fixed at $x = 0$. The speed of the waves in the string is 100 m s^{-1}. The other end of the string is vibrating in the y direction so that stationary waves are set up in the string. The possible waveform of these stationary waves is

A. $y(t) = A\sin\dfrac{\pi x}{3}\cos\dfrac{50\pi t}{3}$

B. $y(t) = A\sin\dfrac{\pi x}{3}\cos\dfrac{100\pi t}{3}$

C. $y(t) = A\sin\dfrac{5\pi x}{6}\cos\dfrac{250\pi t}{6}$

D. None of these

6. The quantity $[(rh)/(2\pi qB)]$ has the dimensions of (Here r is a positive integer, h is Planck's constant, q is charge and B is magnetic field.)

A. Area
B. Speed
C. Length
D. Acceleration

7. Two discs A and B are mounted coaxially on a vertical axle, have moments of inertia I and $2I$ respectively about the common axis. Disc A is imparted an initial angular velocity 2ω and kinetic energy K_A using the entire potential energy of a spring compressed by a distance x_1. Disc B is imparted an angular velocity ω and kinetic energy K_B by the same spring compressed by a distance x_2. Both the discs rotate in the clockwise direction initially. When disc B is brought in contact with disc A, they acquire a common angular velocity in time t. The average frictional torque on one disc by the other during this period and the new kinetic energy acquired by the system are respectively

A. $\dfrac{2I\omega}{3t}$ and $\dfrac{8}{3}K_B$

B. $\dfrac{9I\omega}{2t}$ and $\dfrac{8}{3}K_B$

C. $\dfrac{9I\omega}{4t}$ and $\dfrac{4}{3}K_A$

D. $\dfrac{3I\omega}{2t}$ and $\dfrac{4}{3}K_A$

8. The temperature of the water of pond is 0°C while that of the surrounding atmosphere is –20°C. If the density of ice is ρ, coefficient of thermal conductivity is k and latent heat of melting is L, then the thickness Z of ice layer formed increases as function of time t as

A. $Z^2 = \dfrac{60k}{\rho L}t$

B. $Z = \sqrt{\dfrac{40k}{\rho L}t}$

C. $Z^2 = \dfrac{40k}{\rho L}\sqrt{t}$

D. $Z^2 = \dfrac{20k}{\rho L}t$

9. A horizontal tube of length 1 m closed at both ends contains an ideal gas of molecular weight M. The tube is rotated at a constant angular velocity 2 rad/s about a vertical axis passing through an end. Assuming T be the temperature of gas and it is uniform and constant. P_2 and P_1 denote the pressures at the free end and the fixed end respectively. R is the gas constant. Choose the correct relation.

A. $P_2 = P_1\left(\dfrac{2M}{RT}\right)$

B. $P_2 = P_1\left(\dfrac{2RT}{M}\right)$

C. $P_2 = P_1\, e^{\left(\dfrac{2M}{RT}\right)}$

D. $P_2 = P_1\, e^{\left(\dfrac{M}{2RT}\right)}$

10. The driver of a train moving with a constant speed v_1 along a straight track sights another train at a distance d ahead of him on the same track moving in the same direction with a constant speed v_2. He at once applies the brakes and gives his train a constant retardation f. There will be a collision of the trains if

A. $v_1 > v_2$ and $\dfrac{(v_1 - v_2)^2}{2f} < d$

B. $v_1 < v_2$ and $\dfrac{(v_1 + v_2)^2}{2f} > d$

C. $v_1 > v_2$ and $\dfrac{(v_1 - v_2)^2}{2f} > d$

D. $v_1 > v_2$ and $\dfrac{(v_1^2 - v_2^2)}{2f} > d$

11. Pitch of a screw gauge is 1 mm and there are 100 divisions on its circular scale. While measuring diameter of a wire, the linear scale reads 1 mm and 45th division of circular scale coincides with reference line of main scale. Length of wire measured by metre scale is 5.0 cm. The curved surface area of the wire to correct significant figure is

A. 2.32 cm^2

B. 2.3 cm^2

C. 23.2 cm^2

D. None of these

12. A rigid cubical block of mass $2M$ and side $2L$ is fixed rigidly on a surface. Its modulus of rigidity is η. A small force F is applied tangential to the upper face of the block. After the force is withdrawn, the block executes small oscillations, time period of which is given by

A. $2\pi\sqrt{M\eta L}$

B. $2\pi\sqrt{\dfrac{M\eta}{L}}$

C. $2\pi\sqrt{\dfrac{ML}{\eta}}$

D. $2\pi\sqrt{\dfrac{M}{\eta L}}$.

13. The specific heat c of a solid at low temperature shows temperature dependence according to the relation $c = DT^3$, where D is a constant in SI units and T is the temperature in kelvin. A piece of this solid of mass m kg is taken and its temperature is raised from 10 K to 20 K. The amount of heat (in SI units) required in the process is

A. $5 \times 10^4\, Dm$

B. $(33/4) \times 10^4\, Dm$

C. $(15/4) \times 10^4\, Dm$

D. $(5/4) \times 10^4\, Dm$

CHEMISTRY

14. Correct matching amongst the following is

I. Linear - H_2O, SO_2, N_3^-
II. V-shaped - $:CH_2$, $SnCl_2$, O_3
III. See Saw - SF_4, $TeCl_4$, XeO_2F_2
IV. T-shaped - ICl_3, ClF_3, $XeOF_2$

A. I only

B. I and II only

C. III only

D. II, III and IV only.

15. Arrange the following into increasing order of number of molecules.

I. 36 g of water
II. 28 g of carbon monoxide
III. 115 g of ethyl alcohol
IV. 18 g of dimethyl ether
V. 54 g of nitrogen pentoxide

A. III < I < II < V < IV

B. V < I < IV < III < II

C. II < III < I < V < IV

D. IV < V < II < I < III

16. When electromagnetic radiation of wavelength 3500 Å falls on a metal surface, electrons are emitted with a kinetic energy of 1.91×10^5 J mol^{-1}. The threshold frequency to remove an electron will be

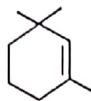A. 3.78×10^{14} s^{-1}

B. 2.5×10^{-19} s^{-1}

C. 6.73×10^{-8} s^{-1}

D. 4.57×10^{12} s^{-1}

17. Which of the following statements is/are incorrect?

    I. Acetaldehyde on reaction with HCN gives racemic mixture.

    II. The IUPAC name of [structure] is 1,1,3-trimethylcyclohex-2-ene.

    III. The correct order of reactivity towards electrophilic substitution is $C_6H_5CH_3 > C_6H_6 > C_6H_5Cl > C_6H_5NO_2$.

    IV. $(Me_3CCO)_3CH$ does not exhibit tautomerism.

    A. I and III only
    B. II and IV only
    C. IV only
    D. None of these

18. Some of the orders are given below for the properties mentioned.

    I. $BCl_3 > AlCl_3 > GaCl_3$: Lewis acid character
    II. $KI < KCl < NaCl < LiCl$: Lattice enthalpy
    III. $GeCl_2 > SnCl_2 > PbCl_2$: Reducing character
    IV. $CaCO_3 > NaHCO_3 > KHCO_3$: Solubility

    The correct one(s) is/are

    A. I and III only
    B. IV only
    C. I, II and III only
    D. I, II, III and IV

19. Classify the following compounds into aromatic, non-aromatic and anti-aromatic compounds.

    (i)   (ii)   (iii)   (iv)   (v)   (vi)
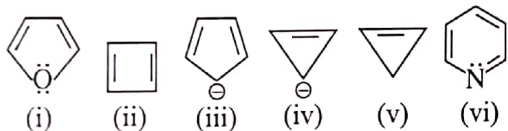
	Aromatic	Non-aromatic	Anti-aromatic
A.	(i) and (iv)	(iii) and (v)	(ii) and (vi)
B.	(i), (iii) and (vi)	(v)	(ii) and (iv)
C.	(ii) and (v)	(iv) and (vi)	(i) and (iii)
D.	(i), (iii) and (vi)	(ii) and (v)	(iv)

20. Using the standard electrode potential, find out the pair(s) between which redox reaction(s) is/are feasible.

    (Given : $E°$ values : $Fe^{3+}/Fe^{2+} = +0.77$; $I_2/I^- = +0.54$; $Cu^{2+}/Cu = +0.34$; $Ag^+/Ag = +0.80$ V)

    I. Fe^{3+} and I^-
    II. Ag^+ and Cu
    III. Fe^{3+} and Cu
    IV. Ag and Fe^{3+}

    A. IV only
    B. I, II and III only
    C. II and III only
    D. I, II, III and IV

21. The internal energy change when a system goes from state 'P' to 'Q' is 40 kJ/mole. If the system goes from 'P' to 'Q' by a reversible path and returns to state 'P' by an irreversible path, what would be the net change in internal energy?

    A. 40 kJ
    B. > 40 kJ
    C. < 40 kJ
    D. Zero

22. Which of the following properties would you predict for a hydrocarbon with the structural formula given below?

    [structure: $CH=CH_2$ on benzene ring]
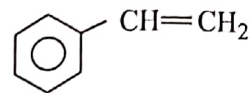
    I. Liquid at room temperature.
    II. Decolourises aqueous bromine.
    III. Undergoes addition polymerisation.

    A. II and III only
    B. I and III only
    C. I, II and III
    D. I and II only

23. Read the given passage and fill in the blanks by selecting an appropriate option.

    A mixture of SO_3, SO_2 and O_2 gases is maintained at equilibrium in 10 L flask at a temperature at which K_c for the reaction, $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ is 100 mol^{-1} L. At equilibrium,

    I. if number of moles of SO_3 and SO_2 in the flask are same, moles of O_2 present are __p__.

    II. if number of moles of SO_3 in the flask are twice the number of moles of SO_2, moles of O_2 present are __q__.

    p and q are respectively

    A. 0.1 mol and 0.4 mol
    B. 2 mol and 5 mol
    C. 0.4 mol and 0.1 mol
    D. 0.7 mol and 0.3 mol.

24. Match column I with column II and select the correct option from the codes given below.

Column I (Hydride)	Column II (Type of hydride)
(a) BeH_2	1. Complex
(b) AsH_3	2. Interstitial
(c) LaH_3	3. Covalent
(d) $LiAlH_4$	4. Intermediate

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

25. In the given graph, a periodic property (R) is plotted against atomic numbers (Z) of the elements. Which property is shown in the graph and how it is correlated with reactivity of the elements?
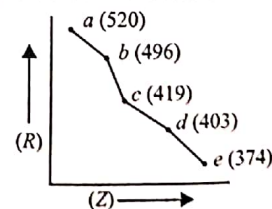

    A. Ionisation enthalpy in a group, reactivity decreases from $a \rightarrow e$.
    B. Ionisation enthalpy in a group, reactivity increases from $a \rightarrow e$.
    C. Atomic radius in a group, reactivity decreases from $a \rightarrow e$.
    D. Metallic character in a group, reactivity increases from $a \rightarrow e$.

Direction (Q.No. 26 and 27): Read the given passage and answer the following questions.

When a sodium salt (X) is treated with dilute H_2SO_4, a colourless gas (Y) is liberated. This gas (Y) turns lime water milky and a burning magnesium ribbon continues to burn when shown to it giving a residue (Z). This residue dissolves in dilute HCl leaving a black mass.

26. The salt 'X" and the residue 'Z' are respectively

   A. Na_2SO_3 and $MgSO_4$
   B. Na_2CO_3 and MgO, C
   C. $NaHSO_3$ and S
   D. Na_2CO_3 and MgC.

27. At high temperature, the residue 'Z' gets reduced to

   A. Mg and CO_2
   B. $MgCO_3$
   C. $MgC + O_2$
   D. Mg and CO

28. If a 2 L flask of N_2 at 20°C and 70 cm pressure is connected with a 3 L flask of O_2 at same temperature and 100 cm pressure, the final pressure after the gases have thoroughly mixed at the same temperature will be __(i)__. The mole % of N_2 and O_2 in the resulting mixture will be __(ii)__ and __(iii)__ respectively. (The volume of stopcock may be neglected.)

	(i)	(ii)	(iii)
A.	1.158 atm	68.2%	31.8%
B.	0.368 atm	75.3%	24.7%
C.	1.158 atm	31.8%	68.2%
D.	0.79 atm	58.2%	41.8%

29. A boy is sitting on a seat of merry-go-round moving with a constant angular velocity. At $t = 0$, the boy is at position A as shown in the figure.
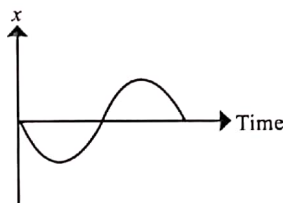

Top view of merry-go-round
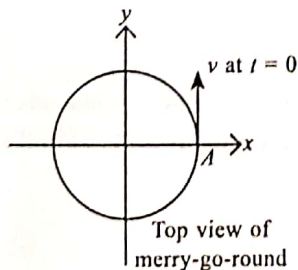
Which of the following graphs are correct?
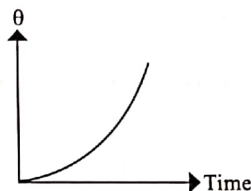
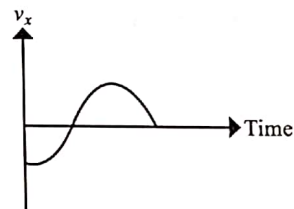A. F_y is the y-component of the force keeping the boy moving in a circle.
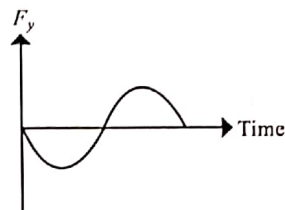
B. x is the x-components of the boy's position.

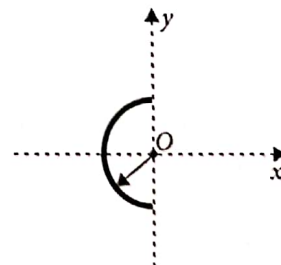C. θ is the angle that the position vector of the boy makes with the positive x-axis.

D. v_x is the x-components of the boy's velocity.

30. The figure shows a semicircle of mass 20 π kg and radius 1 m. Find the gravitational field intensity (in SI units) at centre O of the semicircle. (Here G is universal gravitational constant.)

   A. $40\,G$
   B. $20\,G$
   C. $4\,G$
   D. $2\,G$

31. If the roots of the equation $x^2 + x + 1 = 0$ are α, β, then the equation whose roots are α^{19}, β^7 is

    A. $x^2 - x + 1 = 0$
    B. $x^2 + x - 1 = 0$
    C. $x^2 + x + 1 = 0$
    D. $x^2 - x - 1 = 0$

32. Equation of the hyperbola with eccentricity $\dfrac{3}{2}$ and foci at $(\pm 2, 0)$ is

    A. $\dfrac{x^2}{4} - \dfrac{y^2}{5} = \dfrac{4}{9}$

    B. $\dfrac{x^2}{9} - \dfrac{y^2}{9} = \dfrac{4}{9}$

    C. $\dfrac{x^2}{4} - \dfrac{y^2}{9} = 1$

    D. None of these

33. In a town of 10,000 families, it was found that 40% family buy newspaper A, 20% buy newspaper B and 10% families buy newspaper C, 5% families buy A and B, 3% buy B and C and 4 % buy A and C. If 2% families buy all the three newspapers, then number of families which buy newspaper A only, is

    A. 3100
    B. 3300
    C. 2900
    D. 1400

34. If $x + iy = \sqrt{\dfrac{3+i}{1+3i}}$, then $(x^2 + y^2)^2$ equals

    A. 0
    B. 2
    C. 3
    D. 1

35. If the letters of the word SACHIN are arranged in all possible ways and these words are written in dictionary order, then the word SACHIN appears at serial number

    A. 600
    B. 601
    C. 602
    D. 603

36. If z_1 and z_2 are two complex numbers, then which of the following options is true?

    A. $2\left(|z_1|^2 + |z_2|^2\right) = |z_1 + z_2|^2 + |z_1 - z_2|^2$

    B. $\left|\dfrac{z_1 + z_2}{2} + \sqrt{z_1 z_2}\right| + \left|\dfrac{z_1 + z_2}{2} - \sqrt{z_1 z_2}\right| = |z_1| + |z_2|$

    C. $|z_1 + z_2|^2 - |z_1 - z_2|^2 = 2\left(z_1 \bar{z}_2 + \bar{z}_1 z_2\right)$

    D. All of these

37. Given that x is a real number satisfying $\dfrac{5x^2 - 26x + 5}{3x^2 - 10x + 3} < 0$, then

    A. $x < \dfrac{1}{5}$

    B. $\dfrac{1}{5} < x < 3$

    C. $x > 5$

    D. $\dfrac{1}{5} < x < \dfrac{1}{3}$ or $3 < x < 5$

38. The mean and S.D. of the marks of 200 candidates were found to be 40 and 15 respectively. Later, it was discovered that a score of 40 was wrongly read as 50. Find the correct mean and approx. S.D. respectively.

    A. 14.98, 39.95
    B. 39.95, 15.20
    C. 39.95, 224.5
    D. None of these

39. $\lim\limits_{x \to \frac{\pi}{4}} \dfrac{8 - \sqrt{2}(\sin x + \cos x)^5}{1 - \sin 2x} =$

    A. 8
    B. 10
    C. 12
    D. 6

40. The ratio in which the yz-plane divides the line segment joining the points $(-2, 4, 7)$ and $(3, -5, 8)$ is

    A. $2 : 3$
    B. $3 : 2$
    C. $4 : 5$
    D. None of these

41. Which of the following statements is a tautology?

A. $(\sim q \wedge p) \wedge q$

B. $(\sim q \wedge p) \wedge (p \wedge \sim p)$

C. $(\sim q \wedge p) \vee (p \vee \sim p)$

D. $(p \wedge q) \wedge (\sim(p \wedge q))$

42. If $a_1, a_2, ..., a_n$ are in A.P. ($a_i > 0$ for all i), then

$$\frac{1}{\sqrt{a_1}+\sqrt{a_2}}+\frac{1}{\sqrt{a_2}+\sqrt{a_3}}+...+\frac{1}{\sqrt{a_{n-1}}+\sqrt{a_n}}=$$

A. $\dfrac{2n-1}{\sqrt{a_1}+\sqrt{a_n}}$

B. $\dfrac{n+1}{\sqrt{a_1}+\sqrt{a_n}}$

C. $\dfrac{n+2}{\sqrt{a_1}+\sqrt{a_n}}$

D. $\dfrac{n-1}{\sqrt{a_1}+\sqrt{a_n}}$

43. The line parallel to the x-axis and passing through the point of intersection of the lines $ax + 2by + 3b = 0$ and $bx - 2ay - 3a = 0$ is

A. below the x-axis at a distance of $\dfrac{2}{3}$ from it

B. below the x-axis at a distance of $\dfrac{3}{2}$ from it

C. above the x-axis at a distance of $\dfrac{2}{3}$ from it

D. above the x-axis at a distance of $\dfrac{3}{2}$ from it.

44. The major axis of the ellipse, whose axis are the coordinate axes with latus rectum 20, whose minor axis is the distance between the foci, is

A. 18

B. 20

C. 36

D. 40

45. If the coefficients of x^{-2} and x^{-4} in the expansion of $\left(x^{1/3}+\dfrac{1}{2x^{1/3}}\right)^{18}$, ($x > 0$), are m and n, respectively, then m/n is equal to

A. 27

B. 182

C. 5/4

D. 4/5

46. If the letters of the word BOOK are arranged in all possible ways, then what is the probability of arrangement in which the two O's are not adjacent?

A. $\dfrac{1}{3}$

B. $\dfrac{1}{2}$

C. $\dfrac{1}{5}$

D. $\dfrac{1}{4}$

47. Consider the following statements:

I. The number of roots of the equation
$$\cos 3x + \cos 2x = \sin\frac{3x}{2} + \sin\frac{x}{2} \text{ in } [0, 2\pi] \text{ is 3.}$$

II. The value of $\cos\dfrac{\pi}{7}\cos\dfrac{4\pi}{7}\cos\dfrac{5\pi}{7}$ is $\dfrac{1}{4}$.

Which of the statements given above is/are correct?

A. Only I

B. Only II

C. Both I and II

D. Neither I nor II

48. Let R be the relation in N defined by
$R = \{(1 + x, 1 + x^2) : x \le 5, x \in N\}$.
Which of the following is false?

A. $R = \{(2, 2), (3, 5), (4, 10), (5, 17), (6, 26)\}$

B. Domain of $R = \{2, 3, 4, 5, 6\}$

C. Range of $R = \{2, 3, 10, 17, 26\}$

D. None of these

49. If n is an odd positive integer, then $a^n + b^n$ is divisible by

A. $a + b$

B. $a - b$

C. $a^2 - b^2$

D. None of these

50. The mean of 5 observations is 4 and their variance is 5.2. If three of the observations are 1, 2 and 6, then the other two are

A. 2 and 9

B. 3 and 8

C. 4 and 7

D. 5 and 6

31. Rahul divided 30 pots of plant 'X' in similar condition into 10 plants per group, with each group being treated with different photoperiods. After a month, the flowering results of each group are shown in the table given below.

Group of flowers	Photoperiod		Flowering result
	☐ Light	☐ Darkness	
I	12 hr	12 hr	All 10 pots flowered
II	14 hr	10 hr	All 10 pots flowered
III	16 hr	8 hr	All 10 pots failed to flower

According to the information given above, which of the following descriptions with regard to plant X are incorrect?

(i) Plant X is a long day plant (LDP).
(ii) The critical dark-length required by plant X for flowering may be 10 hours.
(iii) Plant X is a short day plant (SDP).
(iv) If group-III is given a "few-minutes dark treatment" in the middle of light period, most plants in this group will flower.
(v) If group-II is given a "few-minutes red light treatment" in the middle of the dark period, most plants in this group will not flower.

A. (i), (ii) and (iv) only
B. (i), (iv) and (v) only
C. (ii), (iii) and (v) only
D. (i) and (iv) only

32. Refer to the given dichotomous key and select the correct statement regarding P, Q, R and S.

I. (a) Tissue originates from all the three germ layers. – Go to II
(b) Tissue originates from mesoderm and helps in support and protection. – Go to III
II. (a) It forms the gastric glands, intestinal glands and pancreatic lobules. – P
(b) It is present in Eustachian tube and tympanic cavity. – Q
III. (a) Growth of the tissue is bi-directional and lacunae give off canaliculi. – R
(b) Growth of the tissue is unidirectional and lacunae do not have canaliculi. – S

A. P could also be present in gall bladder and bile duct whereas Q could also be present in fallopian tubes.
B. R could form the skeleton of elasmobranch fishes whereas S could be present in intervertebral disc.
C. P could also be present in ventricles of brain whereas Q could also be present in choroid and iris of the eyes.
D. R could be present in intervertebral disc whereas S could be present in eyelids of crocodiles.

33. The given table shows differences between two types of fruit X and Y.

		Fruit X	Fruit Y
(i)		These fruits develop from hypanthodium type of inflorescence.	These fruits develop from spike, spadix or catkin inflorescence.
(ii)		Fleshy receptacle of these fruits is edible.	Bracts, perianth and seeds become succulent and are used for eating.

Identify fruits X and Y and select the correct statement regarding them.

A. X has fruitlets that develop from different flowers of the inflorescence and possesses a small pore protected by scale leaves.
B. Pineapple and jack fruit are the examples of X type of fruit whereas fruit of fig and *Peepal* are the examples of Y type of fruit.
C. Y is a collection of simple fruit or fruitlets which develops from the multi-carpellary, apocarpous ovary of a single flower.
D. Both B and C

34. Identify X, Y and Z in the given figure of a contractile protein and select the incorrect statement regarding this.
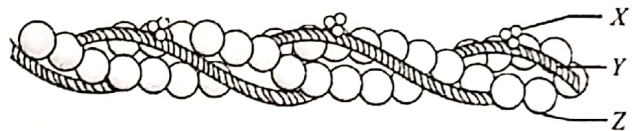
A. Monomeric units of Z polymerises in the presence of Mn^{3+}.
B. In the resting state, molecules of Y bind to active sites of Z strands so that attraction cannot occur between contractile proteins to cause contraction.
C. X is a complex of 3 polypeptides and its strong affinity for Mg^{2+} is believed to initiate contraction process.
D. Both A and C

35. Refer to the given cladogram and select the incorrect statements regarding it.
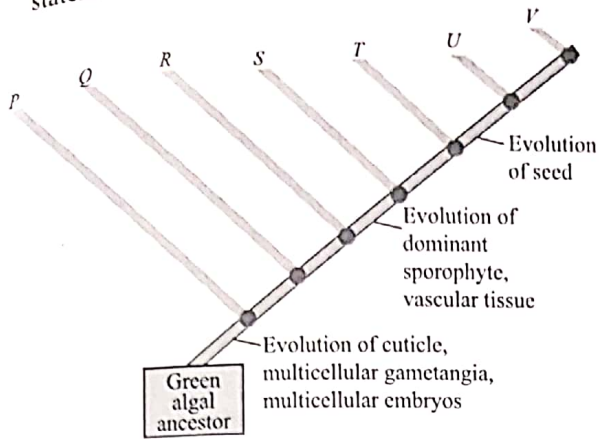
(i) Gametophytic plant body of R is erect and differentiated into root, stem and leaves.

(ii) Sporophyte of P and Q is always differentiated into foot, seta and capsule.

(iii) S could shows traits which resemble the characteristics essential for the formation of seed.

(iv) The female gametophyte contains distinct archegonia in U whereas it is absent in V.

(v) Both sporophyte and gametophyte are independent in R, S and T.

A. (i), (ii) and (v) only
B. (ii) and (v) only
C. (i), (ii), (iii) and (iv) only
D. (ii), (iii) and (iv) only

36. Refer to the given table showing effect on different muscles by various nerves during micturition and select the correct option regarding L, M and N.

Nerve	Muscle	During micturition
Parasympathetic	Detrusor muscle	L
M	Internal urethral sphincter	Constriction
Somatic motor	External urethral sphincter	N

	L	M	N
A.	Constriction	Parasympathetic	Constriction
B.	Constriction	Sympathetic	Constriction
C.	Relaxation	Parasympathetic	Constriction
D.	Constriction	Parasympathetic	Relaxation

37. Which of the following graphs correctly depicts the amount of DNA present in the nucleus of a cell undergoing meiosis?

Key : $P = G_1$ stage, $Q = G_2$ stage,
R = Telophase I, S = Metaphase II
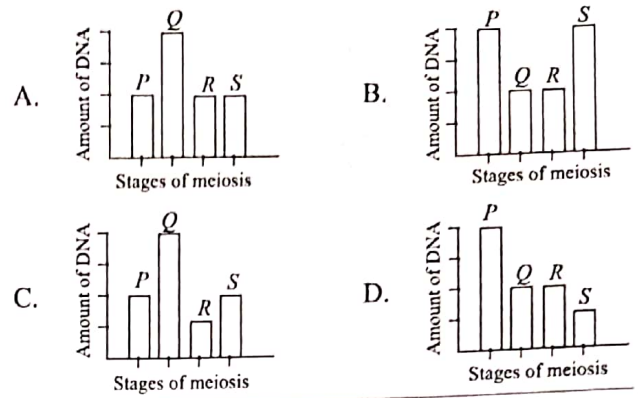
38. Which of the following statements are correct?

(i) Stomach secretes Castle's intrinsic factor which is necessary for the absorption of vitamin B_{12} in the intestine.

(ii) Duocrinin stimulates the Brunner's glands to release mucus and enzymes into the intestinal juice.

(iii) Enterocrinin inhibits the release of pancreatic juice from the pancreas.

(iv) Pancreatic polypeptide stimulates pancreas to secrete and release digestive enzymes in the pancreatic juice.

(v) Enterocrinin stimulates the crypts of Lieberkuhn to release the enzymes into the intestinal juice.

A. (iii) and (iv) only
B. (i), (iii) and (v) only
C. (i), (ii) and (v) only
D. (iii), (iv) and (v) only

39. Refer to the given flow chart.
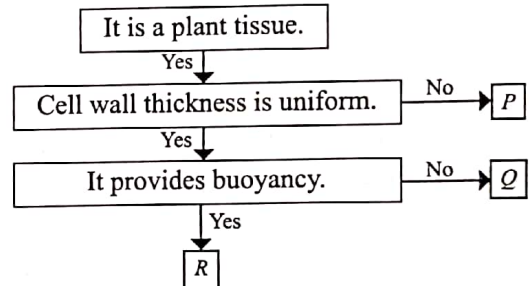
Select the correct statement regarding P, Q and R.

A. P is a living tissue whereas Q and R could be dead tissues.
B. R forms stony endocarp of almond and coconut.
C. P provides flexibility to the organs and allows bending.
D. Q can store food and take part in photosynthesis.

40. In which of the following reactions of glycolysis, ATP is produced by substrate level phosphorylation.

A. Fructose–6–phosphate → Fructose 1, 6–bisphosphate
B. 3-PGA → 2-PGA
C. PEP → Pyruvic acid
D. 2–phosphoglycerate → PEP

41. The figures show four animals (W-Z). Select the correct option with respect to a common characteristic of two of these animals.

W   X   Y   Z
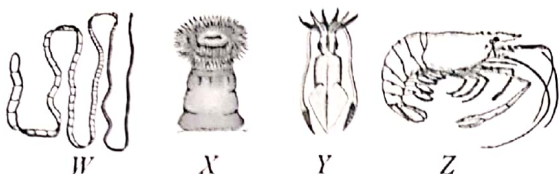
   A. X and Y have cnidoblasts for self defence.
   B. The bodies of W and Z show true metamerism.
   C. Y and Z have a true coelom.
   D. Both W and Y exhibit metagenesis.

42. Refer to the given table showing differences between arteries and veins and select the incorrect differences.

|	Arteries	Veins
(i)	Tunica media is thick, having more muscle fibres.	Tunica media is thin, having fewer muscle fibres.
(ii)	Tunica interna has strong elastic membrane and more elongated endothelial cells.	Tunica interna has simple elastic membrane and elongated endothelial cells.
(iii)	They are collapsible.	They are not collapsible.
(iv)	They have no valves.	They have valves which prevent backward flow of blood.
(v)	The flow of blood is not so fast because the blood is under low pressure.	The flow of the blood is fast as the blood in them is under great pressure.

   A. (iii) and (v) only
   B. (i), (ii) and (iv) only
   C. (i), (iii) and (iv) only
   D. (ii) and (v) only

43. For the given members, how many have an intervening dikaryotic stage?

Colletotrichum, Amanita, Neurospora, Trichoderma, Ustilago, Aspergillus, Claviceps, Puccinia, Rhizopus, Phytophtora.

   A. 2
   B. 1
   C. 4
   D. 6

44. If three cells X, Y and Z are joined to each other and their solute potential and turgor pressure values are given in the figure; then demonstrate the direction of water flow in this system.

$\Psi_s = -60$
TP = 35

$\Psi_s = -50$
TP = 40

$\Psi_s = -30$
TP = 15
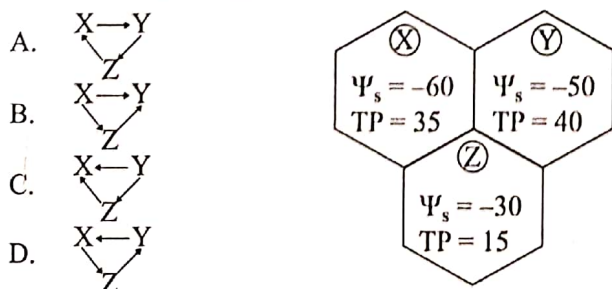
45. Match column I with column II and III and select the correct option from the given codes.

Column I (Hormone)		Column II (Secreted by)		Column III (Function)
a. Oxytocin	(i)	Alpha-cells of islets of Langerhans	P.	Promotes contraction of the uterine muscle during child birth
b. Norepine-phrine	(ii)	Posterior pituitary	Q.	Stimulates glycogenolysis
c. Glucagon	(iii)	Anterior pituitary	R.	Constricts blood vessels, inhibits gastro-intestinal tract, increases heart activity
d. Prolactin	(iv)	Adrenal medulla	S.	Regulates growth of mammary glands during pregnancy

   A. (a)-(ii)-(P); (b)-(iv)-(R); (c)-(i)-(Q); (d)-(iii)-(S)
   B. (a)-(ii)-(Q); (b)-(iii)-(R); (c)-(iv)-(P); (d)-(i)-(S)
   C. (a)-(iii)-(Q); (b)-(ii)-(S); (c)-(i)-(P); (d)-(iv)-(R)
   D. (a)-(iii)-(Q); (b)-(ii)-(P); (c)-(iv)-(P); (d)-(i)-(R)

46. The given figure shows a man experiencing a sudden withdrawal of the leg that got in contact with a pointed object. Which of the following nervous pathways gives such response?


   A. Receptor → Efferent nerve fibre → Grey matter of spinal cord → Afferent nerve fibre → Effector
   B. Receptor → Afferent nerve fibre → Grey matter of spinal cord → Efferent nerve fibre → Effector
   C. Effector → Afferent nerve fibre → White matter of spinal cord → Efferent nerve fibre → Receptor
   D. Receptor → Efferent nerve fibre → White matter of spinal cord → Afferent nerve fibre → Effector

47. Select the incorrect match.
   A. Fibroin – Receptor protein
   B. Glutelin – Storage protein
   C. β-globulin – Carrier protein
   D. Keratin – Protective protein

48. Identify the labelled structures in the given diagram of the digestive system of the cockroach and select the incorrect statement(s) from the following.
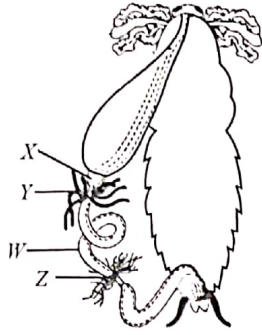
I.   X is highly muscular, provided with both longitudinal and circular muscles and 12 teeth for grinding the food.
II. Y are about 100-150 finger-like, blind structures that secrete digestive enzymes.
III. Z are about 6-8 fine, thread-like structures which are excretory in function.
IV. W is thin walled tube, and is the main site of only digestion.

A. II, III and IV only
B. II only
C. I and IV only
D. I, II, III and IV

49. Select the mismatched pair out of the following.
A. Radial vascular bundle – Xylem and phloem on different radii
B. Bicollateral vascular bundle – Phloem present on both sides of xylem
C. Amphivasal vascular bundle – Phloem surrounds xylem
D. Conjoint, collateral vascular bundle – Xylem and phloem on same radii

50. Which of the following statements is correct regarding plasma membrane?
A. Plasma membrane is selectively permeable for solutes.
B. Plasma membrane has carrier protein for active transport.
C. The lipid molecules present in plasma membrane are amphipathic.
D. All of these.

SPACE FOR ROUGH WORK