Techfest™
IIT Bombay

NSO

SOF NATIONAL SCIENCE OLYMPIAD 2017-18

CLASS 10

QUESTION PAPER SET B

DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Total Questions: 50 | Time: 1 hr.

Name:.....

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

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 on your mobile number.
3. The Question Paper comprises three sections:

   Logical Reasoning (10 Questions), **Science** (35 Questions) and **Achievers Section** (5 Questions)

   Each question in Achievers Section carries 3 marks, whereas all other questions carry one mark each.
4. All questions are compulsory. There is no negative marking. Use of calculator is not permitted.
5. There is only ONE correct answer. Choose only ONE option for an answer.
6. 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. ● Ⓑ Ⓒ Ⓓ
7. Rough work should be done in the blank space provided in the booklet.
8. Return the OMR Sheet to the invigilator at the end of the exam.
9. Please fill in your personal details in the space provided on this page before attempting the paper.
10. *For classes 8, 9 & 10, "Innovation Challenge" is being conducted by Techfest IIT Bombay in association with SOF. For details, please turn to last page.*

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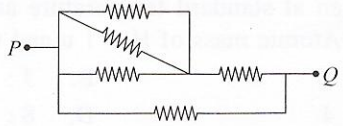
SCIENCE OLYMPIAD FOUNDATION
Inspiring Young Minds Through Knowledge Olympiads

11. A constant force is acted on a body which is initially at rest on a smooth track. The force acts for a short time interval t, and causes the body to move at a certain final speed. What is the time interval required to move the same body when the force is reduced by half so that the body can move at the same final speed?

A. t B. $2t$

C. $t/2$ D. $4t$

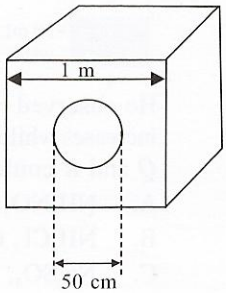
12. Five coils, each having the same resistance are joined according to the given circuit diagram. The equivalent resistance between points P and Q is 1 Ω. Then the resistance of each coil will be



A. 1 Ω B. 4 Ω

C. $\frac{1}{7}$ Ω D. $\frac{7}{4}$ Ω

13. A cube of side 1 m has a mass of 7500 kg before a through hole of diameter 50 cm is drilled on it. The hole is then completely filled with cement of density 3.2 g cm^{-3}. What is the density of the composite object?



A. 4320 kg m^{-3}

B. 5355 kg m^{-3}

C. 6655 kg m^{-3}

D. 8130 kg m^{-3}

14. A slide with an image 4 cm × 2 cm is placed at a distance of 10 cm behind a converging lens and a clear image is formed on a screen 1.1 m from the slide. The size of the image on the screen is

A. 40 cm × 20 cm B. 36 cm × 18 cm

C. 20 cm × 40 cm D. 10 cm × 50 cm

15. A mass of M kg is suspended by a weightless string of length l. A horizontal force is applied to displace it slowly until the string makes an angle of 30° with the initial vertical direction. What is the work done by the applied force?

A. $Mgl\left(1-\frac{\sqrt{3}}{2}\right)$ B. $Mgl\left(1-\frac{1}{2}\right)$

C. $Mg\frac{l\sqrt{3}}{2}$ D. $\frac{Mgl}{4}$

16. Read the given statements and select the correct option.

Statement 1 : Thermonuclear bombs can be more devastating than the atomic bombs.

Statement 2 : Process of nuclear fusion is involved in atomic bomb.

A. Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.

B. Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.

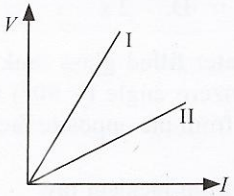
C. Statement 1 is true but statement 2 is false.

D. Statement 1 is false but statement 2 is true.

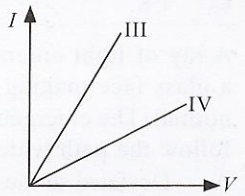
17. Two students X and Y perform experiments on series and parallel combination of two given resistors R_1 and R_2 and plot the graphs as shown here. Which of the following options is true about the graphs obtained by the students?

(V is potential difference and I is current)

Graph by student X



Graph by student Y



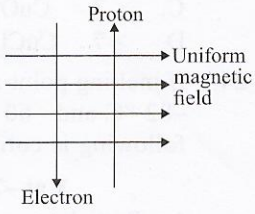
	Series	Parallel
A.	I, III	II, IV
B.	I, IV	II, III
C.	II, III	I, IV
D.	II, IV	I, III

18. A car accelerates from rest at a constant rate α for some time after which it decelerates at a constant rate β and comes to rest. If total time elapsed is t, then the maximum displacement of the car will be

A. $\frac{\alpha+\beta}{\alpha\beta t^2}$ B. $\frac{(\alpha^2-\beta^2)t^2}{\alpha\beta}$

C. $\frac{\alpha\beta t^2}{2(\alpha+\beta)}$ D. $\frac{(\alpha+\beta)t^2}{\alpha\beta}$

19. A uniform magnetic field exists in the plane of paper pointing from left to right as shown in figure. In the field, an electron and a proton move as shown. The electron and the proton experience



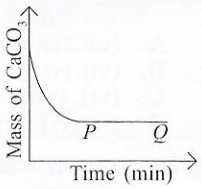
A. Forces both pointing into the plane of paper

B. Forces both pointing out of the plane of paper

C. Forces pointing into the plane of paper and out of the plane of paper respectively

D. Forces pointing opposite and along the direction of the uniform magnetic field respectively.

30. Kunal, a class 10 student studied the reaction between marble chips and dilute HCl. He took 50 g of marble chips and 100 mL of 0.1 molar HCl solution. The given graph shows how the total mass of marble chips varies with time as the reaction proceeds.



Which of the following statements are incorrect?

I. More and more CO_2 gas is evolved along PQ.
II. $CaCO_3$ remains unreacted after point P.
III. Reaction gets completed at point P.
IV. Dilute HCl remains unreacted after point P.

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

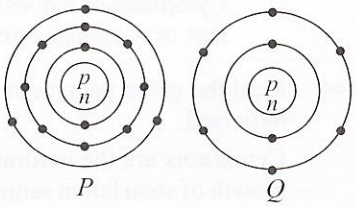
31. A part of the periodic table is represented as :

H							He
P						R	
Q						S	T

In the given section of the periodic table, the most metallic element, the most non-metallic element, the smallest atom and the atom which has complete octet in M shell are respectively

A. Q, R, R and T
B. R, P, P and S
C. Q, R, P and T
D. P, R, S and T.

32. Atomic structures of elements P and Q are schematically represented as :



Which of the following statements is/are correct?

I. P and Q will form the compound P_2Q_3.
II. P will form phosphide with formula PP_3.
III. Q exists as a divalent cation.
IV. P can form P^{5-} anion to attain the noble gas configuration.

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

33. Consider the following reactions :

I. Ethanol is oxidised by acidified $K_2Cr_2O_7$.
II. Methane undergoes complete combustion.
III. Ethanoic acid reacts with anhyd.Na_2CO_3.
IV. Ethanol reacts with sodium metal.

Reaction(s) in which water is one of the products is/are

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

34. The percentage by mass of water of crystallisation in hydrated copper sulphate is

[Given: Atomic mass of Cu = 63.5 u, H = 1 u, O = 16 u and S = 32 u]

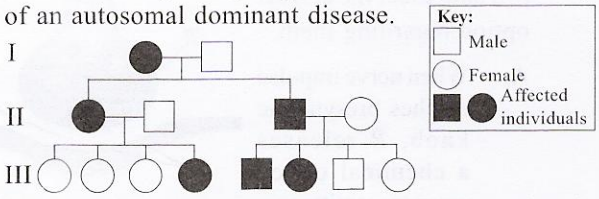
A. 42%
B. 36%
C. 63%
D. 24%

35. Refer to the given dichotomous key. Identify K, L, M, N, O and P and select the incorrect statement regarding them.

I. (a) The cells of tissue have wall. – Go to II
   (b) The cells of tissue lack wall. – Go to V
II. (a) Tissue is made up of similar or only one type of cells. – Go to III
   (b) Tissue is made up of more than one type of cells. – Go to IV
III. (a) Wall thickening in tissue cells is uniform. – $\boxed{K}$
   (b) Wall thickening in tissue cells is not uniform. – $\boxed{L}$
IV. (a) Conducting elements are of two types. – $\boxed{M}$
   (b) Conducting element is of one type. – $\boxed{N}$
V. (a) It helps in gamete formation. – $\boxed{O}$
   (b) It helps in absorption of water from digested food. – $\boxed{P}$

A. O could be cuboidal epithelium while P could be columnar epithelium.
B. In M conduction occurs only in one direction, *i.e.*, upward while in N, conduction occurs in both directions, *i.e.*, upward and downward.
C. L provides mechanical support and flexibility to the plant body.
D. K could be parenchyma that occurs chiefly in leaf stalks, leaf midribs and herbaceous dicotyledonous stems but is usually absent in monocots.

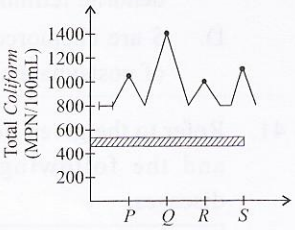
36. Refer to the given pedigree showing a case study of an autosomal dominant disease.



The genetic make-up of the first generation (female and male respectively) is

A. AA, aa
B. AA, Aa
C. Aa, AA
D. Aa, Aa.

37. In a study, water samples of Ganga river were collected from four different cities (P, Q, R and S) to check the presence of *Coliform* bacteria. The result obtained was plotted in the given graph.



Select the correct option regarding this.

A. People living in city Q are more prone to water-borne diseases like typhoid, cholera, etc.
B. The river water of city P is most suitable for agriculture.
C. The biological oxygen demand in river of city R is more than that found in city S.
D. Dissolved oxygen content of river Q will be more than that of river R.

(iii) Hormone released by gland *S*, enhances blood pressure by stimulating contraction of smooth muscles of arterioles.

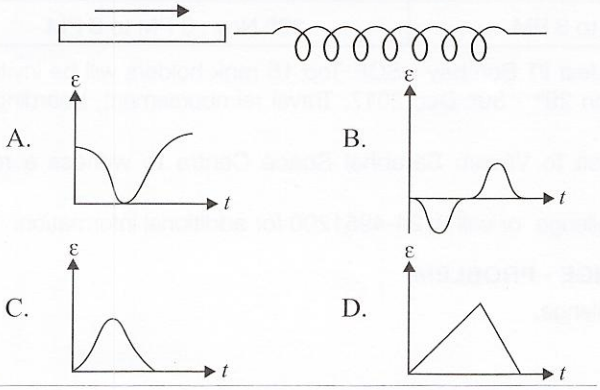
(iv) Hypersecretion of a hormone by gland *R* causes myxedema whereas its hyposecretion causes Graves' disease.

(v) Hormones secreted by gland *T* regulate the calcium and phosphate levels in blood.

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

ACHIEVERS SECTION

46. The variation of induced emf (ε) with time (*t*) in a coil if a short bar magnet is moved along its axis with a constant velocity is best represented as



Direction (Q. No. 47 and 48) : Read the given passage and answer the following questions.

When an alcohol is heated with excess of conc. H_2SO_4 at about 170 °C, it gets dehydrated to form alkene(s). In this reaction, conc. H_2SO_4 acts as a dehydrating agent.

47. Which of the following statements is/are correct when 2-butanol undergoes dehydration?

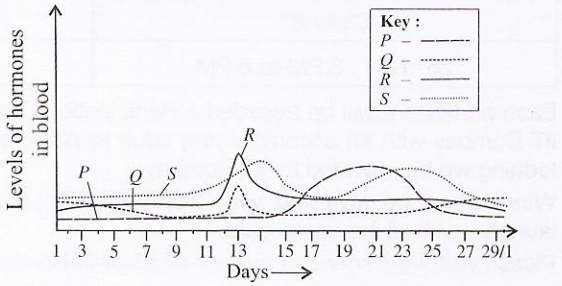
I. Only one alkene having same number of carbon atoms as in 2-butanol is formed.
II. Two alkenes having different structural formulae but same molecular formula are formed.
III. Only one alkene having one carbon atom less than 2- butanol is formed.
IV. Two alkenes are formed out of which one is terminal and other is non-terminal.
V. Two alkenes having the same percentage composition by mass are formed.

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

48. If boiling point of an alkene formed in a dehydration reaction of an alcohol is –6°C then, which of the following could be the boiling points of succeeding and preceding members of this alkene in its homologous series respectively?

A. –48 °C and –104 °C
B. 30 °C and 64 °C
C. –104 °C and –48 °C
D. 30 °C and –48 °C

49. Refer to the given graph showing levels of different hormones (*P*-*S*) during menstrual cycle in a normal woman.



Identify the hormones *P*-*S* and select the incorrect statement regarding them.

A. *R* stimulates the ovarian follicles to produce estrogen during proliferative phase while *Q* stimulates the corpus luteum of the ovary to secrete progesterone.
B. Menstrual phase is caused by the reduction of *P* and *S*.
C. Proliferative phase is characterised by increased production of *S* whereas secretory phase is characterised by increased production of *P*.
D. In males, *Q* causes spermatogenesis whereas *R* stimulates Leydig's cells to secrete testosterone.

50. Read the given statements each with one or two blanks. Select the option that correctly fills the blanks in any two statements.

(a) (i) is the process of aerobic burning whereas (ii) is anaerobic burning of combustible constituent of solid waste at high temperature.
(b) (i) secretes mucus and watery alkaline fluid that contains fructose.
(c) Tendrils of *Cucurbita* and thorns of *Bougainvillea* are (i) organs while wings of birds and insects are (ii) organs.
(d) Rate of heart beat and breathing movements of human body are controlled by (i).

A. (b) - (i) - Seminal vesicles;
(c) - (i) - Analogous, (ii) - Homologous
B. (c) - (i) - Homologous, (ii) - Analogous;
(d) - (i) - Medulla oblongata
C. (a) - (i) - Pyrolysis, (ii) - Incineration;
(b) - (i) - Cowper's gland
D. (a) - (i) - Incineration, (ii) Pyrolysis;
(d) - (i) - Diencephalon

SPACE FOR ROUGH WORK

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PRESENTS
INNOVATION CHALLENGE
FOR CLASSES 8, 9 & 10

INNOVATION CHALLENGE - INTRODUCTION

Innovation Challenge (IC) is being conducted by Techfest IIT Bombay in association with SOF. Students studying in classes 8, 9 or 10 may appear in the IC provided they have registered for SOF NSO during 2017-18.

Appearing in the IC is not compulsory. In case you wish to appear in the IC, please visit www.techfest.org/innovationchallenge. No registration fee / any other formality is required to be fulfilled.

To appear in IC, please read the question given below and upload your answer at the above site as per following schedule:

Time Slots for Uploading Answer		
Class 8th	Class 9th	Class 10th
28th Nov : 3 PM to 8 PM	27th Nov : 3 PM to 8 PM	26th Nov : 3 PM to 8 PM

Each participant will be awarded a Participation Certificate from Techfest IIT Bombay - SOF. Top 15 rank holders will be invited to IIT Bombay with an accompanying adult to participate in the finals on 29th - 30th Dec 2017. Travel reimbursement, boarding and lodging will be provided by IIT Bombay.

Winners will be awarded with Trophies, Gifts, Certificates and visit to Vikram Sarabhai Space Centre to witness a rocket launch – with all expenses paid.

Please visit www.sofworld.org/sof-techfest-iit-bombay-innovation-challenge or call 0124-4951200 for additional information.

INNOVATION CHALLENGE - PROBLEM

Student may attempt the following problem as part of Innovation Challenge.

Research Proposal

Any important discovery needs thousands of researches. Imagine you are a scientist and you want to do a research of your own. Due to very heavy investment in researches you seek monetary help. In order to get help from the concerned authorities, you have to submit your own research proposal. The format of research proposal (for online submission) is as follows:

- **Title of the proposal** (in about 20 words) : For example, Proposal to (research on some ink materials) devise a process that can be used to remove ink from printed materials.
- **Problem statement** (about 50 words) : Briefly describe the problem that your research is going to address. You can also present examples.
- **Importance of problem** (about 100 words) : Why are you interested in this topic. Write why your research proposal is important and support your claim with reliable data (if possible).
- **Expectation and Conclusion** (about 50 words) : Justify why you think your research proposal has a good chance of success. Write about the possible impact if you succeed in your proposed research. The answer can be as simple as "This research will address problems in plants transportation theory" or "This research will help reducing water borne disease in rural areas".

Note: You have to submit a **research proposal only, not an actual research**. Students are free to choose any category/topic for this purpose such as environment, healthcare, technology, space, biology etc.

Students are expected to submit a research proposal based on new idea that should not be copied from internet. You are not expected to do an actual research.

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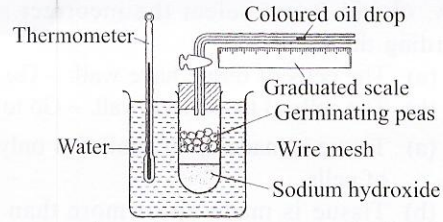
Note: Please address all communication to the National Office only.

38. Study the given experimental setup.



By measuring the movement of oil drop in the apparatus, what can be investigated?

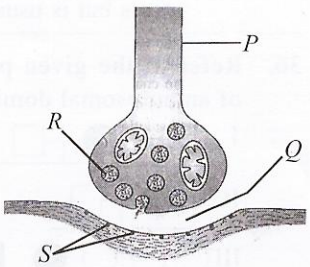
A. Carbon dioxide released during germination
B. Heat released during germination
C. Oxygen used during germination
D. Water produced during germination

39. Refer to the given figure of a bryophyte. Identify the labelled parts *P*, *Q*, *R* and *S* and select the option which represents the correct number of chromosome in these parts.

Note : [For the given plant, 2n = 24]

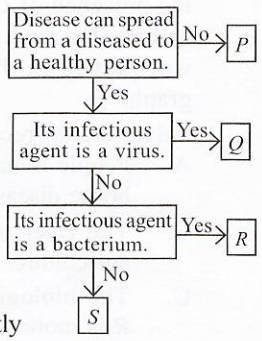
	P	*Q*	*R*	*S*
A.	12	24	12	24
B.	24	24	12	12
C.	24	24	8	8
D.	8	24	24	12

40. Refer to the given figure. Identify labelled parts *P*-*S* and select the correct option regarding them.



A. When nerve impulse reaches presynaptic knob, *R* releases a chemical called neurotransmitter.
B. *P* contains Nissl's granules and neurofibrils and conducts impulses away from the cell body.
C. *Q* is a narrow fluid filled space that lies between presynaptic and postsynaptic knobs formed by dendrite terminal of both neurons.
D. *S* are chemoreceptors present on axon terminal of postsynaptic membrane.

41. Refer to the given flow chart and the following list of diseases.



(i) Polio (ii) Cholera
(iii) Kala azar (iv) Influenza
(v) Malaria (vi) Kwashiorkor
(vii) Goitre (viii) Diphtheria
(ix) Pellagra
(x) Whooping cough

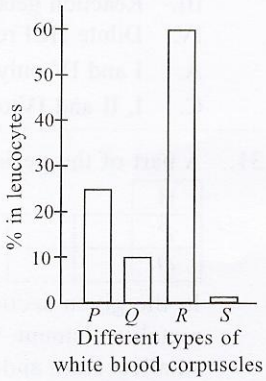
Now, select the option that correctly categorises these diseases into *P*, *Q*, *R* and *S*.

	P	*Q*	*R*	*S*
A.	(vi), (vii), (ix)	(i), (iv)	(ii), (viii), (x)	(iii), (v)
B.	(vi), (vii), (ix)	(i), (iv), (x)	(ii), (viii)	(iii), (v)
C.	(vi), (vii)	(i), (iv), (ix)	(ii), (viii), (x)	(iii), (v)
D.	(i), (vi), (vii)	(iv), (ix)	(ii), (v), (x)	(iii), (viii)

42. Ruby crossed a tall pea plant with white flowers and a dwarf pea plant with violet flowers. She performed a _____ .

A. Test cross
B. Dihybrid cross
C. Natural selection
D. Monohybrid cross

43. Refer to the given graph showing different types of white blood corpuscles in a normal man.



Identify *P*, *Q*, *R* and *S* and select the incorrect statement regarding them.

A. *P* produces antibodies to destroy microbes and their toxins, rejects grafts and kills tumour cells.
B. *Q* could be phagocytic in nature and is able to engulf bacteria and cellular debris.
C. Nucleus of *R* is many lobed whereas nucleus of *S* is usually two lobed.
D. Cytoplasm of *P* does not contain granules whereas that of *R* contains granules.

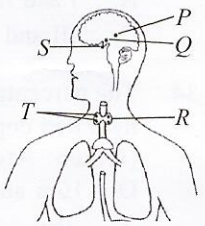
44. Read the given paragraph where few words have been italicised.

Cytokinins are the natural substances which enhance growth of stem but in same concentration are incapable of causing growth of intact root. *Naphthalene acetic acid* is natural whereas *indole-3 acetic acid* is synthetic auxin. Gibberellins *inhibit* growth and cause bolting in rosette plants. Abscisic acid *stimulates* growth and causes abscission of flowers and fruits. *Ethylene* induces ripening of climacteric fruits and formation of root hair.

Select the correct option regarding it.

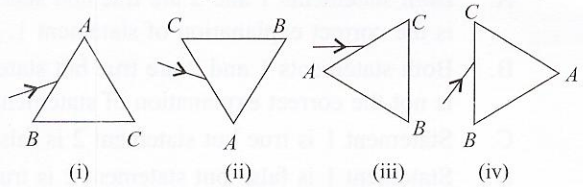
A. *Cytokinins* should be replaced with *ethylene*.
B. *Cytokinins* should be replaced with *auxins* whereas *napthalene acetic acid* and *indole-3 acetic acid* should be interchanged.
C. *Inhibit* and *stimulates* should not be interchanged as they are correctly mentioned.
D. *Ethylene* should be replaced with *cytokinin*.

45. Refer to the given figure. Identify *P* - *T* and select the correct statements regarding them.



(i) Gland *P* secretes a hormone which plays role in the development of immune system of body.
(ii) Gland *Q* transmits messages in the form of electrical impulses.

20. A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in figure. In which of the following cases, after dispersion, the third colour from the top corresponds to the colour of the sky?



A. (i) B. (ii)
C. (iii) D. (iv)

21. There are two walls X and Y which are 120 m apart from each other. A boy standing 40 m away from wall X claps his hands once. If the speed of sound in air is 330 m s^{-1}, then what is the time interval between the first and the second echo that he hears?

A. 0.05 s B. 0.24 s
C. 1 s D. 2 s

22. A ray of light enters a water filled glass tank from a glass face making a nonzero angle (< 90°) to the normal. The emergent ray from the opposite face will follow the path which is

A. Deviated to the right from incident ray
B. Deviated to the left from incident ray
C. Same as incident ray
D. Parallel but not along the incident ray.

23. Fill in the blanks in the given table by choosing an appropriate option.

S. No.	Salt	Parent acid	Parent base	pH of aq. salt solution
1.	NaClO	HClO	NaOH	i
2.	ii	HCl	$Cu(OH)_2$	iii
3.	NH_4HCO_3	iv	v	≈7
4.	CH_3COOK	CH_3COOH	KOH	vi

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
A.	7	$CuCl_2$	> 7	NH_3	CO_2	7
B.	> 7	$CuCl_2$	< 7	H_2CO_3	NH_4OH	> 7
C.	< 7	CuO	> 7	NH_4OH	H_2CO_3	7
D.	> 7	$CuCl_2$	> 7	NH_3	HCl	> 7

24. If melting point and boiling point of substance X are –82 °C and –60 °C respectively then, which of the following is correct for the substance X?

	X at –70 °C	X at –50 °C
A.	Particles are tightly packed and not moving	Particles are loosely packed and randomly moving
B.	Has definite volume but no definite shape	Neither has definite volume nor definite shape
C.	Possesses fluidity	Possesses rigidity
D.	Is almost incompressible	Is completely incompressible

25. Read the given passage and fill in the blanks by choosing an appropriate option.

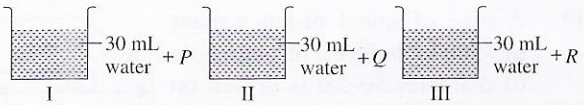
Bleaching powder is a (i) powder. When exposed to air, it reacts with (ii) of the air to liberate Cl_2 gas. It is (iii) in cold water and milkiness of the solution is due to the presence of unreacted (iv). It reacts with HCl and H_2SO_4 liberating (v) gas.

	(i)	(ii)	(iii)	(iv)	(v)
A.	Blue crystalline	Moisture	Soluble	CO_2	SO_2
B.	Yellowish white	CO_2	Soluble	Lime	Cl_2
C.	White	O_2	Insoluble	Lime	Cl_2
D.	Yellow	Moisture	Soluble	CO_2	Cl_2

26. The ratio of the number of molecules in 4 g of hydrogen to the number of molecules in 5.6 dm^3 of oxygen at standard temperature and pressure is [Given: Atomic mass of H = 1 u and O = 16 u]

A. 2 : 1 B. 3 : 4
C. 1 : 4 D. 8 : 1

27. Rohan added different substances P, Q and R to three beakers each containing 30 mL of water as shown in the figure.



He observed that the temperature of beakers I and II increases while that of beaker III decreases. Substances P, Q and R could be respectively

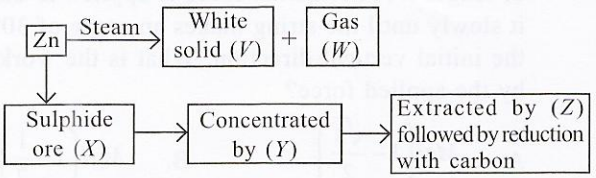
A. NH_4NO_3, KOH and $Na_2CO_3 \cdot H_2O$
B. NH_4Cl, $CuSO_4$ and NaCl
C. Na_2SO_4, CaO, $CuSO_4 \cdot 5H_2O$
D. $NaNO_3$, KCl and K_2SO_4.

28. The boiling points of some gases are given in the table. If their liquid mixture is subjected to fractional distillation, the order in which gases will distil over is

Gas	B.pt. (°C)
Kr	–153
Ne	–246
N	–196
O	–183

A. Kr, O, N, Ne B. O, N, Kr, Ne
C. Ne, N, Kr, O D. Ne, N, O, Kr

29. Study the given flow chart carefully and identify V, W, X, Y and Z.



	V	W	X	Y	Z
A.	$Zn(OH)_2$	H_2	Cinnabar	Leaching	Roasting
B.	ZnO	H_2	Zinc blende	Froth floatation	Roasting
C.	Zn_2O_3	H_2O	Galena	Froth floatation	Calcination
D.	ZnO	H_2	Calamine	Calcination	Roasting

1. Find the missing term in the given series.

APZ, BRY, DTW, GVT, KXP, ?

A. PZK B. PZL
C. OZK D. OYL

2. In which of the following figures, Fig. (X) is exactly embedded as one of its parts?

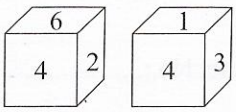
Fig. (X)

A.  B. 

C.  D. 

3. Two positions of a dice are shown. Find the number opposite to number 3.

A. 6
B. 5
C. 2
D. 1



4. If > stands for +, < stands for –, + stands for ÷, ∧ stands for ×, – stands for =, × stands for > and = stands for <, then which of the following options is correct?

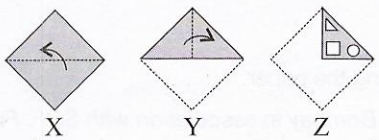
A. $18 > 12 + 4 \times 7 > 8 \wedge 2$
B. $31 > 1 < 2 = 4 > 6 \wedge 7$
C. $29 < 18 + 6 = 36 + 6 \wedge 4$
D. $32 > 6 + 2 = 6 < 7 \wedge 2$

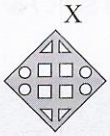
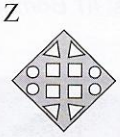
5. How many 2's are there in the given arrangement, each of which is not immediately preceded by a perfect square and followed by an odd number?

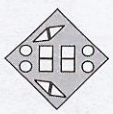
6 4 2 5 2 8 2 9 2 1 3 8 6 2 1 2 5 8 6 1 2 4 2 5

A. 4 B. 3
C. 2 D. 5

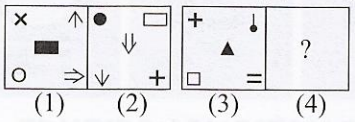
6. A set of three figures X, Y and Z showing a sequence of folding of a piece of paper is given. Fig. (Z) shows the manner in which the folded paper has been cut. Select a figure from the options which would most closely resemble the unfolded form of Fig. (Z).



A.  B. 

C.  D. 

7. There is a certain relationship between figures (1) and (2). Establish the similar relationship between figures (3) and (4) by selecting a suitable figure from the given options which will replace the (?) in figure (4).



A.  B. 

C.  D. 

8. In a certain code language,

1. *pod na joc* means very bright boy;
2. *tam nu pod* means the boy comes;
3. *nu per ton* means keep the doll;
4. *joc ton su* means very good doll.

Which of the following means good in that language?

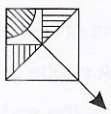
A. *su* B. *joc*
C. *ton* D. *pod*

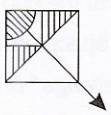
9. A word arrangement machine, when given a particular input, rearranges it following a particular rule. The following is the illustration of the input and the steps of arrangement:

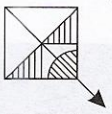
Input : top the name good for is there
Step I : is top the name good for there
Step II : is for top the name good there
Step III : is for the top name good there
Step IV : is for the top good name there
Step IV is the last step for this input.
As per the rules followed in the above steps, which of the following is the last step of the given input?
Input : if there was no good man

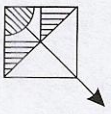
A. V
B. III
C. IV
D. Cannot be determined

10. Which of the following options will complete the pattern given in Fig. (X)?

A. 

B. 

C. 

D. 

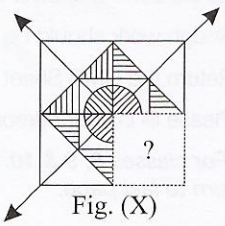


Fig. (X)

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10th Std.

ANSWER KEY

1.	[A]	2.	[C]	3.	[C]	4.	[B]	5.	[C]	6.	[A]
7.	[B]	8.	[A]	9.	[C]	10.	[B]	11.	[B]	12.	[D]
13.	[C]	14.	[A]	15.	[A]	16.	[C]	17.	[B]	18.	[C]
19.	[A]	20.	[B]	21.	[B]	22.	[D]	23.	[B]	24.	[B]
25.	[B]	26.	[D]	27.	[C]	28.	[D]	29.	[B]	30.	[A]
31.	[A]	32.	[D]	33.	[B]	34.	[B]	35.	[D]	36.	[A]
37.	[A]	38.	[C]	39.	[B]	40.	[A]	41.	[A]	42.	[B]
43.	[C]	44.	[B]	45.	[C]	46.	[B]	47.	[A]	48.	[D]
49.	[A]	50.	[B]								

NSO-SOF NATIONAL SCIENCE OLYMPIAD 2017-18
CLASS-11 / SET-B / LEVEL - SOLUTIONS

1. Difficulty : Easy

Topics :

Physics,

$\ell_1 = \frac{m_L d}{m_S + m_L}$ $\quad$ $\ell_2 = \frac{m_S d}{m_S + m_L}$ $\quad$ $a_{C_S} = \frac{G m_S m_L}{d^2 m_S}$

$$\frac{G m_S}{\ell_1^2} \times \frac{d^2}{G m_L} = \frac{16}{27}$$

$$\frac{m_S}{m_L} \frac{d^2 (m_S + m_L)^2}{m_L^2 d^2} = \frac{16}{27}$$

$$\left(\frac{m_S}{m_L}\right) \left(\frac{m_S}{m_L} + 1\right)^2 = \frac{16}{27}$$

$$X \quad (X+1)^2 = \frac{16}{27}$$

$$X = \frac{1}{3}$$

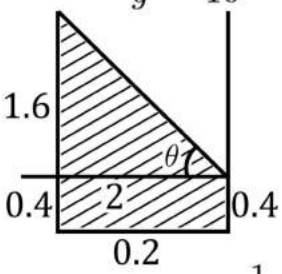
2. Difficulty : Easy

Topics :

Physics,

Volume initial $= 2 \times 2 \times 1.5 = 6m^3$

$\tan\theta = \frac{a}{g} = \frac{8}{10} = \frac{4}{5}$



Volume final $= \frac{1}{2}[2 + 0.4]2 \times 2 = 4.8\ m^3$

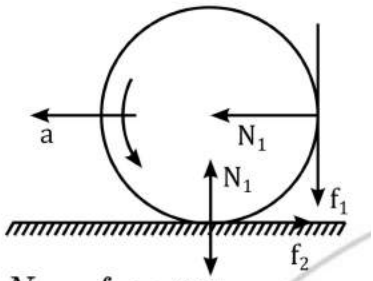
$\therefore$ Volume spilled $= 1.2\ m^3 \Rightarrow 1200$ litres

3.

Difficulty : Easy

Topics :

Physics,



$N_1 - f_2 = ma$
$N_2 - f_1 = mg$
$(f_2 - f_1)r = mr^2\alpha$
$a = r\alpha$
$N_2 = 2, \quad a = 0.3$
$\Rightarrow \quad 0.8 = \mu \times 2$
$\mu = 0.4$

4.

Difficulty : Easy

Topics :

Physics,

$$t' = t\left(1 - \frac{\mu_1}{\mu_2}\right) < 0$$

Apparent distance from S to $P = d - t' = d + t\left(\frac{\mu_2}{\mu_1} - 1\right)$

5.

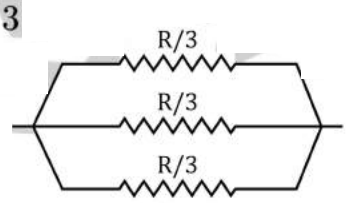
Difficulty : Easy

Topics :

Physics,

When a wire is ent into 3 parts, the resistance becomes $\frac{1}{3}^{\text{rd}}$

$\frac{V^2}{R} \times 5 = H_1$
$\Rightarrow \quad H_1 \ : \ H_2 = 1 : 9$



$\left(\frac{3V^2}{R} + \frac{3V^2}{R} + \frac{3V^2}{R}\right) \times 5 = H_2$

6.

Difficulty : Easy

Topics :

Physics,

At centre only, the distance from A & D will be equal, hence, magnet is field must be zero.

7.

Difficulty : Easy

Topics :

Physics,

$$\frac{\mu_0 i}{2\pi r} = 0.4T$$
$$\frac{\mu_0 i}{2\pi \times 2r} = 0.2T$$

8.

Difficulty : Easy

Topics .

Physics,

$J \to K$, isochoric process, $W = 0$ & $\Delta U < 0$ hence $Q < 0$
$K \to L$ isoboric process, $W > 0$ & $Q > 0$
$L \to M$ isochoric process, $W = 0$ & $\Delta U > 0$ hence $Q > 0$
$M \to J$ general process, $W < 0$ & $\Delta U < 0$ hence $Q < 0$

9.

Difficulty : Easy

Topics :

Physics,

$i_c \leq 60^o$
So, maximum possible value of i_c is 60^c
Now, $\frac{\mu_g}{\mu_\ell} = \frac{1}{\sin i_c}$
or $\mu_L = \mu_g \sin i_c = 1.5 \sin 60^o = 1.3$

10.

Difficulty : Easy

Topics :

Physics,

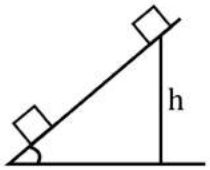
$$\text{As } R \propto \ell$$
$$15 = \rho\frac{(l_1 + l_2)}{A} \qquad l_1 + l_2 = \frac{15A}{\rho}$$
$$\frac{5}{18} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow \frac{l_1 l_2}{l_1 + l_2} = \frac{18A}{5p}$$
$$\frac{5}{18} = \frac{A}{\rho l_1} + \frac{A}{\rho l_2}, \text{ use } l_2 = l - l_1 \text{ and solve quandratic.}$$

11.

Difficulty : Easy

Topics :

Physics,



True

Statement-2 : Coefficient of friction remains same.
Hence Statement-2 is wrong.

12.

Difficulty : Easy

Topics :

Physics,

Conservation of energy

$$O = mg\left(\frac{h}{3}\right) - mg\left(\frac{2h}{5}\right) + \frac{1}{2}m\left(V_A^2 + V_B^2\right)$$
$$= mg\left(\frac{h}{3}\right) - mg\left(\frac{2h}{3}\right) + \frac{1}{2}m\left(V_A^2 + \left(\frac{V_A}{2}\right)^2\right)$$
$$O = \frac{-gh}{3} + \frac{5}{8}V_A^2$$
$$V_A = \sqrt{\frac{8gh}{15}}$$

13.

Difficulty : Easy

Topics :

Physics,

$$\text{Speed} = k \cdot \rho^a \cdot g^b \cdot \lambda^c$$
$$[LT^{-1}] = [M^o L^o T^o] \cdot [ML^{-3}]^a \ [LT^{-2}]^b \ [L]^c$$
$$M^o LT^{-1} = M^a L^{-3a+b+c} T^{-2b}$$
$$\Rightarrow \quad a = 0$$
$$b = \frac{1}{2}$$
$$c = \frac{1}{2}$$

14.

Difficulty : Easy

Topics :

Chemistry,

(I) For H atom energy is decided by principle quantum number (n)
Higher the value of n, more will be the energy.
(IV) Radial nodes $= n - \ell - 1$
$3s \Rightarrow 3 - 0 - 1 = 2$
$2p \Rightarrow 2 - 1 - 1 = 0$
(III) $m = -\ell$ to $+\ell$

15.

Difficulty : Easy

Topics :

Chemistry,

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$
Rate of reaction of Mg with HCl increases by concentration of acid.

16.

Difficulty : Easy

Topics :

Chemistry,

$$\text{Eq. of } KI = \text{Eq. of } H_2O_2 = \text{Eq. of } I_2 = \text{Eq. of } Na_2S_2O_3$$
$$25 \times N = 20 \times 0.3$$
$$N = \frac{4}{5} \times 0.3$$
$$\text{Vol. strength} = 5.6 \times \frac{4}{5} \times 0.3$$
$$= 1.2 \times \frac{5.6}{5} = 1.344$$

17.

Difficulty : Easy

Topics :

Chemistry,

$X -$ Decolourise Br_2/water so it is an alkene
$Y \rightarrow C_2H_4$
$Z \rightarrow \ C_5H_{12} \rightarrow$ alkane
$W = CH_3COOH$

18.

Difficulty : Easy

Topics :

Chemistry,

$$C = \underset{\underset{CH_3}{|}}{C} - C = C + HCl \longrightarrow CH_2 = \underset{\underset{CH_3}{|}}{C} - \overset{\oplus}{C}H - CH_3 \xrightarrow{Cl^{\ominus}} CH_2 = \underset{\underset{CH_3}{|}}{Cl} - \underset{|}{\overset{Cl}{|}}CH - CH_3$$

19.

Difficulty : Easy

Topics :

Chemistry,

$P_C = \dfrac{a}{27b^2}$
$T_C - \dfrac{8a}{27Rb}$
$V_C = 3b$
(I) is correct as $V_C \propto b$
(II) for gas Q
$(T_C)_C < (T_C)_P$
Hence gas $'P'$ can be easily liquified.

20.

Difficulty : Easy

Topics :

Chemistry,

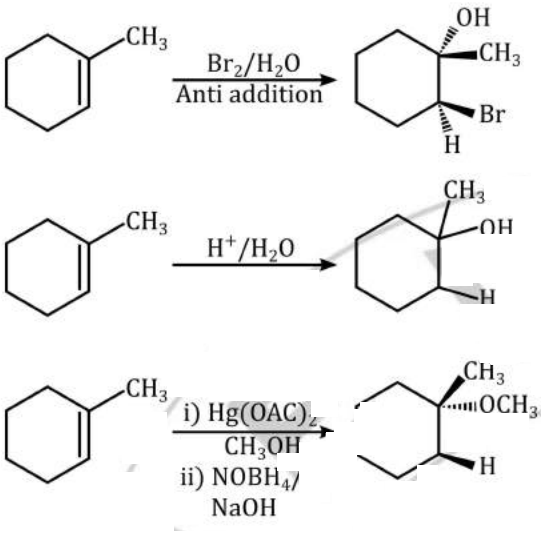
Sulphide ores are concentrated by roasting not by calcination.

21.

Difficulty : Easy

Topics :

Chemistry,



22.

Difficulty : Easy

Topics :

Chemistry,

$pH = -\log(H^+)$
Higher pH means lower H^+

23.

Difficulty : Easy

Topics :

Chemistry,

Metallic character ↑ down the group.

24.

Difficulty : Easy

Topics :

Chemistry,

$\Delta G = \Delta H - T\Delta S$
If $\Delta H = -ve$
$\Delta S = +ve$
Reaction is always spontaneous.

25.

Difficulty : Easy

Topics :

Chemistry,

C^+ stability decreases by withdrawing groups.

26.

Difficulty : Easy

Topics :

Physics,

$$F_x = \frac{3}{4}x + 10,\ F_y = -\frac{4}{3}x + 20,\ F_z = \frac{4}{3}x - 16$$

$$W = \int_{x=4}^{} \vec{F} \cdot d\vec{s}$$

$$= \int_{x=0}^{y=20} f_x d_x + \int_{y=5}^{y=0} f_y d_y + \int_{z=12}^{} f_z d_z = 192\ J$$

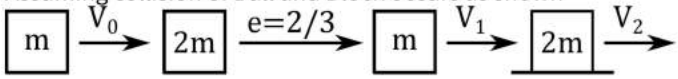
27.

Difficulty : Easy

Topics :

Physics,

Assuming collision of Ball and Block occurs as shown



$$mV_0 = mV_1 + 2mV_2 \quad \Rightarrow V_0 = V_1 + 2V_2$$
$$e = \frac{2}{3} = \frac{V_2 - V_1}{V_0} \quad \Rightarrow \frac{2}{3}V_0 = V_2 - V_1$$
$$\frac{5}{3}V_0 = 3V_2$$
$$\frac{5}{9}V_0 = V_2$$
$$\frac{2}{3}V_0 = \frac{5}{9}V_0 - V_1$$
$$V_1 = \frac{5}{9}V_0 - \frac{2}{3}V_0$$
$$V_1 = \frac{-V_0}{9}$$
$$V_2^2 = 2\mu g\frac{3L}{2}$$
$$\frac{25}{81}V_0^2 = 2\mu g\frac{3L}{2}$$
$$\frac{25}{81} \times 2gL = \mu g3L$$
$$\frac{50}{243} = \mu$$
$$V_1^2 = 2gh$$
$$\frac{V_0^2}{81}2gL(1-\cos\theta)$$
$$\frac{2gL}{81} = (1-\cos a)$$
$$\frac{1}{81} = 1-\cos\theta$$
$$\cos\theta = \frac{80}{81}$$

28.

Difficulty : Easy

Topics :

Chemistry,

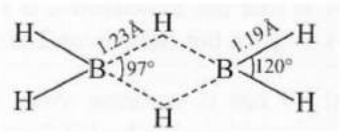
$$(X) = BF_3$$
$$(Y) = B_2H_6$$

29.

Difficulty : Easy

Topics :

Chemistry,



30.

Difficulty : Easy

Topics :

Chemistry,

Using steric number

Steric number = (Number of lone pair on central atom) + (Number of atoms bonded to central atom)

And calculate hybridisation..

31.

Difficulty : Easy

Topics :

Mathematics,

Number of ways arranging n flowers

$= \frac{|\underline{n-1}}{2}$

If $(n = 8)$ and 4 particular flowers are never separated is ____

$\underbrace{f_1 f_2 f_3 f_4}_{\text{always together}} f_5 f_6 f_7 f_8$

No. of ways arranging 5 flowerings is

$= \frac{|\underline{5-1}}{2} \times |\underline{4}$

$= \frac{|\underline{4} \times |\underline{4}}{2}$

$= \frac{4 \times 3 \times 2 \times 1 \ \times \ 4 \times 3 \times 2 \times 1}{2}$

$= 288$

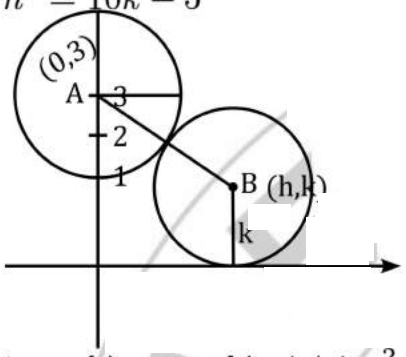
32.

Difficulty : Easy

Topics :

Mathematics,

$A(0,3),\ B(h,k)$
$AB = 2 + k$
$\sqrt{(h-0)^2 + (k-3)^2} = (2+k)$
$h^2 + k^2 + 9 - 6k = 4 + k^2 + 4k$
$h^2 = 10k - 5$



Locus of the centre of the circle is $x^2 = 10y - 5$
Which is a parabola.

33.

Difficulty : Easy

Topics :

Mathematics,

$x^2 - 3x + 5 = 0, \quad x^2 + 5x - 3 = 0$
$\alpha + \beta = 3 \qquad \gamma + \delta = -5$
$\alpha\beta = 5 \qquad \gamma\delta = -3$
Now, If roots are $(\alpha\gamma + \beta\delta)$ and $(\alpha\delta + \beta\gamma)$
then
$(\alpha\gamma + \beta\delta) + (\alpha\delta + \beta\gamma)$
$\Rightarrow \alpha(\gamma + \beta) + \beta(\delta + \gamma)$
$\Rightarrow (\alpha + \beta)(\gamma + \delta)$
$\Rightarrow \quad (3)(-5)$
$= -15 \quad .....(1)$
= (sum of the roots)
and $(\alpha + \gamma)(\alpha\delta + \beta\gamma)$
$\alpha^2\gamma\delta + \gamma^2\alpha\beta + \delta^2\alpha\beta + \beta^2\gamma\alpha$
$\gamma\delta(\alpha^2 + \beta^2) + \beta(\gamma^2 + \delta^2)$
$\gamma\delta[(\alpha+)^2 - 2\alpha\beta] + \beta[(\gamma+\delta)^2 - 2\gamma\delta]$
$\Rightarrow \quad (-3)[9 - 2 \times 5] + 5[25 - 2 \times (-3)]$
$\Rightarrow \qquad 3 \quad + \quad 5[25 + 6]$
$\Rightarrow \qquad 3 \quad + 155$
$\Rightarrow \quad 158$ (Product of the roots)
Equation is $x^2 + 15x + 158 = 0$

34.

Difficulty : Easy

Topics :

Mathematics,

Statement-1 is true.

$(n+1)^7 - n^7 - 1$

$\Rightarrow \ {}^7C_0 n^7 + {}^7C_1 n^6 + {}^7C_2 n^5 + {}^7C_3 n^4 + \ldots\ldots + {}^7C_7 - n^7 - 1$

$= n^7 + 7n^6 + \dfrac{7\times 6}{1\times 2} n^5 + \dfrac{7\times 6\times 5}{1\times 2\times 3} n^4 + \ldots\ldots + 1 - n^7 - 1$

$= 7\left(n^7 + \dfrac{6n^5}{2} + 5n^4 + \ldots\ldots\ldots\right)$

$=$ multiple of 7

$\Rightarrow \ (n+1)^2 - n^7 - 1$ is divisible by 7.

Statement-2 is true

If $n^7 - n$ is divisible by 7.

then $n^7 - n = 7p \qquad p \in I$

$\ldots.(1) \qquad n \in N$

If $n = 1$, equation (1) is true

$n = 2 \quad 2^7 - 2 = 2(2^6 - 1)$

$= \dfrac{2(63)}{7} = 16$

By mathematical induction method :

Let for $n = k \quad k^7 - k = 7P \quad \ldots.(2)$

for $n = k+1 \quad (k+1)^7 - (k+1)$

$\Rightarrow \ k^7 + 7k^6 + {}^7C_2 k^5 + \ldots\ldots + 1 - k - 1$

$(k^7 - k) + 7(k^6 + 3k^5 + 5k_1^4 + \ldots\ldots)$

From (2)

$\Rightarrow \ 7(P + k^6 + 3k^5 + 5k^4 + \ldots\ldots)$

$\Rightarrow$ Multiple of 7

$\Rightarrow \ n^7 - n$ is divisible by $7 \ \forall \ N$

35.

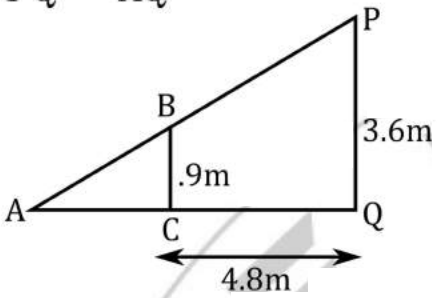
Difficulty : Easy

Topics :

Mathematics,

(Lamp)

$$\frac{BC}{PQ} = \frac{AC}{AQ}$$



AC=?

$$\frac{0.9}{3.6} = \frac{AC}{AC + 4.8}$$

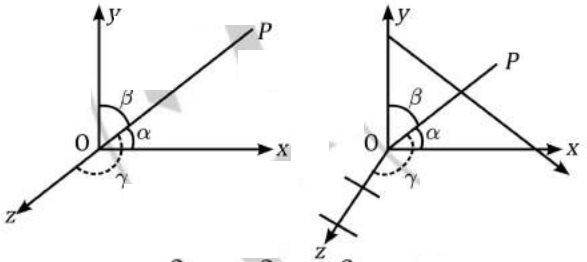
$$\Rightarrow \quad 4AC = AC + 4.8$$
$$\Rightarrow \quad 3AC = 4.8$$
$$\Rightarrow \quad AC = 1.6$$

36.

Difficulty : Easy

Topics :

Mathematics,



We know that $\ell^2 + m^2 + n^2 = 1$

$\ell = \cos\alpha,\ m = \cos\beta,\ n = cos\gamma$

$\therefore \quad \cos^2\alpha + \cos^2 + \cos^2\gamma = 1$

$1 - \sin^2\alpha \ + \ 1 - \sin^2\beta \ + \ 1 - \sin^2\gamma = 1$

$2 = \sin^2\alpha + \sin^2\beta + ^2\gamma$

37.

Difficulty : Easy

Topics :

Mathematics,

$$\tan^2\theta + (1-\sqrt{3})\tan\theta - \sqrt{3} = 0$$

$$\tan\theta = \frac{-(1-\sqrt{3}) \pm \sqrt{(1-\sqrt{3})^2 - 4(-\sqrt{3})}}{2}$$

$$= \frac{-1+\sqrt{3} \pm \sqrt{(1+\sqrt{3})^2}}{2}$$

$$\tan\theta = \frac{-1+\sqrt{3} \pm (1+\sqrt{3})}{2}$$

If $+ve$

$$\tan\theta = \frac{-1+\sqrt{3}+1+\sqrt{3}}{2}$$

$$\tan\theta = \sqrt{3} \Rightarrow \theta = n\pi + \frac{\pi}{3}$$

If $-ve$

$$\tan\theta = \frac{-1+\sqrt{3}-1-\sqrt{3}}{2}$$

$$\tan\theta = 1- \Rightarrow \theta = n\pi - \frac{\pi}{4}$$

$n \in z$

38.

Difficulty : Easy

Topics :

Mathematics,

(1) The function of the given graph is $\sec x$

(2) Domain $= R - (2n+1)\frac{\pi}{2}$

(3) Range $= R - (-1, 1)$

39.

Difficulty : Easy

Topics :

Physics,

$P-4; Q-3; R-2; S-1$

(P) e - eccentricity

$b^2 = a^2(1-e^2)$ for ellipse $\qquad L.R = \frac{1}{2}$ (Major axis)

$\frac{2b^2}{a} = \frac{1}{2}(2a)$ $\qquad \boxed{2b^2 = a^2}$

$b^2 = 2b^2(1-e^2) \rightarrow \frac{1}{2} = 1-e^2 \qquad \Rightarrow e = \frac{1}{\sqrt{2}}$

(Q) $x^2 - 4x + 4y^2 = 12$

$(x-2)^2 + 4y^2 = 16 \qquad \frac{(x-2)^2}{16} + \frac{y^2}{4} = 1$

$a^2 = 16 \qquad b^2 = a^2(1-e^2) \qquad b^2 = 14 \qquad 4 = 16(1-e^2)$

$\frac{1}{4} = 1 - e^2 \Rightarrow e^2 = \frac{3}{4} \qquad e = \frac{\sqrt{3}}{2}$

(R) Length of $LR = \frac{2b^2}{a} = \frac{1}{3}(2a)$

$b^2 = \frac{1}{3}a^2$

$b^2 = a^2(1-e^2) \qquad \frac{1}{3}a^2 = a^2(1-e^2)$

$e^2 = 1 - \frac{1}{3} \qquad e^2 = \frac{2}{3}$

$e = \sqrt{\frac{2}{3}}$

(S) L(major axis) = 3L(Minor axis)

$2a = 3(2b) \qquad a = 3b$

$a^2 = 9b^2 \qquad b^2 = a^2(1-e^2)$

$b^2 = 9b^2(1-e^2) \qquad \frac{1}{9} = 1 - e^2$

$e^2 = 1 - \frac{1}{9} = \frac{8}{9} \qquad e = \frac{2\sqrt{2}}{3}$

40.

Difficulty : Easy

Topics :

Mathematics,

Let the radii of the hemispherical shape and the conical shape be r each. If is given that $2\pi r^2 = \pi r \ell$

$\ell = 2r$

$h = \sqrt{\ell^2 - r^2} = \sqrt{(2r)^2 - r^2} = \sqrt{3}r$

$\frac{\text{radius}}{\text{height}} = \frac{r}{\sqrt{3}r} = \frac{1}{\sqrt{3}} = 1 : \sqrt{3}$

41.

Difficulty : Easy

Topics :

Mathematics,

$$\text{Sum of series } \frac{7}{2^3}+\frac{19}{6^3}+\frac{37}{12^3}+\frac{61}{20^3}+.....\infty$$
$$\text{is } \frac{2^3-(1)^3}{2^3,1^3}+\frac{(3)^3-(2)^3}{2^3,3^3}+\frac{(4)^3-(3)^3}{3^3,4^3}+\frac{(5)^3-(4)^3}{4^3,5^3}+.....\infty$$
$$\Rightarrow 1-\frac{1}{2^3}+\frac{1}{2^3}-\frac{1}{3^3}+\frac{1}{3^3}-\frac{1}{4^3}+\frac{1}{4^3}-\frac{1}{5^3}+.....$$
$$=1$$

42.

Difficulty : Easy

Topics :

Mathematics,

$$x^2+y^2=t-\frac{1}{t} \quad .....(1)$$
$$x^4+y^4=t^2+\frac{1}{t^2} \quad .....(2)$$
$$(1)^2$$
$$x^4+y^4+2x^2y^2=t^2+\frac{1}{t^2}-2 \quad .....(3)$$

from (3) and (2)

$$t^2+\frac{1}{t^2}+2x^2y^2=t^2+\frac{1}{t^2}-2$$
$$x^2y^2=-1$$
$$y^2=\frac{-1}{x^2}$$

diff. w.r. to x

$$2y\frac{dy}{dx}=-\left(\frac{-2}{x^3}\right)$$
$$\Rightarrow x^3y\frac{dy}{dx}=1$$

43.

Difficulty : Easy

Topics :

Mathematics,

The most stable measure of central tendency is the median.

44.

Difficulty : Easy

Topics :

Mathematics,

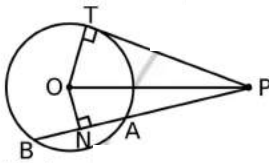
Statement - 1 is wrong
Statement - 2 is wrong
Statement - 3 is wrong
Therefore None of the statement is true.

45.

Difficulty : Easy

Topics :

Mathematics,



We know that

$OP^2 = OT^2 + PT^2$

$OP^2 = ON^2 + NP^2$

$PA \cdot PB = PT^2, \quad AN = NB$

Option (A) $PA \cdot PB = PN^2 - AN^2$

$= (PN - AN)(PN + AN)$

$= PA \cdot (PN + NB)$

$= PA \cdot PB$ (correct)

Option (B) $PN^2 - AN^2 = PA \cdot PB = OP^2 - OT^2$

$PA \cdot PB = PT^2$

(Correct)

Option (C) $PA \cdot PB = 2PT^2$ (wrong)

46.

Difficulty : Easy

Topics :

Mathematics,

Let $E_1 \equiv$ Event of passing first exam.

$E_2 \equiv$ Event of passing second exam

$E_3 \equiv$ Event of passing third exam.

Then a student can quility in any one of following ways.

(1) He passes first and second exam.

(2) He passes first, fails in second but passes third exam.

(3) He fails in I, passes II and third

$P(E_1)P(E_2/E_1) + P(E_1)P(E_2/E_1)p(E_3/E_2) + P(E_1)P(E_2/E_1)P(E_3/E_2)$

$= P.P + P(1-P)\frac{P}{2} + (1-P)\frac{P}{2}.P$

$= P^2 + \frac{P^2}{2} - \frac{P^3}{2} + \frac{P^2}{2} - \frac{P^3}{2}$

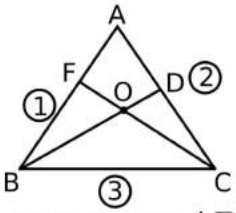
$= 2P^2 - P^3$

47.

Difficulty : Easy

Topics :

Mathematics,



Equation of side $AB; \rightarrow 3x - 2y + 6 - 0$ .....(1)
equation of side $AC \rightarrow 4x + 5y - 20 - 0$ .....(2)
orthocentre $0(1,1)$equation of $BD \perp AC$

$$m_{BD} = \frac{-1}{m_{AC}} = \frac{-1}{-\frac{4}{5}} = \frac{5}{4}$$

equation of BD

$$(y-1) = \frac{5}{4}(x-1)$$
$$4y - y = 5x - 5$$
$$5x - 4y - 1 = 0$$ .....(3)

Point B is $\rightarrow$ From (1) and (3)

$$3x - 2y + 6 = 0$$
$$5y - 4y - 1 = 0$$
$$B\left(-13, -\frac{33}{2}\right)$$

equation of CF :

$$m_{cF} = -\frac{1}{m_{AB}} = \frac{-1}{\frac{-3}{-2}} = \frac{-2}{3}$$
$$y - 1 == \frac{-2}{3}(x-1)$$

Equation of C.F - $3y + 2x - 5 = 0$ ____(4)

Point C: -> from (2) & (4)

$$3y + 2x - 5 = 0$$
$$5y + 4x - 20 = 0$$
$$C\left(\frac{35}{2}, -10\right)$$

Equation of line BC is : $B\left(-13, \frac{-33}{2}\right)$ and $C\left(\frac{35}{2}, -10\right)$

$$y + 10 = \frac{-\frac{33}{2} + 10}{-13\frac{-35}{2}}\left(x - \frac{35}{2}\right)$$
$$y + 10 = \frac{13}{61}\left(x - \frac{35}{2}\right)$$
$$y + 10 = \frac{13}{122}(2x - 35)$$
$$122y + 1220 = 26x - 455$$
$$26x - 122y - 455 - 1220 = 0$$
$$26x - 122y - 1675 = 0$$

48.

Difficulty : Easy

Topics :

Mathematics,

Total families $= 10,000$
$A \longrightarrow 40\%$
$B \longrightarrow 20\%$
$C \longrightarrow 10\%$
$A \cap B$; A and $C \longrightarrow A \cap B \cap C \longrightarrow 2\%$
$n(A \cup B \cup C) = 40 + 20 + 10 - 5 - 3 - 4 + 2 = 60\%$
$n(A) = n(A \cup B \cup C) - n(B \cup C)$
$= 60 - [n(B) + n(c) - n(B \cap C)]$
$= 60 - [-20 + 10 - 3]$
$= 33\%$
Number of families which buy newspaper A only is $\frac{33}{100} \times 1000 = 3300$

49.

Difficulty : Easy

Topics :

Mathematics.

Given that $(x+y)^n$ $T_2 = {}^nC_1\, x^{n-1}y^1 = 135$ _____(1)
$T_3 = {}^nC_2\, x^{n-2}y^2 = 30$_____(2)
$T_4 = {}^nC_3\, x^{n-3}y^3 = \frac{10}{3}$_____(3)
$nx^{n-1}y = 135$_____(4)
$\frac{n(n-1)}{2}x^{n-1}x^{-1}y = 30$ _(5)
(4) & (5)
$\frac{(n-1)}{2}\frac{135y}{x} = 30$
$(n-1)\frac{9y}{x} = 4$_____(6)
Now from (2) and (3)
$\frac{n(n-1)(n-2)}{1 \times 2 \times 3}x^{n-2}y^2x{-}1y = \frac{10}{3}$
$(n-2)\frac{30}{3}\frac{y}{x} = \frac{10}{3}$
$(n-2)\frac{3y}{x} = 1$___(7)
from (6) / (7)
$\frac{(n-2)}{(n-1)}\frac{1}{3} = 4 \Rightarrow 4n - 8 = 3n - 3$
$\Rightarrow n = 5$

50.

Difficulty : Easy

Topics :

Mathematics,

Given that

$s_n = a_1 - 36$ .....(1)

$s_n = a_n$ .....(2)

$T_{10} - T_6 = -16$ .....(3)

$a + 9d - (a + 5d) = -16$

$4d = -16$

$\boxed{d = -4}$

from (1) & (2)

$a_n = a_1 - 36$

$a_1 + (n-1)d = a_1 - 36$

$(n-1)d = -36$

$(n-1)(-4) = -36$

$n - 1 = 9$

$\boxed{n = 10}$

Now from equation (i)

$s_n = a_1 - 36$

$\frac{n}{2}[2a_1 + (n-1)d] = a_1 - 36$

$5[2a_1 + 9d] = a_1 - 36 \qquad 9a_1 = 180 - 36$

$10a_1 + 35(-4) = a_1 - 36 \quad \Rightarrow \quad a_1 = 144$

$\boxed{a_1 = 16}$

BIOLOGY

31.

Difficulty : Medium

Topics :

Zoology,
BODY FLUIDS and Circulation,

Option B is incorrect as ventricular ejection occurs during systole but not diastole.
Option C is also incrrocet as durings isovolumetric relaxation, the ventricular pressure decreases considerably. When it becomes less than the atria, the AV valves open gets open.
Option D is incorrect as ventricular filling occurs during diastole.
Option A is correct as during Isometric contraction, the pressure within the ventricles increases above the pressure in the aorta and pulmonary artery leading to opening of semilunar valves.

32.

Difficulty : Medium

Topics :

Zoology,
CHEMICAL COORDINATION AND INTEGRATION,

Zona Glomerulosa forms the outer layer of cortex, the cells of which have enzymes required for converting corticosterone to cortisol, but not androgen as androgen is a male sex hormone.

33.

Difficulty : Medium

Topics :

Zoology,
Structural Organisation in Animals,

R is the pallic gland or conglobate gland whose secretions forms the outer layer of spermatophore.

34.

Difficulty : Easy

Topics :

Biology,

Centriole, ciliium and flagellum possess nine peripneral fibrils of microtubles is right and also cytoplasm is surrounded by single membrane which is plasma membrane. It is bilayer of lipids where proteins floats in between.
Whereas sphaersomes are unit membranous organalle (option i) wrong, Leucoplast double membrane bound organelle (option ii) wrong and rose flower have anthocyanin but not fucoxanthin.

35.

Difficulty : Medium

Topics :

Biology,

B option is right. 5th position of sugar joined with phosphate and 1st position of sugar joined by nitrogenous base at 7 position. (Correctly joined.)

36.

Difficulty : Difficult

Topics :

Zoology,
Animal Kingdom,

37.

Difficulty : Medium

Topics :

Zoology,

Topic : Excretion and Osmoregulation

The correct step / sequence of urine formation is

(iv) filtration of water and dissolved substances from the blood into lumen of Bowmen's capsule that is known as Glomerular filtration. The urine than travels to PCT.

(i) Reabsorption of glucose, amino acids and other substance from the filtrate. The descending limb of henle's loop is freely permeable to water. Hence, the next step is

(iii) Reabsorption of water which makes the urine hypertonic. The ascending limb of henle's loop is impermeable to water but permeable to salt and ions, hence the next step is

(ii) Reabsorption of Na^+ and other ions from filltrate. Aldosterone is a hormone which regulates the Na^+ concentration in the terminal parts of nephron, that is DCT, collecting tubules and collecting duct and hence the next step is

(v) Reabsorption of Na^+ under the influence of aldosterone.

38.

Difficulty : Medium

Topics :

Zoology,
EVOLUTION.

(1) Fins at shark and flippers of dolphins and (3) proteins is blood of man and ape are examples of convergent evolution. Statement 2, 4 and 5 describes homologouos organs that is having structure but performing different functions and hence showing modifications according to their functional needs, thus representing examples of Divergent evolution.

39.

Difficulty : Medium

Topics :

Biology,

'P' is the point of agricultural waste discharge. Hence it will contain biodegradable waste material. BOD [Biological oxygen demand] is the amount of oxygen needed by aquatic organisms (Bacteria) to breakdown the biodegradable waste.
'P' is the source having highest concentration of waste and hence. BOD in that particular point is greater than point elsewhere apart from it.

40.

Difficulty : Difficult

Topics :

Zoology,
LOCOMOTION,

ATP performs all the above mentioned functions in skeletal muscle contraction like formation of cross bridge, dissociaiton of cross-bridge and tranfer of calcium ions.

41.

Difficulty : Medium

Topics :

Biology,

'X' is T.S of monocot root where pith is well developed and 'Y' is T.S. of dicot root where pith is reduced. Also 'Y' is discots hypodermis can be sclerenchymatous.

42.

Difficulty : Medium

Topics :

Biology,

X is haplontic life cycle followed by algae - Ulothrix, chara, spirogyra and oedogonium.
Y is diplontic life cycle pattern which is present in higher plants but there are some exceptions in algae which shows diplontic life cycle i.e., Cladophora, Fucus and Sargassum.

43.

Difficulty : Medium

Topics :

Biology,

As the blood group of Mr. Mehra is A and that of his wife is B. So if they both are homozygous for their respective blood group, then 'O' blood group is not possible is the offspring.
So the Genotype must be

Male	**Female**
I^AI^O	I^BI^O

Possibilities in offspring - $I^AI^B \quad (AB)$
$I^AI^O \quad (A)$
$I^BI^O \quad (B)$
$I^OI^O \quad (O)$

Hence they are Heterozygous, for their respective blood group.

44.

Difficulty : Medium

Topics :

Biology,

R is transpiration pull which helps in maintaining the shape and structure of the plants by keeping cells turgid.

45.

Difficulty : Medium

Topics :

Biology,

(i) Process is ammonification by Bacillus gruop of bacteria.
(ii) Nitrification and
(iii) is also nitrification done by nitroccoccus, nitrosomonas and nitrobacter and nitrocystis bacteria respectively
(iv) is denitrification done by Pseudomonas and thiobacillus bacteria.

46.

Difficulty : Medium

Topics :

Biology,

Hydrophilous flowers contain light and mucilaginous pollen grains, rest all are correct statements.

47.

Difficulty : Medium

Topics :

Biology,

(i) Isocitric acid converts into oxaloacetic acid and then to α-ketoglutaric acid and
(ii) α-ketoglutaric acid converts into succinyl CoA involves both the process decarboxylation and dehydrogenation.

48.

Difficulty : Easy

Topics :

Biology,

In anaphase II of meiosis division no. of chromosomes remains half to the parent cell and amount of DNA will be half to parent cell.

49.

Difficulty : Medium

Topics :

Biology,

a floral diagram is of Fabaceae.
b floral diagram is of Solanaceae.
Fruit of fabaceae is legume and of solanaceae is berry. Asparagus belongs to Liliaceae therefore option B is correct one.

50.

Difficulty : Medium

Topics :

Biology,

It is Urn shaped pyramid. Tree is one is number, on which many Caterpillar $\longrightarrow$ will be eaten by many more sparrows and many sparrows will be eaten by less number of falcon.