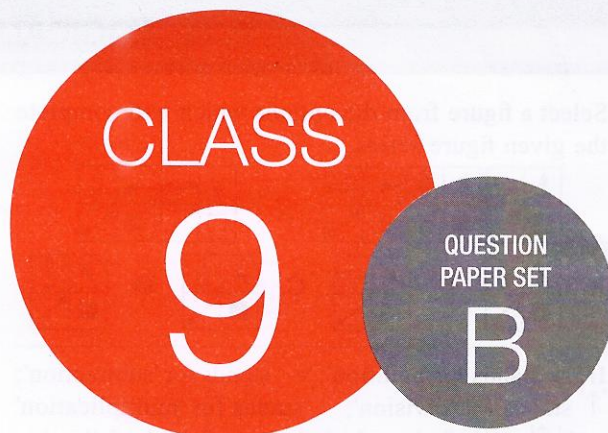


**SOF NATIONAL SCIENCE  
OLYMPIAD 2017-18**



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

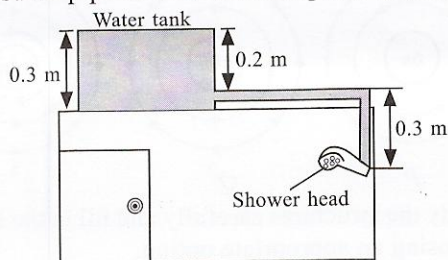
1. You will get additional ten minutes to fill up information about yourself on the OMR Sheet, before the start of the exam.
2. Write your **Name, School Code, Class, Section, Roll No.** and **Mobile Number** clearly on the **OMR Sheet** and do not forget to sign it. We will share your marks / result 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.
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.

16. ☒ A ☐ B ☐ C ☐ D



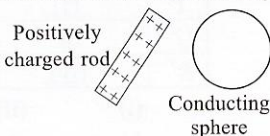
must raise the water tank to, so that the water pressure at the shower head can be 8 kPa.

(Assume pipe of sufficient length is given.)



- A. 0.2 m    B. 0.3 m    C. 0.5 m    D. 1 m

14. A positively charged rod is moved near conducting sphere as shown. What will be the movements of the electrons and protons in the conducting sphere?



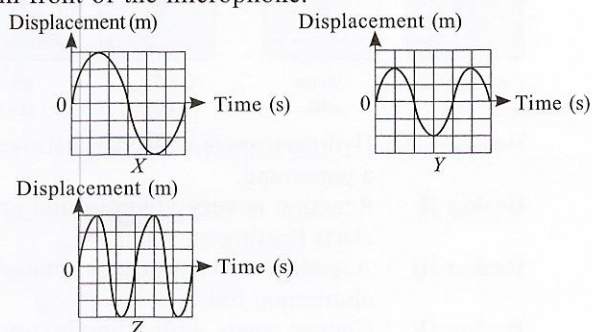
**Electrons**

- A. Move to left  
B. Move to right  
C. Do not move  
D. Move to left

**Protons**

- Move to right  
Move to left  
Move to left  
Do not move

15. The diagram shows three waves X, Y and Z displayed on the screen of the oscilloscope connected to a microphone when three different sounds are made in front of the microphone.



Which of the following statements is correct regarding different sounds?

- A. Sound X has a higher pitch than sound Y.  
B. Sound X has the same pitch as sound Z.  
C. Sound Y is louder than sound Z.  
D. Sound Y has a lower pitch than sound Z.

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

**Statement 1 :** The blood pressure in human is greater at the feet than at the brain.

**Statement 2 :** In a liquid, pressure at any point is proportional to the height, density of the liquid and the acceleration due to gravity.

- 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. Both statements 1 and 2 are false.

17. The maximum vertical distance through which a fully dressed astronaut can jump on the earth is 0.5 m. Estimate the maximum vertical distance through which he can jump on the moon, which has a mean density  $(2/3)^{\text{rd}}$  that of the earth and radius one quarter that of the earth.

- A. 3 m    B. 6 m    C. 8 m    D. 9 m

18. If two plane mirrors are inclined at an angle of  $60^\circ$  to each other, how many images of an object are seen?

- A. Only 3    B. Only 4  
C. Only 5    D. None of these

19. A man of mass 70 kg is standing on a bus which is moving at a speed of  $70 \text{ km h}^{-1}$ . At one point of his journey, he jumps upward to a height of 30 cm. Where does he land his feet on the floor of the bus again?

- A. At the same spot where he was standing.  
B. A short distance behind where he was standing.  
C. A long distance behind where he was standing.  
D. A long distance in front of where he was standing.

20. The gravitational force between two masses kept at a certain distance is  $p \text{ N}$ . The same two masses are now kept in water and the distance between them is same. If the gravitational force between these two masses in water is  $q \text{ N}$ , then

- A.  $p = q$     B.  $p < q$   
C.  $p > q$     D. None of these.

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

**Statement 1 :** The loudness or softness of a sound is determined basically by its amplitude.

**Statement 2 :** The amplitude of the sound wave depends upon the force with which an object is made to vibrate.

- 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. Both statements 1 and 2 are false.

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

- (i) Cones in our eyes are sensitive to bright light.  
(ii) The type of lens in our eyes is concave.  
(iii) In cataract, eye lens becomes clouded.  
(iv) Splitting of white light into its colours is known as scattering of light.

- A. (i) Only    B. (i) and (iv) only  
C. (ii) and (iii) only    D. (i) and (iii) only

23. Which of the following statements are correct?

- I. A pure substance has fixed melting and boiling points.  
II. If a liquid is impure, it will boil over a range of temperatures but will freeze at a fixed temperature.  
III. If the pressure acting on a liquid is increased, the boiling point will increase.  
IV. A pure orange juice will have a fixed boiling point.

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



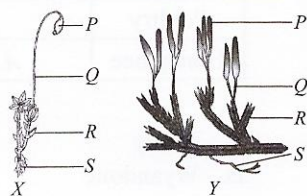
31. Elements  $X$  and  $Y$  have octet configuration in their  $L$  shell after forming stable dipositive and dinegative ions respectively. The respective electronic configuration of the succeeding element of  $X$  and the preceding element of  $Y$  are

A. 2, 7 and 2, 5                      B. 2, 8, 3 and 2, 5  
C. 2, 5 and 2, 8, 3                  D. 2, 8, 1 and 2, 7

32. A solid sample of sulphur contains 0.25 mol of sulphur molecules. The number of moles of sulphur atoms, number of sulphur molecules and number of sulphur atoms present in the given sample are respectively

A.  $6.023 \times 10^{23}$ , 3 and  $3.2 \times 10^{23}$   
B. 2,  $3.2 \times 10^{23}$  and  $6.02 \times 10^{23}$   
C. 2,  $1.5 \times 10^{23}$  and  $1.2 \times 10^{24}$   
D.  $1.2 \times 10^{24}$ ,  $3.2 \times 10^{23}$  and 2

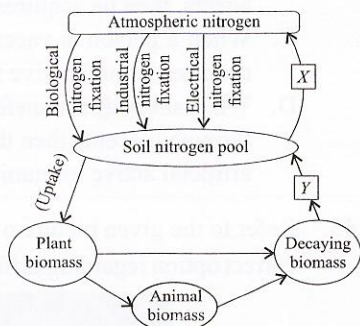
33. Refer to the given figures of two plants  $X$  and  $Y$  with their parts labelled as  $P$ ,  $Q$ ,  $R$  and  $S$ .



Select the correct option regarding them.

- A. Plant body of both  $X$  and  $Y$  is diploid sporophyte where  $P$  is the spore producing part.  
B.  $Q$  represents true stem,  $R$  represents true leaves whereas  $S$  represents true roots in both  $X$  and  $Y$ .  
C. Seed setting is absent in both plants  $X$  and  $Y$  and they reproduce through spores.  
D. All parts of plant  $Y$  possess vascular tissues whereas vascular tissues are present only in part  $P$  of plant  $X$ .

34. Refer to the given outline of nitrogen cycle. Identify  $X$  and  $Y$  and select the correct statement regarding them.



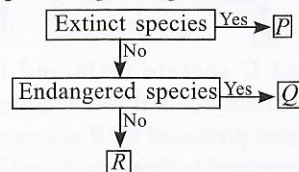
- A. In the process  $X$ , protein is converted into ammonia by the action of bacteria while in the process  $Y$ , nitrates present in the decaying remains get converted into free nitrogen gas.  
B. In the process  $X$ , nitrates present in the soil get converted into free nitrogen gas while in the process  $Y$ , proteins are converted into ammonia by the action of bacteria.  
C. Process  $X$  represents the conversion of ammonia into nitrates while process  $Y$  represents the conversion of nitrates into the free nitrogen gas.  
D. Process  $X$  represents the conversion of ammonia into nitrites while process  $Y$  represents the conversion of complex organic compounds like proteins into ammonia.

35. Select the pair that shows the same relationship as the animals in the box.

*Amoeba* : *Paramecium*

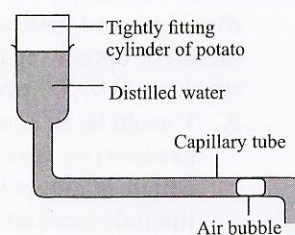
A. *Rhizopus* : *Chlamydomonas*  
B. *Candida* : *Saccharomyces*  
C. *Pteridium* : *Fasciola*  
D. *Albugo* : *Adiantum*

36. Identify  $P$ ,  $Q$  and  $R$  in the given flow chart and select the correct option regarding them.



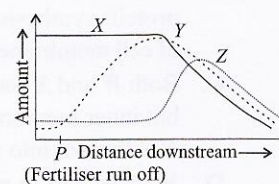
$P$	$Q$	$R$
A. Blackbuck	Golden langur	Giant panda
B. Silvery pigeon	Chinkara	Desert kangaroo rat
C. Passenger pigeon	Asian elephant	Sloth bear
D. Dodo	Thorny tree frog	Blue whale

37. What would happen to the air bubble in the following set-up after 30 minutes?



- A. It will disappear.  
B. It will move to the left.  
C. It will move to the right.  
D. It will remain stationary.

38. The given graph shows changes in three components  $X$ ,  $Y$  and  $Z$  in a water body after point  $P$  (where fertiliser run off from crop field took place).



Select the correct statement regarding  $X$ ,  $Y$  and  $Z$ .

- A.  $X$  could be phosphate compounds whose concentration gradually reduced downstream due to their consumption by growing aquatic plants.  
B.  $Y$  could be nitrate compounds which initially increased due to introduction of NPK fertilisers whereas  $Z$  represents decomposer microbes whose number increased in order to decompose these compounds.  
C.  $Y$  could be algae which multiplied rapidly due to nutrient enrichment of water body whereas  $X$  could be dissolved oxygen which started reducing simultaneously with the increase in decomposition activity of microbes  $Z$  after death of algae.  
D.  $Y$  could be aquatic animals which initially increased in number due to consumption of large amount of aquatic plants  $X$  and then decreased gradually with the reduction in plant population.

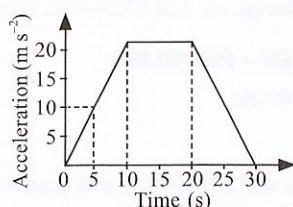


## ACHIEVERS SECTION

46. Fill in the blanks by choosing an appropriate option.  
In a (i) wave the particles of the medium oscillate in a direction (ii) to the direction of propagation. Thus, during their oscillations, the particles may move upwards or downwards from the plane passing through their mean positions. The point of maximum positive displacement on a transverse wave is called (iii) and the point of maximum negative displacement is called (iv). The wave produced in a stretched string when plucked are (v) waves.

(i)	(ii)	(iii)	(iv)	(v)
A. Longitudinal	Parallel	Crest	Trough	Longitudinal
B. Transverse	Perpendicular	Trough	Crest	Longitudinal
C. Longitudinal	Parallel	Trough	Crest	Transverse
D. Transverse	Perpendicular	Crest	Trough	Transverse

47. Acceleration-time graph for a particle in translatory motion is given here. Match the quantities of column I with column II and select the correct option from given codes.



Column I	Column II
I. Average acceleration from 0 to 5 s	P. $5.0 \text{ m s}^{-2}$
II. Average acceleration from 0 to 10 s	Q. $10.0 \text{ m s}^{-2}$
III. Average acceleration from 0 to 20 s	R. $13.3 \text{ m s}^{-2}$
IV. Average acceleration from 0 to 30 s	S. $15.0 \text{ m s}^{-2}$
A. I-S, II-P, III-R, IV-Q	B. I-P, II-Q, III-S, IV-R
C. I-Q, II-P, III-R, IV-S	D. I-S, II-R, III-P, IV-Q

Direction (Q. No. 48 and 49) : Refer to the given passage and answer the following questions.

*P*, *Q* and *R* are acoelomate organisms whereas *S* and *T* are true coelomates. *P* possesses cellular level of body organisation whereas others possess tissue and organ level of body organisation. *Q* possesses special stinging cells called cnidoblasts. *R* is the first triploblastic animal and has flame cells as excretory organs. The body of

*S* is metamerically segmented whereas *T* bears jointed appendages and chitinous exoskeleton.

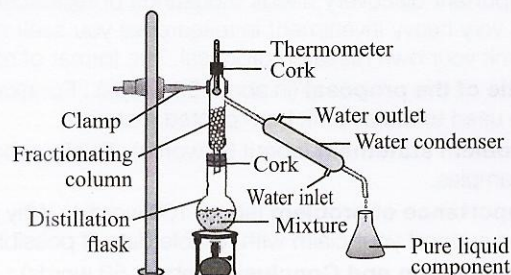
48. Select the option that correctly identifies organisms *P*, *Q*, *R*, *S* and *T*.

<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>	<i>T</i>
A. <i>Euspongia</i>	<i>Hydra</i>	<i>Hirudinaria</i>	<i>Fasciola</i>	<i>Periplaneta</i>
B. <i>Euplectella</i>	<i>Obelia</i>	<i>Dugesia</i>	<i>Pheretima</i>	<i>Palaemon</i>
C. <i>Sycon</i>	<i>Taenia</i>	<i>Adamsia</i>	<i>Scolopendra</i>	<i>Musca</i>
D. <i>Aurelia</i>	<i>Schistosoma</i>	<i>Ascaris</i>	<i>Nereis</i>	<i>Palaemon</i>

49. Which of the following is incorrect regarding organisms *P*, *Q*, *R*, *S* and *T*?

- P* possesses endoskeleton of calcareous spicules whereas *Q* is always aquatic.
- R* could be a parasite which attaches to the body of host through hooks and suckers whereas *S* possesses metanephridia for excretion.
- T* sheds off its chitinous exoskeleton periodically during its growth which is referred to as moulting.
- None of these

50. The given apparatus shows a method to separate ethanol-water mixture.



Which of the following statements are correct?

- During the process, the liquid with the highest boiling point distils over first.
  - Ethanol reaches the upper part of the column first.
  - Thermometer first shows a constant reading at  $100^\circ\text{C}$ .
  - Ethanol vapours and water vapours both rise up the column but water vapours condense in the fractionating column and drop back into the distillation flask.
- A. I and II only      B. II and III only  
C. II and IV only      D. I, II, III and IV

SPACE FOR ROUGH WORK





## 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](http://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 8 <sup>th</sup>	Class 9 <sup>th</sup>	Class 10 <sup>th</sup>
28 <sup>th</sup> Nov : 3 PM to 8 PM	27 <sup>th</sup> Nov : 3 PM to 8 PM	26 <sup>th</sup> 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 29<sup>th</sup> - 30<sup>th</sup> 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](http://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.

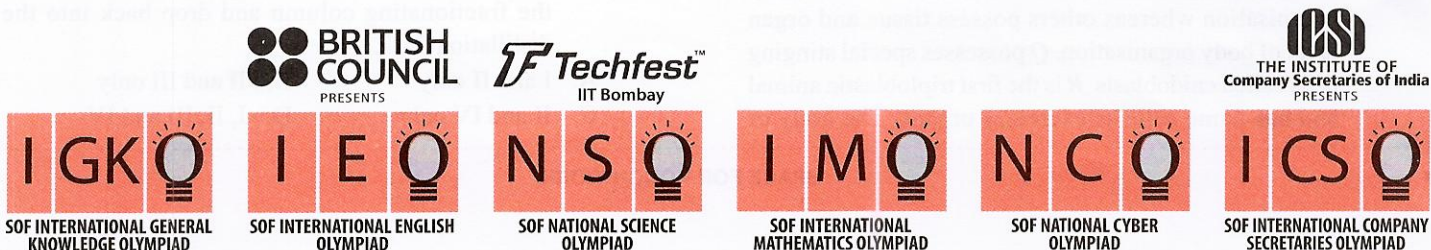
### Research Proposal

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.



For latest updates & information, please like our Facebook page ([www.facebook.com/sofworld](http://www.facebook.com/sofworld)) or register on

<http://www.sofworld.org/subscribe-updates.html>

For Level 1 and Level 2 preparation material / free sample papers, please log on to [www.mtg.in](http://www.mtg.in)



**National Office:** Plot 99, First Floor, Sector 44 Institutional area, Gurgaon -122 003 (HR) India

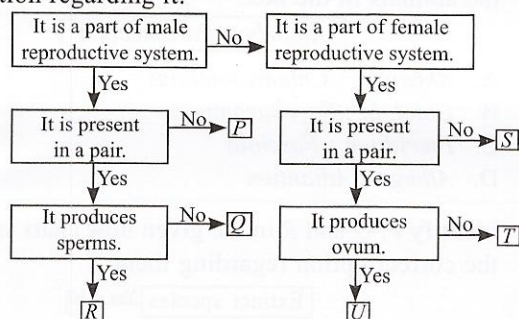
Email: [info@sofworld.org](mailto:info@sofworld.org) | Website: [www.sofworld.org](http://www.sofworld.org)

Regd. Office: 406, Taj Apt., Ring Road, New Delhi-110 029

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

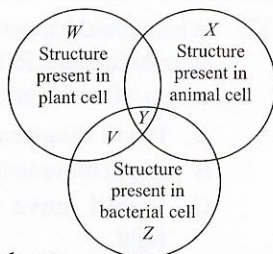


39. Refer to the given flow chart and select the correct option regarding it.



- A. *R* and *U* secrete male and female hormones respectively called testosterone and estrogen but gametes produced by *R* are much more in number as compared to those produced by *U*.  
 B. Secretion of both *P* and *Q* nourish and activate sperms to swim but secretion of *Q* contains a type of sugar which is not present anywhere else in the body.  
 C. *T* is the site of fertilisation whereas *S* is the site of implantation of embryo.  
 D. All of these

40. Refer to the given Venn diagram and select the incorrect option regarding structures *V*, *W*, *X*, *Y* and *Z*.



- A. *V* could be an outermost protective covering which is composed of lipopolysaccharides in bacteria and cellulose in plants.  
 B. *Y* could be a membrane-less organelle involved in protein synthesis whereas *Z* could be an ingrowth of cell membrane that contains respiratory enzymes.  
 C. Both *W* and *X* could be double membrane structures but inner membrane of *W* is smooth whereas that of *X* is thrown into folds.  
 D. *W* takes part in photosynthesis whereas *Z* connects genetic material with plasma membrane.
41. Select the incorrect statement.
- A. Osmosis is a slow process, occurs down the concentration gradient and does not expend energy.  
 B. Electron microscope uses electromagnets instead of glass lenses and beam of electrons instead of light.  
 C. A semipermeable membrane does not allow both solvent and solute molecules to pass through it.  
 D. Active transport of materials across plasma membrane is rapid and usually occurs against the concentration gradient involving carrier proteins and energy in the form of ATP.

42. Refer to the given box containing names of some human diseases and select incorrect statement regarding it.

Chikungunya,	Rabies,	Yellow fever,
Gonorrhoea,	Malaria,	Trypanosomiasis,
Dengue,	Kala azar,	Tetanus,
Genital herpes		

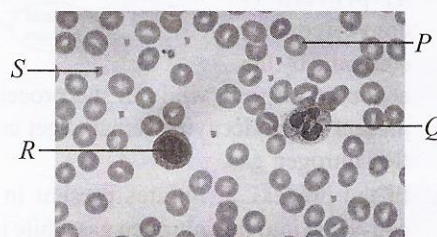
- A. The given box contains five viral diseases out of which four are vector borne and one is sexually transmitted.  
 B. The given box contains two protozoan diseases and three bacterial diseases where all the protozoan diseases are vector borne.  
 C. Out of the two bacterial diseases listed in the given box, one is sexually transmitted while DPT vaccine is available for the other.  
 D. Female *Aedes aegypti* serves as a vector for three of the diseases listed in the box.

43. Refer to the given table and select the option that correctly fills the blanks in it.

Animal	Indigenous breed	Exotic breed
Cow	Sahiwal	<i>P</i>
Poultry	<i>Q</i>	Plymouth rock
Honey bee	<i>A. indica</i>	<i>R</i>

<i>P</i>	<i>Q</i>	<i>R</i>
A. Jersey	Aseel	<i>A. mellifera</i>
B. Wyandotte	Malvi	<i>A. dorsata</i>
C. Alpine	Bakharwal	<i>A. dorsata</i>
D. Australorp	Ghagus	<i>A. adamsoni</i>

44. Which of the following correctly exemplifies acquisition of active immunity by a person?
- A. A person who has recovered from an attack of mumps, develops natural active immunity.  
 B. When ready-made antibodies are directly injected into a person's body to protect him against foreign agents, then he acquires artificial active immunity.  
 C. When a person is vaccinated for a disease then he acquires natural active immunity for that disease.  
 D. When antibody is transferred from mother to the fetus through placenta then the developing baby acquires artificial active immunity.
45. Refer to the given picture of blood smear and select the correct option regarding different blood corpuscles (*P-S*).



- A. Blood cell *Q* plays a major role in transport of gases within the body.  
 B. A person who is unable to produce blood cell *S* bleeds continuously even from a minor injury.  
 C. Blood cell *P* produces antibodies in response to a pathogenic infection in the body.  
 D. Blood cell *R* contains a red pigment called haemoglobin that shows affinity for oxygen.



24. Rohit studied the properties of a few common substances and recorded his observations in the given table.

S.No.	Material	Combustible	Forms flame
1.	Candle	✓	✓
2.	Coal	×	✓
3.	Magnesium ribbon	×	×
4.	Camphor	✓	×
5.	Petrol	✓	✓

The incorrect observations are

- A. 1, 4 and 5 only      B. 2, 3 and 4 only  
C. 2 and 3 only      D. 1 and 3 only.
25. The physical properties of two substances  $P$  and  $Q$  are given in the table.

	Melting point ( $^{\circ}\text{C}$ )	Boiling point ( $^{\circ}\text{C}$ )
$P$	-95	69
$Q$	-91	104

If in liquid states,  $P$  and  $Q$  are miscible then which of the following statements is correct regarding their separation?

- A.  $P$  and  $Q$  both are volatile liquids at room temperature hence, can be separated by fractional distillation.  
B.  $P$  is a solid while  $Q$  is a volatile liquid at room temperature hence, can be separated by evaporation.  
C.  $P$  is a solid and  $Q$  is a liquid at room temperature hence, can be separated by filtration.  
D.  $P$  and  $Q$  both are liquids at room temperature and can be separated from each other by simple distillation.
26. A few polymers are grouped together on the basis of a common property as follows :
- Group I : Dacron, acrylic, nylon, jute  
Group II : PVC, melamine, teflon  
Group III : Polycot, terrywool, acrylic  
Choose the odd one out in groups I, II and III.

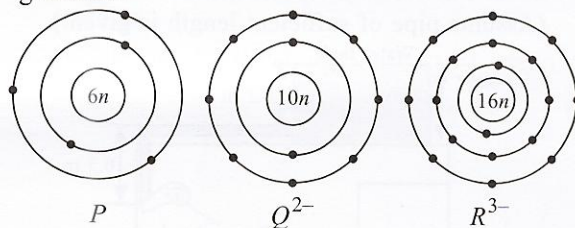
I	II	III
A. Dacron	Teflon	Terrywool
B. Nylon	Teflon	Acrylic
C. Jute	Melamine	Terrywool
D. Jute	Melamine	Acrylic

27. A few compounds are listed as :  
(i) Ammonia, (ii) Aluminium fluoride, (iii) Magnesium sulphide, (iv) Magnesium oxide  
Find the ratio by mass of the combining elements in each compound.

(Given : Atomic mass of N = 14 u, H = 1 u, Mg = 24 u, O = 16 u, S = 32 u, F = 19 u and Al = 27 u)

	(i) (N : H)	(ii) (Al : F)	(iii) (Mg : S)	(iv) (Mg : O)
A.	1 : 3	1 : 3	1 : 1	1 : 1
B.	14 : 3	9 : 19	3 : 4	3 : 2
C.	3 : 1	2 : 1	1 : 1	1 : 2
D.	14 : 3	10 : 9	6 : 3	4 : 1

28. Schematic atomic structures of three species are given as :

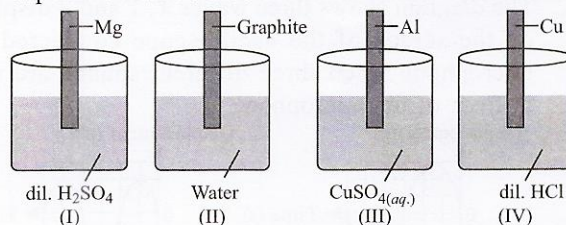


Study the structures carefully and fill in the blanks by choosing an appropriate option.

	Mass number	Number of electrons in neutral atom	Valence shell
$P$	(i)	5	$L$
$Q^{2-}$	18	(ii)	(iii)
$R^{3-}$	(iv)	15	(v)

	(i)	(ii)	(iii)	(iv)	(v)
A.	11	8	$L$	30	$L$
B.	16	6	$M$	16	$N$
C.	11	8	$L$	31	$M$
D.	16	8	$L$	30	$M$

29. Nitika, a class 9 student conducted the following experiment and stated her observations as follows :



- Beaker I : Hydrogen gas is evolved which burns with a pop sound.  
Beaker II : Reaction is very vigorous and graphite starts floating on water.  
Beaker III : A reddish brown deposit is obtained over aluminium rod.  
Beaker IV : Copper reacts with dilute hydrochloric acid to form blue coloured solution of copper chloride.

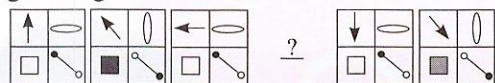
Observation(s) is/are incorrect in case of beaker(s)

- A. II and III only      B. II only  
C. II and IV only      D. IV only.
30. At a refinery, petroleum is separated into several components by a process called fractional distillation using a fractionating column.  
Which of the following statements is correct about the fractional distillation of petroleum?
- A. At each level in the column, only one compound is collected.  
B. Temperature increases from bottom to top of the column.  
C. The fractions collected at the top of the column are less volatile.  
D. The fraction with the highest boiling point condenses first and gets collected near the base of the fractionating tower.



## LOGICAL REASONING

1. Select a figure from the options which will complete the given figure series.



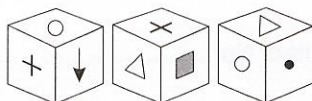
- A. B. C. D.

2. If ' $\rightarrow$ ' stands for 'addition'; ' $\leftarrow$ ' stands for 'subtraction'; ' $\uparrow$ ' stands for 'division'; ' $\downarrow$ ' stands for 'multiplication' and ' $\nearrow$ ' stands for 'equal to', then which of the following options is incorrect?

- A.  $2 \downarrow 5 \leftarrow 6 \rightarrow 2 \nearrow 6$   
 B.  $3 \rightarrow 7 \leftarrow 3 \uparrow 3 \nearrow 9$   
 C.  $3 \downarrow 6 \nearrow 2 \rightarrow 3 \leftarrow 6 \downarrow 5$   
 D.  $7 \nearrow 5 \leftarrow 4 \rightarrow 3 \downarrow 4 \uparrow 2$

3. Three positions of a dice are given. Find the symbol opposite to symbol  $\blacksquare$ .

- A.  $+$   
 B.  $\bullet$   
 C.  $\circ$   
 D.  $\downarrow$



4. A number arrangement machine, when given an input line of numbers rearranges them following a particular rule in each step. The following is an illustration of input and the steps of rearrangement.

**Input :** 85 16 36 04 19 97 63 09

**Step I :** 97 85 16 36 04 19 63 09

**Step II :** 97 85 63 16 36 04 19 09

**Step III:** 97 85 63 36 16 04 19 09

**Step IV:** 97 85 63 36 19 16 04 09

**Step V :** 97 85 63 36 19 16 09 04

Step V 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 :** 88 26 07 36 11 64 21

- A. IV      B. VI      C. V      D. VII

5. How many pairs of letters are there in the word EXCLAMATORY which have as many letters between

them in the word as in the English alphabet?

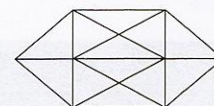
- A. 2      B. 3  
 C. 4      D. More than four

6. Which of the following options satisfies the given Venn diagram?



- A. English, French, German  
 B. Mothers, Females, Cricketers  
 C. Prime numbers, Integers, Even numbers  
 D. Planets, Mars, Sun

7. Count the number of triangles and minimum number of straight lines respectively in the given figure.



- A. 30, 11      B. 28, 13  
 C. 26, 14      D. None of these

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



- A. B. C. D.

9. Find the correct water image of Fig.(X).



- A. B. C. D.

10. Read the following information carefully and answer the question that follows.

- (i)  $P * Q$  means P is the father of Q.  
 (ii)  $P \div Q$  means P is the sister of Q.  
 (iii)  $P \$ Q$  means P is the brother of Q.  
 (iv)  $P \# Q$  means P is the wife of Q.  
 How is A related to B in " $A \div C \$ D \# B$ "?

- A. Mother      B. Aunt  
 C. Sister-in-law      D. Mother-in-law

## SCIENCE

11. Two unequal masses  $P$  and  $Q$  moving along straight lines are brought to rest by applying equal retarding forces. If  $P$  moves twice the time as  $Q$ , but goes only  $(1/3)^{\text{rd}}$  of the distance covered by  $Q$  before coming to rest, the ratio of their initial velocities is

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

12. Mass of a man is 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform

acceleration of  $5 \text{ m s}^{-2}$ . What would be the reading on the scale? ( $g = 10 \text{ m s}^{-2}$ )

- A. zero      B. 400 N      C. 120 N      D. 1200 N

13. The given diagram shows the water tank and the position of the shower head in the bathroom of a household. The water pressure must be 8 kPa in order to function shower head effectively. The density of water is  $1000 \text{ kg m}^{-3}$ . Find the minimum height that a plumber



## NSO-SOF - 2017 - 18

### 9th Std.

#### ANSWER KEY

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



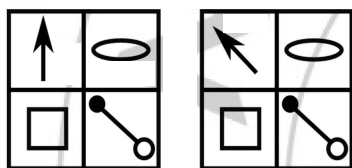
# NSO-SOF NATIONAL SCIENCE OLYMPIAD 2017-18

## CLASS-9 / SET-B / LEVEL - SOLUTIONS




1. Difficulty : Easy


**Topics :**



**Logical Reasoning,**



1st figure  is moving  $45^\circ$  anticlockwise

2nd figure  is moving alternate  and 

3rd figure  is alternating becoming black & white

4th figure  alternating change to 



2. Difficulty : Easy

**Topics :**

**Logical Reasoning,**

$$\begin{array}{l} 3 \downarrow 6 \nearrow 2 \rightarrow 3 \leftarrow 6 \downarrow 5 \\ 3 \times 6 = 2 + 3 - 6 \times 5 \end{array}$$

3. Difficulty : Easy

**Topics :**

**Logical Reasoning,**

Neighbours of  $\triangle$  is  $\blacksquare$  &  $+$  from figure 2.

Neighbours of  $\circ$  is  $+$  &  $\blacktriangledown$  from figure 1

6 faces  $\triangle, \blacksquare, +, \circ, \bullet, \blacktriangledown$ .

as  $\uparrow$  is not neighbours of  $\circ$  is opposite of  $\triangle$ .

From figure 2,  $\triangle$  and  $+$  are neighbours of  $\blacksquare$  so only one option  $\circ$  left which should be opposite  $\blacksquare$ .

4. Difficulty : Easy

**Topics :**

**Logical Reasoning,**

Each step starts for arranging the number in decreasing order and shift the remaining numbers to right like in

85 16 36 04 19 97 63 09

Step I 97 85 16 36 04 19 63 09

2nd number is 85 which is already at 2nd position so arrange 3rd number.

97 85 63 16 36 04 19 09

↓ Like this for given value

Input = 88 26 07 36 11 64 21

Step I 88 26 07 36 11 64 21

Step II 88 64 36 26 07 11 21

Step III 88 64 36 26 21 07 11

Step IV 88 64 36 26 21 11 07

Finish as we got the decreasing order of series.



5. Difficulty : Easy

Topics :

Logical Reasoning,

*EXCLAMATORY*

(1)  $EC \rightarrow E\underline{X}C$  one alphabet  $\underline{E}DC$

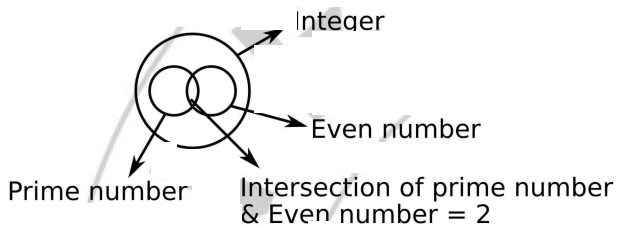
(2)  $TR \rightarrow T\underline{O}R$  one alphabet  $R\underline{S}T$

(3)  $CA \rightarrow C\underline{L}A$  one alphabet  $A\underline{B}C$

6. Difficulty : Easy

Topics :

Logical Reasoning,



7. Difficulty : Easy

Topics :

Logical Reasoning,

Total 28 triangles & 13 lines

So correct option is (B)

8. Difficulty : Easy

Topics :

Logical Reasoning,



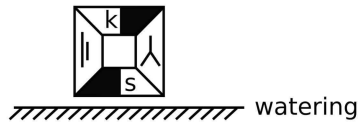
Correct option is (D) .



9. Difficulty : Easy

Topics :

Logical Reasoning,



Option (A) is correct.

10. Difficulty : Easy

Topics :

Logical Reasoning,

$A$ ,  $C$ ,  $D$  are siblings  
↓     ↓     ↓  
Female   Male   Female  
 $A$  is sister in law of  $B$ .



11. Difficulty : Easy

Topics :

Science,

$$\begin{array}{ll} \text{time} & \text{distance} \\ \text{P} & 2t = t_1 \quad d/3 = s_1 \\ \text{Q} & t = t_2 \quad d = s_2 \end{array}$$

$$s = ut + \frac{1}{2}at^2 \quad \dots(1)$$

$$v = u + at \quad \dots(2)$$

Since force is opposing so it will be deceleration

$$a = -(-a)t$$

$$a = \frac{at}{t}$$

$$a = \frac{\mu}{t} \quad \dots(3)$$

put (3) in (1)

$$s = ut + \frac{1}{2} \times \frac{u}{t} \times t^2$$

$$s = \frac{3}{2}ut$$

$$\text{So } \frac{\mu_1}{\mu_2} = \frac{s_1}{s_2} \times \frac{t_2}{t_1}$$

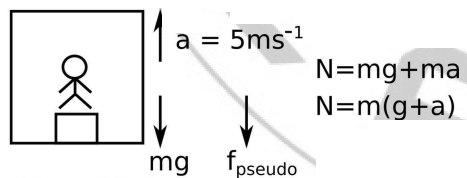
$$= \frac{d}{3d} \times \frac{t}{2t}$$

$$\frac{\mu_1}{\mu_2} = \frac{1}{6}$$

12. Difficulty : Easy

Topics :

Science,



$$M = 80 \text{ kg}$$

$$f_{\text{pseudo}} = ma$$

Net reading  $m$  the scale will be

$$= m(g + a)$$

$$= 80(10 + 5)$$

$$N = 1200 \text{ N}$$



13. Difficulty : Easy

**Topics :**

**Science,**

$$\text{Pressure} = 8 \text{ kpa} = 8000 \text{ pa};$$

$$\text{Density } \rho' = 1000 \text{ kgm}^{-3}$$

$$g = 10$$

Assume  $x'$  is the mini. height that a plumber should raise the tank.

$$p = \rho gh$$

$$8000 = 1000 \times 10 \times (0.3 + 0.2 + x)$$

$$x = 0.3$$

14. Difficulty : Easy

**Topics :**

**Science,**

Protons will not move because they are bound in the nucleus.

15. Difficulty : Easy

**Topics :**

**Science,**

Pitch is proportional to frequency.

16. Difficulty : Easy

**Topics :**

**Logical Reasoning,**

As the pressure increases with increase in depth, hence the blood pressure is greater at the feet than at the brain.



17. Difficulty : Easy

**Topics :**

**Logical Reasoning,**

On moon

$$\begin{aligned} g_m &= \frac{4}{3}\pi G \left(\frac{R}{4}\right) \left(\frac{2p}{3}\right) \\ &= \frac{1}{6} \left(\frac{4}{3}\pi G R p\right) \\ &= \frac{1}{6}g \end{aligned}$$

$$\begin{aligned} \text{Work done in jumping} &= m \times g_m \times 0.5 = m \times \frac{g}{6} \times h \\ \therefore h &= 0.5 \times 6 = 3m \end{aligned}$$

18. Difficulty : Easy

**Topics :**

**Science,**

$$\begin{aligned} \theta &= 60^\circ \\ n &= \frac{360^\circ}{\theta} = \frac{360}{60} = 6 \end{aligned}$$

$$n = 6 \text{ [even]}$$

but number of usings formed will be  $n - 1 = 6 - 1 = 5$

19. Difficulty : Easy

**Topics :**

**Science,**

Horizontal velocity of man = velocity of bus. He lands at the same spot.

20. Difficulty : Easy

**Topics :**

**Science,**

Gravitational force is independent of the medium between only two bodies.



21. Difficulty : Easy

**Topics :**

**Science,**

Amplitude is also called as pitch. Greater the pitch, greater the loudness. The amplitude of the sound wave directly depends on the force used to vibrate the object.

22. Difficulty : Easy

**Topics :**

**Science,**

No options from (A), (B), (C), (D) is correct, while (iii) is individual correct.

23. Difficulty : Easy

**Topics :**

**Science,**

Pure substances a sample of matter with both definite and constant composition with distinct chemical properties. M.P and B.P occur at single temperature.

24. Difficulty : Easy

**Topics :**

**Science,**

Coal, Magnesium ribbon and camphor are considered as combustible, as a combustible substance is that which is capable of igniting and burning. Flammable and combustible liquids themselves do not burn. It is the mixture of their vapours and air that burns.

25. Difficulty : Easy

**Topics :**

**Science,**

Since both 'p' and 'Q' are liquids at room temperature and their boiling points difference is large then they can be separated by simple distillation.

26. Difficulty : Easy

**Topics :**

**Science,**

Jute, Melamine and Acrylic are synthetic polymers.

27. Difficulty : Easy

**Topics :**

**Science,**

$NH_3$	$AlF_3$	$MgS$	$MgO$
$'N'$ mass = 14 $'H'$ mass = $1 \times 3g$	$Al = 27u$ $F = 19 \times 3 = 57u$	$Mg = 24u$ $S = 32u$	$Mg = 24u$ $O = 16u$
$\therefore 14 : 3$	$\therefore 9 : 19$	$\therefore 3 : 4$	$\therefore 3 : 2$

28. Difficulty : Easy

**Topics :**

**Science,**

$Z$  = atomic number

$A$  = Mass number (No. of protons + No. of neutrons)

$A - Z$  = No. of neutrons

Diagram ' $P$ ' has 5 electrons  $\therefore$  should have '5' protons

From the diagram 5 protons + 6 neutrons = mass numbers

Diagram  $Q^{2-}$  has  $8e^-$  in the valence shell  $\therefore$  these orbits are two in the diagram and the outermost shell is 'L' shell.

Diagram  $R^{3-}$  has 2, 8, 8 electrons and ' $R$ ' will have 2, 8, 5 which means 15 electrons hence '15' protons

Mass no. of  $R^{3-}$  = 15 protons + 16 neutrons = 31

The outermost shell of  $R^{3-}$  is 3d orbit which is 'M' shell.

29. Difficulty : Easy

**Topics :**

**Science,**

II : Graphite does not react with water.

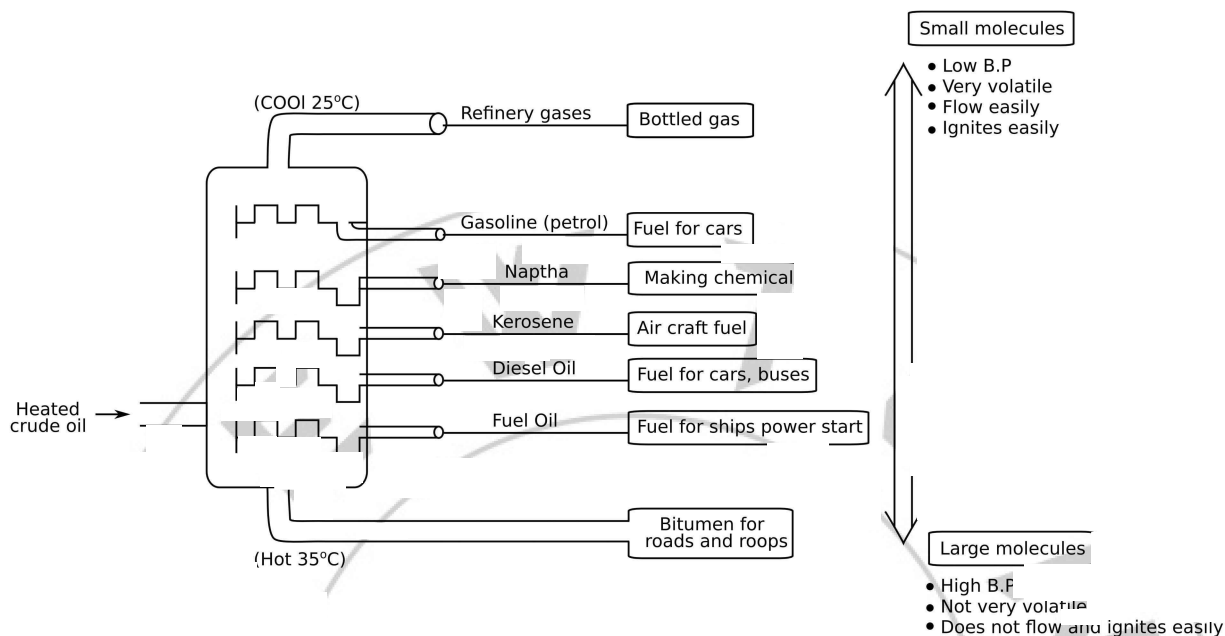
IV :  $HCl$  does not react with copper



30. Difficulty : Easy

Topics :

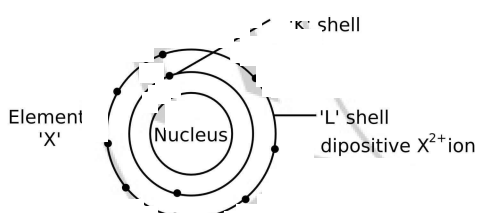
Science,



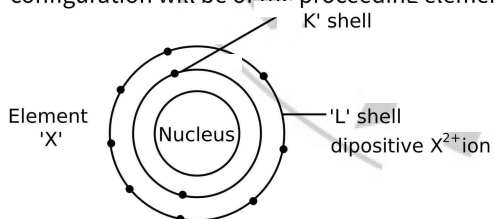
31. Difficulty : Easy

Topics :

Science,



In the diagram  $10e^-$  are present for dipositive ion, then the no. of electrons in the neutral atom must be 12 and the electronic configuration will be of the preceding element of 'X' will be 2, 8, 3.



In the diagram  $10e^-$  are present diengative ion, then the electrons in the neutral atom will be 8 and the electronic configuration of ecceding element will be 2, 5.

32. Difficulty : Easy

**Topics :**

**Science,**

1 mole of sulphur = 8 atoms       $0.25 \times 8 = 2 \text{ atoms}$

0.25 moles of sulphur = ?

$6.023 \times 10^{23} \text{ atoms}$  per one mole of sulphur

and  $1.505 \times 10^{23}$  molecules per 0.25 mole of sulphur [ $0.25 \times 6.023 \times 10^{23} = 1.505 \times 10^{23} \text{ molecules}$ ]

$1.505 \times 10^{23} \times 8 \text{ sulphur atom} = 12.04 \times 10^{23} \text{ sulphur atoms molecules}$

$1.204 \times 10^{24} \text{ sulphur atoms.}$

33. Difficulty : Medium

**Topics :**

**Science,**

Topic : Reproduction

Both the plants shows asexual reproduction through spore formation.

34. Difficulty : Medium

**Topics :**

**Science,**

Topic : Natural Resources

The process  $x$  is denitrification while the process  $y$  is ammonification.

35. Difficulty : Easy

**Topics :**

**Science,**

Topic : Biodiversity

As amoeba and paramecium are unicellular organism similarly candida and saccharomyces are fungus.

Belonging to same class of fungi.

36. Difficulty : Medium

**Topics :**

**Science,**

Topic : Conservation of Plants & Animals

P = Passenger Pigeon (Extinct species)

Q = Asian elephant (Endangered species)

R = Sloth bear (Vulnerable species)



37. Difficulty : Easy

**Topics :**

**Science,**

Potato cells will absorb more water from the capillary tube & air bubble in the capillary tube will move towards left.

38. Difficulty : Medium

**Topics :**

**Science,**

'P' is point where fertilizer run off takes place. The fertilizer run off in water sources may leads to water pollution, eutrophication (Algal bloom).

39. Difficulty : Medium

**Topics :**

**Science,**

Topic : Reproduction

All the above statements are correct,

as R = Testis

Q = Seminal Vesicles

P = Prostrate

U = Ovaries

T = Fallopian Tubes/Oviducts

S = Uterus

40. Difficulty : Medium

**Topics :**

**Science,**

Topic : Cell

W is the exclusive structure present in plant cell that is chloroplast

41. Difficulty : Easy

**Topics :**

**Science,**

Topic : Cell

A semipermeable membrane allows solvent & solute to pass through it.

42. Difficulty : Medium

**Topics :**

**Science,**

Topic : Health & Disease

The given box contains three protozoan diseases, that is malaria, kal-azar and trypanosomiasis.

43. Difficulty : Medium

**Topics :**

**Science,**

Topic : Crop Production & Management

P = Jersey; Q = Aseel ; R = A. Mellifera.

44. Difficulty : Easy

**Topics :**

**Science,**

Topic : Health & Disease

Natural active immunity is acquired by exposure to antigens

45. Difficulty : Easy

**Topics :**

**Science,**

Topic : Health & Disease

$P$  = Red Blood Cell

$Q$  = Neutrophils

$R$  = Plasma Cells (lymphocytes)

$S$  = Platelets

46. Difficulty : Easy

**Topics :**

**Science,**

In transverse waves, the direction of the waves propagation is perpendicular to the particle motion. Crest and Troughs are produced in this type of waves.



47. Difficulty : Easy

**Topics :**

**Science,**

As area under  $a - t$  curve gives change in velocity

(i) from 0 to 5 sec

Change in velocity = Area of triangle

$$= \frac{1}{2} \times 5 \times 10 \\ = 25 \text{ m/s}$$

$$\therefore \text{Average Acceleration} = \frac{\text{change in velocity}}{\text{time interval}} = \frac{25}{5 - 0} = 5 \text{ m/s}^{-2}$$

(ii) from 0 to 10 sec

$$\text{change in velocity} = \frac{1}{2} \times 10 \times 20 \\ = 100 \text{ m/s}^{-1}$$

$$\therefore \text{Average acceleration} = \frac{100}{10 - 0} = 10 \text{ m/s}^{-2}$$

(iii) from 0 to 20 sec

Change in velocity = Area of triangle + Area of rectangle

$$= \frac{1}{2} \times 10 \times 20 + 10 \times 20 \\ = 100 + 200 \\ = 300 \text{ m/s}^{-1}$$

$$\therefore \text{Average acceleration} = \frac{300}{20 - 0} = \frac{30}{2} = 15 \text{ m/s}^{-2}$$

(iv) Change in velocity = whole area under the graph.

$$= \left( \frac{1}{2} \times 10 \times 20 \right) + (10 \times 20) + \left( \frac{1}{2} \times 10 \times 20 \right) \\ = 100 + 200 + 100 \\ = 400 \text{ m/s}^{-1}$$

$$\therefore \text{Average acceleration} = \frac{400}{30 - 0} = \frac{40}{3} = 13.33 \text{ m/s}^{-2}$$

48. Difficulty : Medium

**Topics :**

**Science,**

Topic : Biodiversity

$P$  = Sponges = Euplectella

$Q$  = Coelenterate = Obelia

$R$  = Platyhelminthes = Dugesia (Flatworms)

$S$  = Arthropoda = Plaemon.

49. Difficulty : Medium

**Topics :**

**Science,**

Topic : Biodiversity

All the statements are correct

all *P* are sponges, *Q* is coelenterata, *R* is flatworms, *S* is annelida and *T* is arthropoda.

50. Difficulty : Easy

**Topics :**

**Science,**

Ethanol has b.p of  $78.37^{\circ}C$

Water has b.p of  $100^{\circ}C$

The liquid with lesser b.p reaches the upper part of the column faster than water.