SCIENCE OLYMPIAD FOUNDATION

Inspiring Young Minds
Through Knowledge Olympiads

CLASS 12

SET-B

DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Name:.....

Section:..... Roll No.:.....

Contact No.....

Total Questions: 50 Time: 1 hr.

19TH SOF NATIONAL SCIENCE OLYMPIAD

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 **% of marks/grade** in last class clearly on the **OMR Sheet** and do not forget to sign it.
3. 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)
4. **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.
5. All questions are compulsory. There is no negative marking. Use of calculator is not permitted.
6. There is only ONE correct answer. Choose only ONE option for an answer.
7. To mark your choice of answers by darkening the circles in 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. ● Ⓑ Ⓒ Ⓓ

8. Rough work should be done in the blank space provided in the booklet.
9. Return the OMR Sheet to the invigilator at the end of the exam.
10. Please fill in your personal details in space on top of this page before attempting the paper.

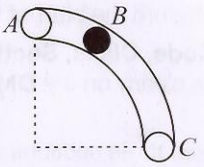
1. An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 rad s^{-1}. When only the capacitance is removed, the current lags behind the voltage by 60°. When only the inductance is removed, the current leads voltage by 60°. Find the power dissipated in the LCR circuit.

A. 100 W B. 300 W
C. 200 W D. 400 W

2. Determine the period of small oscillations of a mathematical pendulum, that is a ball suspended by a thread l = 20 cm in length, if it is located in a liquid whose density is three times less than that of the ball. The resistance of the liquid is to be neglected.

A. 2.2 s B. 1.1 s
C. 0.5 s D. 3.1 s

3. A narrow tube AC forms a quarter circle in a vertical plane. A ball B has an area of cross-section slightly smaller than that of the tube and can move without friction through it.



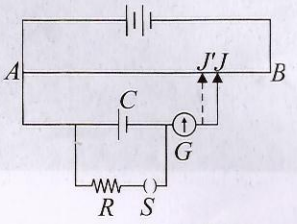
B is placed at A and displaced slightly. During the motion from A to C it will

A. Always be in contact with the lower surface of the tube
B. Always be in contact with the upper surface of the tube
C. Initially be in contact with the lower surface and later with the upper surface
D. Initially be in contact with the upper surface and later with the lower surface.

4. What is the minimum attainable pressure of the gas in the process $T = T_0 + \alpha V^2$, where T_0 and α are the positive constants, and V is the volume of one mole?

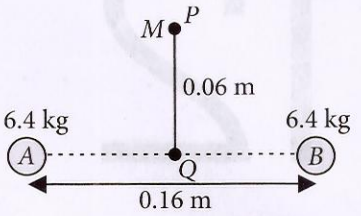
A. $2R\alpha\sqrt{T_0}$ B. $2R\sqrt{\alpha T_0}$
C. $R\sqrt{2\alpha T_0}$ D. 0

5. Figure shows a potentiometer circuit for determining the internal resistance of a cell. When switch S is open, the balance point is found to be at 76.3 cm of the wire. When switch S is closed and the value of R is 4.0 Ω, the balance point shift to 60.0 cm. Find the internal resistance of the cell C.



A. 1 Ω B. 2 Ω
C. 3 Ω D. 4 Ω

6. Two equal masses of 6.4 kg are separated by a distance of 0.16 m. A small body of mass M = 0.10 kg is released from a point P equidistant from the two masses and a distance 0.06 m from the line joining them, as shown in figure.



The velocity of this body when it passes through point Q and the acceleration of this body at point P, respectively are

A. 6.5×10^{-5} m s^{-1} and 5.12×10^{-8} m s^{-2}
B. 8.5×10^{-6} m s^{-1} and 5.12×10^{-6} m s^{-2}
C. 5.5×10^{-5} m s^{-1} and 6.5×10^{-8} m s^{-2}
D. 6.5×10^{-6} m s^{-1} and 5.5×10^{-8} m s^{-2}.

7. A uniform rod of length $2l$ and specific gravity 0.75 is hinged at one end to a point $l/2$ above the surface of water with the other end immersed. The inclination of the rod with the horizontal when the rod is in equilibrium will be

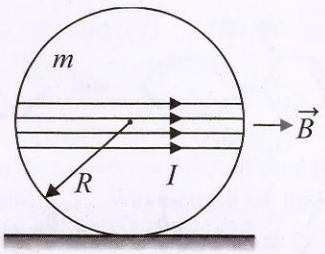
A. 90° B. 45°
C. 60° D. 30°.

8. When 0.005 A current flows through a moving coil galvanometer, it gives full scale deflection. It is converted into a voltmeter to read 5 V using an external resistance of 975 Ω. The resistance of the galvanometer, in ohms, is

A. 5 B. 10
C. 15 D. 25.

9. A wire is wrapped N times over a solid sphere of mass m near its centre, which is placed on a smooth horizontal surface. A horizontal magnetic field of induction $\vec{B}$ is present as shown in figure.

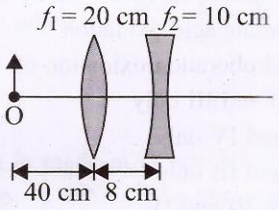
Find the angular acceleration experienced by the sphere if the wire carries a current I. Assume that the mass of the wire is negligible compared to the mass of the sphere.



A. $\frac{2\pi NIB}{5m}$ B. $N\pi R^2 IB$

C. $5\pi IBR$ D. $\frac{5N\pi IB}{2m}$

10. Consider a system of two thin lenses as shown in figure. An object of height 1 cm is placed at 40 cm from convex lens. Mark the correct option related to final image formed by the two lens system.



A. Final image is formed at 32 cm on right of concave lens and is 0.45 cm in size.

B. Final image is formed at 32 cm on left side of convex lens and is 1 cm in size.

C. Final image is formed at 14.5 cm on the left side of concave lens and is 0.45 cm in size.

D. None of these.

11. A chain of mass M and length l is suspended vertically with its lower end touching a weighing scale. The chain is released and falls freely onto the scale. Neglecting the size of the individual links, what is the reading of the scale when a length x of the chain has fallen?

A. $\frac{Mgx}{l}$ B. $\frac{2Mgx}{l}$

C. $\frac{3Mgx}{l}$ D. $\frac{4Mgx}{l}$

12. Two parallel plate capacitors of capacitance C are connected in series with a battery of emf ε. Then one of the capacitors is filled with a dielectric of dielectric constant K. If the final energy of capacitors is x times the value of their initial energy, then value of x will be

A. $\frac{K}{1+K}$ B. $\frac{2K}{1+K}$

C. $\frac{K+1}{K}$ D. $\frac{K+1}{2K}$

CHEMISTRY

13. In an experiment, current was passed for 4 hours through two cells connected in series. The first cell contains a solution of gold and the second cell contains $CuSO_4$ solution. 10.0 g of gold was deposited in the first cell. If the oxidation number of gold is +3 then, the amount of Cu deposited on cathode in second cell and the current strength are respectively (Given : Atomic mass of Au = 197 u and Cu = 63.5 u]

A. 4.763 g and 0.804 A

B. 5.021 g and 2.453 A

C. 4.835 g and 1.021 A

D. 0.804 g and 4.763 A

14. Among the following species, which is not an isostructural pair?

A. NF_3 and H_3O^+

B. NO_2^+ and SO_2

C. PCl_3 and NH_3

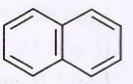
D. NO_3^- and BF_3

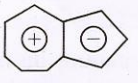
15. An aqueous solution of salt 'P' gives a white crystalline ppt. 'Q' with NaCl solution. 'Q' gives a black ppt. 'R' when H_2S is passed in it. When solution of 'Q' in hot water is treated with NaI and cooled, it gives a yellow ppt. 'S'. The compound 'P' does not give any gas with dil. HCl but liberates reddish brown gas on heating. Identify the compounds P, Q, R and S.

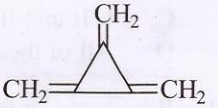
	P	***Q***	***R***	***S***
A.	$ZnSO_4$	$ZnCl_2$	ZnS	ZnI_2
B.	$Sn(OH)_2$	$SnCl_2$	SnS	SnI_2
C.	$AgNO_3$	AgCl	Ag_2S	AgI
D.	$Pb(NO_3)_2$	$PbCl_2$	PbS	PbI_2

16. Which of the following is/are aromatic?

I. 

II. 

III. 

IV. 

A. I, II and III only

B. III and IV only

C. I only

D. All of these

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

I. The coordination number of each type of ion in CsCl crystal is 8.

II. A metal that crystallizes in *bcc* structure has a coordination number of 12.

III. A unit cell of an ionic crystal shares some of its ions with other unit cells.

IV. The edge length of a unit cell in NaCl crystal is 552 pm (r_{Na^+} = 95 pm, r_{Cl^-} = 181 pm).

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

18. Which of the following is true for 100 g of CO_2 confined in a vessel of 5 L capacity at 40°C? (a = 3.59 L^2 atm mol^{-2}, b = 0.0427 L mol^{-1}).

A. $P_{real} < P_{ideal}$
B. $P_{real} = P_{ideal}$
C. $P_{real} > P_{ideal}$
D. None of these

19. An organic compound '*X*' having molecular formula, $C_4H_8O_2$ contains an ester group. '*X*' on treatment with excess of methyl magnesium chloride followed by acidification, gives an alcohol '*Y*'. '*Y*' on oxidation with NaOCl followed by acidification gives acetic acid. Identify the structures of *X* and *Y*.

	X	*Y*
A.	$HCOOCH(CH_3)_2$	$(CH_3)_2CHOH$
B.	$CH_3COOCH_2CH_3$	$CH_3CH_2CH_2OH$
C.	$CH_3CH_2COOCH_3$	$(CH_3)_2CHOH$
D.	$HCOOCH(CH_3)_2$	$CH_3CH_2CH_2OH$

20. Which of the following is the correct order?

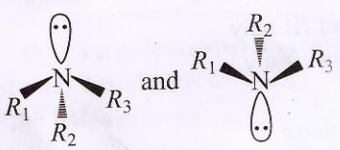
A. B > Al > Ga > In > Tl (Ionization energy)
B. C >> Si < Ge < Sn < Pb (Catenation)
C. $BF_3 > BI_3 > BCl_3 > BBr_3$ (Lewis acid strength)
D. $CX_4 > SiX_4 > GeX_4 > SnX_4 > PbX_4$ (Stability)

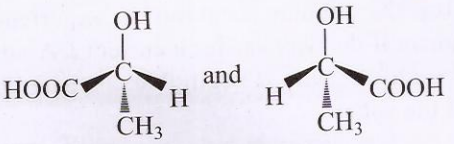
21. Which of the following aqueous solutions will be isotonic with 6% (*W*/*V*) aqueous solution of urea?

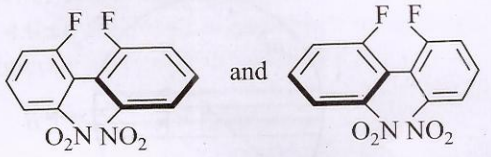
I. 18% (*W*/*V*) solution of glucose
II. 0.5 M solution of NaCl
III. 1 M solution of acetic acid
IV. 6% (*W*/*V*) solution of sucrose

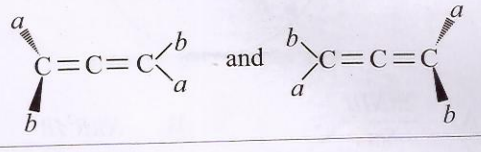
A. II and IV only
B. I and II only
C. I, II and III only
D. All of these

22. Which of the following pairs cannot be resolved?

A. 

B. 

C. 

D. 

23. Which of the following pathways produce 2-hexanone?

I. 1-Hexyne is treated with H_2SO_4, $HgSO_4$ and water
II. 3-Methyl-2-heptene is treated with O_3 followed by hydrolysis
III. *n*-Butyl magnesium bromide is treated with acetaldehyde followed by hydrolysis and then chromic acid oxidation
IV. Hydroboration oxidation of 1-hexyne

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

24. Which of the following statements about coordination compounds are correct?

I. $[Cu(NH_3)_4]^{2+}$ is dsp^2 hybridised and is diamagnetic in nature.
II. $[Pt(NH_3)(Cl)(py)(Br)]$ has three geometrical isomers but does not show optical isomerism.
III. $[Co(en)_3]Cl_3$ will show optical isomerism but *cis*-$[Pt(en)_2Cl_2]$ will not.
IV. The order of increasing crystal field splitting is $[FeCl_6]^{4-} < [Fe(H_2O)_6]^{2+} < [Fe(H_2O)_6]^{3+} < [Ru(H_2O)_6]^{3+}$

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

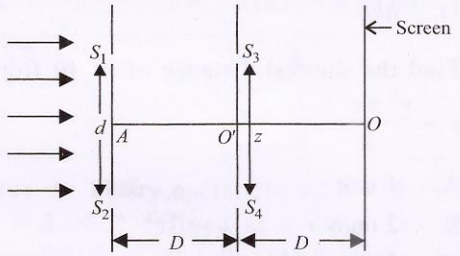
25. For the reaction, $4P \longrightarrow 3Q + R$ if $\frac{-d[P]}{dt} = k_1[P]^4$, $\frac{d[Q]}{dt} = k_2[P]^4$ and $\frac{d[R]}{dt} = k_3[P]^4$

Which of the following is the most appropriate relation between k_1, k_2, k_3?

A. $4k_1 = 3k_2 = k_3$
B. $3k_1 = 4k_2 = 12k_3$
C. $k_1 = k_2 = k_3$
D. $k_1 = 4k_2 = 3k_3$

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

In the arrangement shown in the figure, slits S_3 and S_4 are having a variable separation z. Horizontal line AO passing through point O on the screen is at the common perpendicular bisector of S_1S_2 and S_3S_4. Wavelength of incident light is λ. Also, assume $D >> d$.



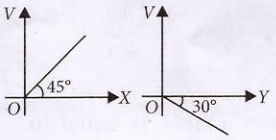
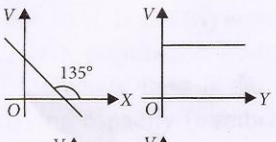
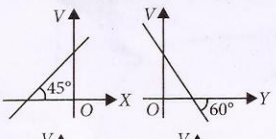
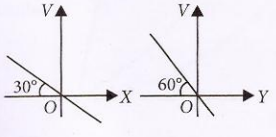
26. When $z = \frac{\lambda D}{2d}$ the intensity measured at O is I_0. The intensity at O when $z = \frac{2\lambda D}{d}$ is

A. I_0 B. $2I_0$
C. $3I_0$ D. $4I_0$

27. If another slit is made at O' on $AO'O$ and the slit S_4 is closed, then the ratio of the maximum intensity to minimum intensity observed on screen at O if $O'S_3$ is equal to $\frac{\lambda D}{4d}$, is

A. 1 B. Infinity
C. 34 D. 4

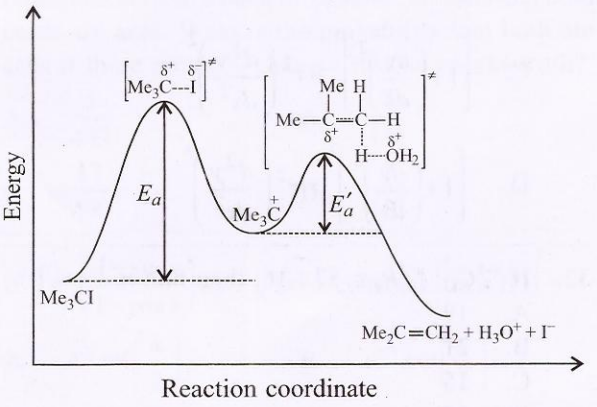
28. Column-I shows graphs of electric potential V versus X and Y in a certain region for four situations. Column-II gives angle which the electric field vector makes with positive X-direction. Match the Column-I with Column-II and choose the correct option using the codes given below.

Column-I		Column-II	
P.		a.	0°
Q.		b.	$\tan^{-1}(3)$
R.		c.	120°
S.		d.	150°

A. P - c, Q - a, R - d, S - b
B. P - d, Q - a, R - c, S - b
C. P - b, Q - c, R - b, S - a
D. P - a, Q - d, R - b, S - d

29. The given graph illustrates the reaction mechanism for a reaction,

$Me_3CI + H_2O \longrightarrow Me_2C{=}CH_2 + H_3O^+ + I^-$



Which of the following statements are incorrect?

I. The reaction follows E1 mechanism.
II. The activation energy of rate determining step is E_a'.
III. For this type of mechanism, the order of reactivity is $1° > 2° > 3°$ alkyl halides.
IV. This type of reaction does not follow Saytzeff rule and is promoted by the presence of highly concentrated strong base.

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

30. Read the given chain of reactions carefully and fill in the blanks by choosing an appropriate option.

$$\underset{\text{(An acid which reduces acidified } KMnO_4)}{X} \xrightarrow{473\ K} Y + \underset{\text{(Gas which is stable in air in pure form)}}{Z} \xrightarrow[H_2O]{AgNO_3} \text{Black ppt.}$$

$Y \xrightarrow[\text{(catches fire)}]{O_2,\ 423\ K}$

	X	Y	Z
A.	Nitric acid	Nitrous acid	Ammonia
B.	Sulphurous acid	Sulphuric acid	Sulphur dioxide
C.	Phosphorous acid	Phosphoric acid	Phosphine
D.	Phosphoric acid	Phosphorous acid	Phosphine

31. The differential equation of the system of all circles of radius r in the xy plane is

A. $\left[1+\left(\frac{dy}{dx}\right)^3\right]^2 = r^2\left(\frac{d^2y}{dx^2}\right)^2$

B. $\left[1+\left(\frac{dy}{dx}\right)^3\right]^2 = r^2\left(\frac{d^2y}{dx^2}\right)^3$

C. $\left[1+\left(\frac{dy}{dx}\right)^2\right]^3 = r^2\left(\frac{d^2y}{dx^2}\right)^2$

D. $\left[1+\left(\frac{dy}{dx}\right)^2\right]^3 = r^2\left(\frac{d^2y}{dx^2}\right)^3$

32. If ${}^{n+2}C_8 : {}^{n-2}P_4 = 57 : 16$, then find n.

A. 19
B. 21
C. 15
D. 25

33. Let A be a square matrix all of whose entries are integers. Then which one of the following is true?

A. If det $A \neq \pm 1$, then A^{-1} exists and all its entries are non-integers.
B. If det $A = \pm 1$, then A^{-1} exists and all its entries are integers.
C. If det $A = \pm 1$, then A^{-1} need not exist.
D. If det $A = \pm 1$, then A^{-1} exists but all its entries are not necessarily integers.

34. If a circle passes through the point (1, 2) and cuts the circle $x^2 + y^2 = 4$ orthogonally, then equation of the locus of its centre is

A. $x^2 + y^2 - 3x - 8y + 1 = 0$
B. $x^2 + y^2 - 2x - 6y - 7 = 0$
C. $2x + 4y - 9 = 0$
D. $2x + 4y - 1 = 0$

35. If $f(x) = (ax^2 + b)^3$, then the function g such that $f\{g(x)\} = g\{f(x)\}$ is given by

A. $g(x) = \left(\frac{b - x^{1/3}}{a}\right)^{1/2}$

B. $g(x) = \frac{1}{(ax^2 + b)^3}$

C. $g(x) = (ax^2 + b)^{1/3}$

D. $g(x) = \left(\frac{x^{1/3} - b}{a}\right)^{1/2}$

36. If p^{th}, q^{th} and r^{th} terms of an A.P. as well as a G.P. are a, b and c respectively, then find the value of $a^{b-c}\, b^{c-a}\, c^{a-b}$.

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

37. Find the shortest distance of (0, 0) from the curve $y = \frac{e^x + e^{-x}}{2}$.

A. 1 unit
B. 2 units
C. 5 units
D. Can't be determined

38. For what value of k, $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x}, & \text{if } x \neq \frac{\pi}{2} \\ 3, & \text{if } x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$.

A. 1
B. 3
C. 2
D. 6

39. If $\cot^{-1}(\sqrt{\cos\alpha}) - \tan^{-1}(\sqrt{\cos\alpha}) = x$, then $\sin x$ is equal to

A. $\tan^2\left(\frac{\alpha}{2}\right)$

B. $\cot^2\left(\frac{\alpha}{2}\right)$

C. $\tan\alpha$

D. $\cot\left(\frac{\alpha}{2}\right)$

40. $\int_{-3\pi/2}^{-\pi/2}[(x+\pi)^3 + \cos^2(x)]dx$ is equal to

A. $\left(\frac{\pi^4}{32}\right) + \frac{\pi}{2}$

B. $\frac{\pi}{2}$

C. $\left(\frac{\pi}{4}\right) - 1$

D. $\frac{\pi^4}{32}$

41. The equation of the plane passing through (1, 1, 1) and (1, – 1, –1) and perpendicular to $2x - y + z + 5 = 0$, is

A. $2x + 5y + z - 8 = 0$
B. $x + y - z - 1 = 0$
C. $2x + 5y + z + 4 = 0$
D. $x - y + z - 1 = 0$

42. If y_1, y_2, y_3 be the ordinates of a vertices of the triangle inscribed in a parabola $y^2 = 4ax$, then the area of the triangle is $\frac{k}{a}|(y_1 - y_2)(y_2 - y_3)(y_3 - y_1)|$. Find k.

A. $\frac{1}{4}$ B. 4
C. 8 D. $\frac{1}{8}$

43. Consider the binary operations $* : R \times R \to R$ and $o : R \times R \to R$ defined as $a * b = |a - b|$ and $aob = a$. Which of the following is true?

A. $*$ is commutative as well as associative.
B. o is commutative as well as associative.
C. $*$ is commutative and o is associative.
D. $*$ is associative and o is commutative.

44. The equation of the tangent to the curve $(1 + x^2)\, y = 2 - x$, where it crosses the x-axis, is

A. $x + 5y = 2$
B. $x - 5y = 2$
C. $5x - y = 2$
D. $5x + y - 2 = 0$

45. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar vectors and λ is a real number, then the vectors $\vec{a} + 2\vec{b} + 3\vec{c}, \lambda\vec{b} + 3\vec{c}$ and $(2\lambda - 1)\vec{c}$ are non-coplanar for

A. All values of λ
B. All except one value of λ
C. All except two values of λ
D. No value of λ

46. The parabolas $y^2 = 4x$ and $x^2 = 4y$ divide the square region bounded by the lines $x = 4$, $y = 4$ and the coordinate axes. If S_1, S_2 and S_3 are respectively the areas of these parts numbered from top to bottom, then

A. $\frac{S_3}{S_2} = \frac{1}{2}$ B. $\frac{S_1}{S_2} = 1$
C. $\frac{S_1}{S_2} = \frac{1}{2}$ D. None of these

47. A person draws two cards successively without replacement from a pack of 52 cards. He tells that both cards are aces. What is the probability that both are aces if there are 60% chances that he speaks truth?

A. $\frac{3}{443}$ B. $\frac{7}{440}$
C. $\frac{17}{490}$ D. $\frac{6}{463}$

48. If $\int e^x \left(\frac{1 - \sin x}{1 - \cos x}\right) dx = f(x) + \text{constant}$, then $f(x) =$

A. $e^x \cot\left(\frac{x}{2}\right)$ B. $e^{-x} \cot\left(\frac{x}{2}\right)$
C. $-e^x \cot\left(\frac{x}{2}\right)$ D. $-e^{-x} \cot\left(\frac{x}{2}\right)$

49. The value of the determinant $\begin{vmatrix} -bc & ca+ab & ca+ab \\ ab+bc & -ca & ab+bc \\ bc+ca & bc+ca & -ab \end{vmatrix}$ is

A. $\Sigma a^3 b^3$ B. $(\Sigma ab)^3$
C. 0 D. None of these

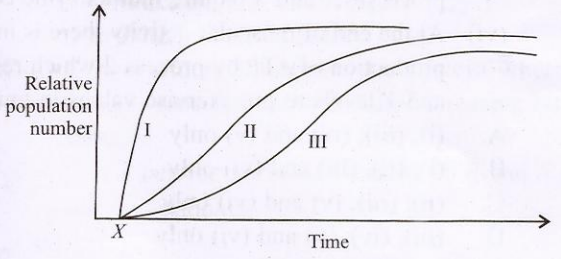
50. If the angles of a triangle are in the ratio 4 : 1 : 1, then the ratio of the longest side to the perimeter is

A. $\sqrt{3} : (2 + \sqrt{3})$ B. 1 : 6
C. $1 : (2 + \sqrt{3})$ D. 2 : 3

OR

BIOLOGY

31. Three curves (I, II and III) in the given graph, represent the relative population number of three different organisms where food is the only limiting factor to the carrying capacity (number of individuals).

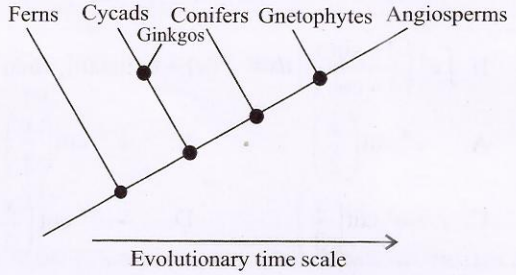


Which of the following best matches the three curves (I, II and III) with the organisms comprising each population given access to an unlimited food supply at time X?

	I	II	III
A.	Elephant	Rabbit	Bacteria
B.	Tiger	Mouse	Cricket
C.	Bacteria	Rabbit	Elephant
D.	None of these		

32. Select the incorrect statement regarding *in vitro* fertilisation.
A. Woman is given hormonal therapy to stimulate her ovaries to produce many eggs per cycle and egg maturation is achieved by administering estrogen hormone *via* injections.
B. For egg retrieval, a fine needle connected to aspiration device is passed through vaginal wall of woman into her ovaries.
C. Testicular aspiration is performed to obtain sperms in case of male partners having very low sperm count.
D. Fertilisation may be achieved through intracytoplasmic sperm injection in case of male partners with abnormal sperm parameters.

33. Refer to the given cladogram based on evolutionary relationship between various plant groups. (Dots in the cladogram indicate common ancestors).



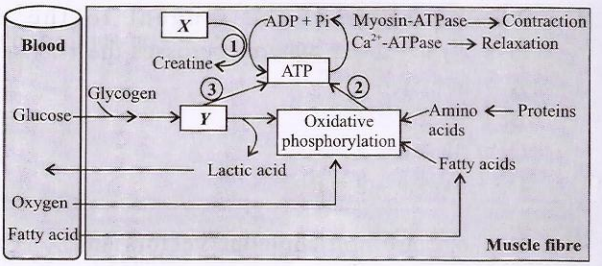
Which of the following holds true regarding this?
A. Cycads, ginkgos, conifers and gnetophytes show paraphyletic origin.
B. Ginkgos and conifers show polyphyletic origin.
C. Cycads, conifers and angiosperms constitute a monophyletic group.
D. Both A and B

34. Select the incorrect statement out of the following with regard to megasporogenesis in angiosperms.
A. A primary archesporial cell develops in the hypodermal region of nucellus usually towards the chalazal end.
B. The primary archesporial cell divides periclinally to form outer parietal cell and inner sporogenous cell.
C. The sporogenous cell functions as MMC, which undergoes reduction division to form 4 haploid megaspores.
D. Only the single functional megaspore develops into female gametophyte, this type of embryo sac development is called as monosporic development.

35. *X* are the vectors used in genetic engineering which contain two types of origin of replication and selectable marker genes, one type that functions in the eukaryotic cell and another type that functions in *E.coli* bacterium. An example of such vectors is *Y*.
Identify *X* and *Y* in the given paragraph and select the correct option.
A. *X*-Shuttle vectors, *Y*-Yeast episomal plasmid
B. *X*-Transposon vectors, *Y*-Transposons
C. *X*-Phagemid vectors, *Y*-Simian Virus 40
D. None of these

36. The flower colour in an annual plant species is controlled by single gene locus with two alleles, *R* and *r* which occur in three compositions *RR* (red), *Rr* (pink) and *rr* (white). This plant species is bisexual and undergoes both self and cross pollination. Cross pollination is accomplished by insects. If large amount of only pink flowered plants are planted in an isolated island where insect pollinators are absent then what will be the most likely outcome after one year?
A. 50% plants will have red flowers and 50% plants will have white flowers.
B. All plants will bear pink flowers.
C. Plants with red, pink and white flowers will be present in the ratio of 1 : 2 : 1.
D. Plants with red, pink and white flowers will be obtained in equal proportions.

37. The given schematic representation shows three sources of ATP production during muscle contraction.

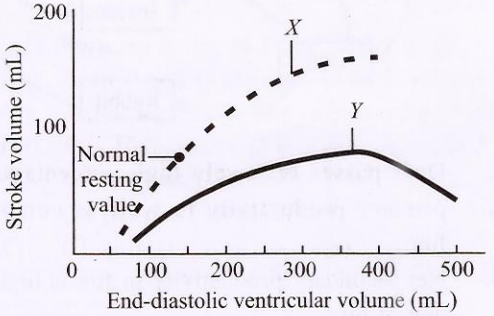


Identify *X* and *Y* and select the correct option regarding processes 1, 2 and 3.
(i) Formation of ATP by process 1 is very rapid and provides energy only for few seconds from the start of the contractile activity of muscle.
(ii) At moderate levels of muscular activity (initial 30 minutes) most of the ATP used is formed by process 2.
(iii) As the intensity of muscle activity increases, a greater fraction of total ATP production is obtained by process 3.
(iv) Large amount of ATP is produced in a short time by process 3 however processes 1 and 2 produce very few ATP molecules.
(v) Process 2 is a single enzymatic reaction whereas processes 1 and 3 require multienzyme complex.
(vi) At the end of muscular activity there is increased production of ATP by process 2 which restores *X* and *Y* levels to pre-exercise values in muscle.
A. (i), (iii), (iv) and (v) only
B. (i), (ii), (iii) and (vi) only
C. (ii), (iii), (v) and (vi) only
D. (iii), (iv), (v) and (vi) only

38. Endoplasmic reticulum provides a large surface inside the cell for various physiological activities. It is the site for all of the following except

A. Glycosylation of lipids and proteins
B. Synthesis of serum proteins
C. Detoxification with the help of cyt P_{450}
D. Storage of Ca^{2+} for release during muscle contraction.

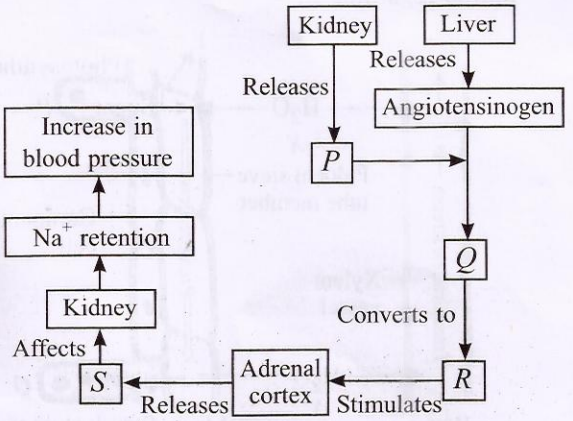
39. The given graph shows relationship between end-diastolic ventricular volume and stroke volume of two persons *X* and *Y*.



What can be best inferred from this graph?

A. The wall of ventricle has reduced compliance in case of person *X*.
B. Person *Y* is undergoing heart failure due to decrease in cardiac contractility.
C. Person *Y* is normal whereas person *X* is suffering from myocardial infarction.
D. None of these

40. Refer to the given flow chart.



Select the correct option regarding *P*, *Q*, *R* and *S*.

A. *P* is secreted by cells of macula densa of distal convoluted tubule of kidney.
B. *S* stimulates Na^+ reabsorption by proximal convoluted tubule of kidney.
C. *R* also affects cardiovascular system where it causes vasoconstriction thereby increasing blood pressure.
D. *Q* is a peptide hormone whereas *P*, *R* and *S* are steroid hormones.

41. A Himalayan variety of rabbits has white hair on the body and black hair on the feet, tail and ears. The allele for the Himalayan rabbit pigment pattern, c^h, is recessive to the alleles for normal colour (all hair agouti), *C*, as well as dark chinchilla (all hair dark grey), c^{chd} but is dominant to the allele for albino (all hair white, no pigment production), *c*. All of the alleles of this gene produce different versions of the same enzyme involved in pigment production.
A patch of white fur was removed from a Himalayan rabbit and an ice pack was applied to the skin. The fur that grew back on the patch was black.

Which of the following holds true regarding this?

	Genotype of Himalayan rabbit	Explanation for pigment pattern in Himalayan rabbit
A.	c^hc^h only	The enzyme is denatured at the high skin temperatures, found on the rabbit's body.
B.	c^hc^h only	The enzyme becomes hyperactive at the low skin temperatures, found on the rabbit's feet, tail, ears and face.
C.	c^hc^h and c^hc only	The enzyme is denatured at the high skin temperatures, found on the rabbit's body.
D.	c^hc^h and c^hc only	The enzyme becomes inactive at the low skin temperatures, found on the rabbit's feet, tail, ears and face.

42. The table shows the DNA triplet codes for some amino acids from the strand complementary to *m*RNA.

Amino acid	DNA code
Glycine	CCA, CCG, CCT, CCC
Leucine	AAT, AAC, GAA, GAG, GAT, GAC
Lysine	TTT, TTC
Methionine	TAC
Proline	GGA, GGG, GGT, GGC
Threonine	TGA, TGG, TGT, TGC

The DNA sequence shows part of a gene which can mutate in a number of ways.
....TAC TTT AAT GGC CCT GAG GGC TAC TGT ....

Which mutation would result in the same phenotype as the original gene sequence?

A. ....TAC TTT AAT GGC CCT GAG GGT CCA TGT ....
B. ....TAC TTC GAT GGC CCT GAG GGC TAC TGT ....
C. ....TAC TTT AAT GGC CCG GAG TGA TAC TGT ....
D. ....TAC TTT AAT GGC CCT GAG GGC TTC TGT ....

43. Refer to the given statements and choose the incorrect one.

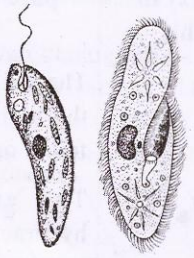
A. The possible defenses against bioweapons include the use of respirator or gas mask, vaccination, administration of appropriate antibiotics and decontamination.

B. Production of polygalacturonase enzyme was activated in the transgenic tomato variety 'Flavr Savr' which has a longer shelf life.

C. Sustainable development primarily makes the use of non-renewable resources, causing minimum pollution and maintains the optimum yield level.

D. Both B and C

44. Which of the following statements is correct for the given figures?



a *b*

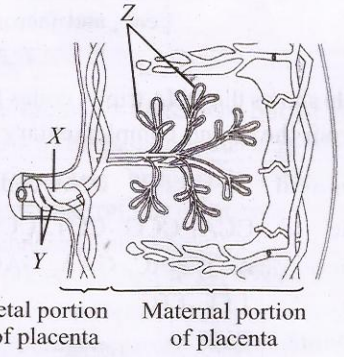
A. Both the organisms belong to Kingdom Protista.

B. Both move with the help of flagella.

C. '*a*' shows heterotrophic as well as autotrophic mode of nutrition, while '*b*' shows only heterotrophic mode of nutrition.

D. Both A and C

45. Refer to the given diagram showing the structural details of a part of human placenta.



Select the correct option regarding structures *X*, *Y* and *Z*.

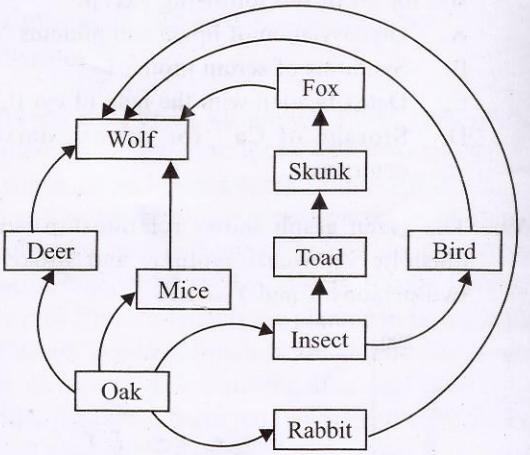
A. *X* has relatively higher urea concentration and lower amino acid concentration than *Y*.

B. *X* has relatively higher oxygen concentration than *Y*.

C. *Z* ensures mechanical stability by anchoring the fetus into the uterus and maximises the area over which carbon dioxide can be taken up by fetal blood.

D. *X* represents umbilical artery, *Y* represents umbilical veins and *Z* represents fetal capillaries.

46. Refer to the given food web and select the correct option regarding it.



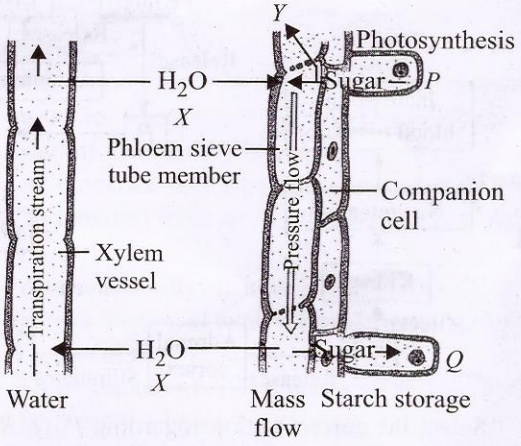
A. Deer passes relatively high percentage of net primary productivity to wolf as compared to fox.

B. Net secondary productivity in fox is higher than that of bird.

C. If an organism is introduced in this community which specifically feeds on skunk, then the insect and bird population will be positively affected.

D. Primary productivity of oak will always be lower than secondary productivity of deer, mice and rabbit.

47. Refer to the given figure and select the incorrect option regarding it.



A. The osmotic concentration of *P* is higher than that of *Q*.

B. *X* is an active process whereas *Y* is a passive process.

C. A low turgor pressure is maintained in *Q* by converting soluble photosynthetic product into insoluble form.

D. All of these

48. The given figures *P*, *Q* and *R* show different types of fruit in angiosperms.

P *Q* *R*

Select the correct statements regarding them.

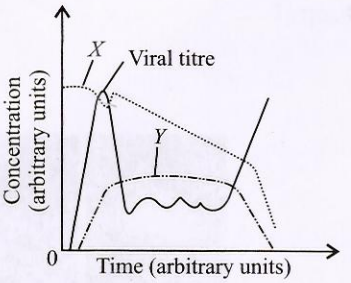
(i) *P* is dispersed through wind, *Q* is dispersed by animals whereas *R* is dispersed through water.
(ii) *P* is simple fruit whereas *Q* and *R* are aggregate fruits.
(iii) Pericarp is dry in *P* and fleshy in *Q*.
(iv) Both *P* and *Q* are derived from inferior ovaries.
(v) *R* develops from free ovaries of a single flower.
(vi) *P* is *Holoptelea*, *Q* is *Citrus* whereas *R* is lotus.

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

49. When wheat and sugarcane leaves are fed with radioactive $^{14}CO_2$, in which molecule would the radioactivity appear first in these plants?

	Wheat	Sugarcane
A.	3-Phosphoglycerate	Oxaloacetate
B.	3-Phosphoglycerate	3-Phosphoglycerate
C.	Oxaloacetate	Oxaloacetate
D.	Malate	3-Phosphoglycerate

50. The course of infection with HIV is shown in the graph. Curves *X* and *Y* indicate



A. *X* - Antigen concentration
Y - Helper cell concentration
B. *X* - Antigen concentration
Y - Interferon concentration
C. *X* - Interferon concentration
Y - Antibody titre
D. *X* - Helper cell concentration
Y - Antibody titre.

SPACE FOR ROUGH WORK