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**NATIONAL  
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**N B T O**

**11**  
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### IMPORTANT INFORMATION

- You are allowed additional 10 minutes to fill the required details in the **RESPONSE SHEET**.
- The question paper is made as per syllabus guidelines & pattern given in the information Booklet. The Question Paper for Classes 1 to 6 contains 25 Questions each to be answered in 40 minutes. The Question paper for classes 7 to 12 contains 50 Questions each to be answered in 60 minutes. All questions are compulsory. Further instructions are given in the instruction letter to the coordinator teacher.
- Use the response sheet to mark your responses by darkening the required circle. The response sheet has to be returned to the foundation, duly filled in. The student can retain the Question Paper.

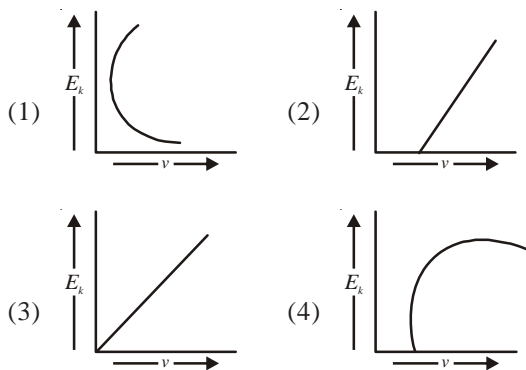
### GENERAL KNOWLEDGE

- Mineral resources can be conserved by
  - Minimizing waste and developing the technologies to recover the resources from the waste
  - Finding the alternative to the fossil fuels
  - Developing alloys that will reduce the demand of the pure metals
  - All of these
- The plant which yield drug for malaria and cancer is?
  - Poppy
  - Quinine
  - Jatropha
  - None of these
- Which one of the following does not come under endangered species?
  - Tiger
  - Penguins
  - Pink duck
  - None of these
- Causes of soil pollution are
  - Municipal, Industrial and Radioactive waste
  - Discarded material
  - Pesticides, fertilizers and organic manures
  - All of these
- Geoscience include
  - Environmental Geology
  - Environmental soil science
  - Volcanic phenomenon
  - All of these
- Ecological sanitation offers a new philosophy of dealing with \_\_\_\_\_ ?
  - Waste water
  - Soil
  - Air
  - None of these
- Free services provided to humans by ecosystems include
  - control of atmospheric carbon dioxide concentration
  - prevention of soil erosion.
  - filtering of pollutants from water and air
  - All of the above
- How do mountain ranges create deserts \_\_\_\_\_ ?
  - by lifting land up into colder, drier air
  - by completely blocking the flow of air into desert areas, thus preventing clouds from getting there
  - by forcing air to first rise and then fall, thus causing rain on one side of the mountains and desert on the other
  - by causing the global wind patterns that make certain latitudes very dry
- The Kyoto Protocol drawn up to set emission targets for greenhouse gases, envisaged various levels of emission reductions for the developed countries. However, world's three largest coal producer and consumer countries did not rectify. Which of the following are those three?
  - China, Japan, US
  - US, China, India
  - France, Germany, India
  - None of these

10. Seismograph
- (1) It measures the intensity of earthquake shocks
  - (2) It determines salinity of solution
  - (3) It measures the emission of radiant energy
  - (4) None of these

### SECTION B : PHYSICS & CHEMISTRY

11. The kinetic energy ( $E_k$ ) of a photoelectron varies with the frequency ( $\nu$ ) of the incident radiation as which of the following graph?



12. If a photon has velocity  $c$  and frequency  $\nu$ , then which of the following represents its wavelength?

- (1)  $\frac{h\nu}{c^2}$
- (2)  $h\nu$
- (3)  $\frac{hc}{E}$
- (4) None of these

13. The dimensions of impulse are equal to that of
- (1) pressure
  - (2) angular momentum
  - (3) force
  - (4) None of these

14. Myopia is due to
- (1) shortening of eye ball
  - (2) older age
  - (3) elongation of eye ball
  - (4) None of these

15. A rocket is based on the principle of
- (1) conservation of linear momentum
  - (2) conservation of angular momentum
  - (3) both (1) and (2)
  - (4) None of these

16. If electron, hydrogen, helium and neon nuclei are all moving with the velocity of light, then the wavelengths associated with these particles are in the order

- (1) electron > hydrogen > helium > neon
- (2) electron > helium > hydrogen > neon
- (3) electron < hydrogen < helium < neon
- (4) None of these

17. If a reaction involves only solids and liquids, which of the following is true?

- (1)  $\Delta H < \Delta E$
- (2)  $\Delta H = \Delta E$
- (3)  $\Delta H > \Delta E$
- (4) None of these

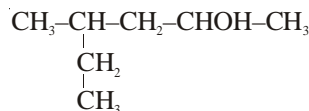
18. During the electrolysis of NaCl solution, the gas liberated at the anode is

- (1)  $H_2$
- (2)  $O_2$
- (3)  $Cl_2$
- (4) None of these

19. Which of the following produce protein?

- (1) Chromosome
- (2) Gene
- (3) Both (1) and (2)
- (4) None of these

20. IUPAC name of the compound is.



- (1) 4-methyl-3-hexanol
- (2) Heptanol
- (3) 4-methyl-2-hexanol
- (4) None of these

### SECTION C : MATHEMATICS

21. What is  $\lim_{x \rightarrow 2} \frac{\sin(e^{x-2} - 1)}{\ln(x-1)}$  equal to?

- (1) 0
- (2) 1
- (3) -1
- (4) None of these

22. What is the number of solutions of the equation  $\sin A + \cos A = 1.4$  which lie between  $0^\circ$  and  $360^\circ$ ?

- (1) 1
- (2) 2
- (3) 4
- (4) None of the above

23.  $M(x_1, x_2, \dots, x_n)$  defines a measure of central tendency based on  $n$  values  $x_1, x_2, \dots, x_n$ .

Consider the following measures of central tendency:

1. Arithmetic mean
2. Median
3. Geometric mean

Which of the above measures satisfy/satisfies the property

$$\frac{M(x_1, x_2, \dots, x_n)}{M(y_1, y_2, \dots, y_n)} = M\left(\frac{x_1}{y_1}, \frac{x_2}{y_2}, \dots, \frac{x_n}{y_n}\right)?$$

Select the correct answer using the code given below:

- (1) 1 only
- (2) 2 only
- (3) 3 only
- (4) None of these

24. Two points  $P(a, 0)$  and  $Q(-a, 0)$  are given. What is the locus

of variable point  $R$  such that  $\angle RPQ - \angle RQP = \frac{\pi}{4}$ ?

- (1)  $x^2 + y^2 - 2xy - a^2 = 0$
- (2)  $x^2 + y^2 + 2xy - a^2 = 0$
- (3)  $x^2 - y^2 - 2xy - a^2 = 0$
- (4) None of these

25. What is the degree of the differential equation

$$x = 1 + xy \left( \frac{dy}{dx} \right) + \frac{x^2 y^2}{2} \left( \frac{dy}{dx} \right)^2 + \frac{x^3 y^3}{6} \left( \frac{dy}{dx} \right)^3 + \dots?$$

- (1) 1 (2) 2  
(3) 3 (4) None of these
26. In how many ways can the letters of the word 'MACHINE' be arranged so that the vowels may occupy only odd positions?  
(1) 5040 (2) 576  
(3) 288 (4) None of these
27. An equilateral triangle has each side equal to 'a'. If the coordinates of its vertices are  $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ ,  

$$\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$
then what is the square of the determinant equal to?  
(1)  $3a^4$  (2)  $(3a^4)/4$   
(3)  $(3a^4)/2$  (4) None of these
28. What is the value of the error when  $\frac{2}{11}$  is approximated by 0.18?  
(1)  $\frac{1}{55}$  (2)  $\frac{1}{550}$   
(3)  $\frac{1}{110}$  (4) None of these
29. If  $z_1, z_2$  and  $z_3$  are complex numbers which lie on a straight line L and if  $z_4 = a z_1 + b z_2 + 4 z_3$  lies on L, then what are the values of a, b respectively?  
(1) 2, -5 (2) 3, -7  
(3) 2, 4 (4) None of the above
30. Consider the equation  $L = a^{\sin x} + a^{\sqrt{3} \cos x}$  ( $a > 0, x$  is real). For any given  $a > 0$ , the value of L is:  
(1) greater than 2  
(2) greater than or equal to  $2/a$   
(3) less than  $2/a$   
(4) None of these
31. What is the amplitude of  $\sin \frac{\pi}{5} + i \left(1 - \cos \frac{\pi}{5}\right)$ ?  
(1)  $\frac{\pi}{5}$  (2)  $\frac{\pi}{10}$   
(3)  $\frac{\pi}{15}$  (4) None of these
32. Three squares of a chess board are selected at random. What is the probability of getting two squares of one colour and other of a different colour?  
(1)  $3/8$  (2)  $16/21$   
(3)  $8/21$  (4) None of these

33. Assume that in a family, each child is equally likely to be a boy or girl. A family with three children is chosen at random. What is the probability that the eldest child is a girl given that the family has at least one girl?  
(1)  $1/3$  (2)  $4/7$   
(3)  $1/2$  (4) None of these
34. An ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  slides between two perpendicular straight lines. What is the locus of its centre?  
(1) Circle (2) Parabola  
(3) Ellipse (4) None of these
35. What is the value of  $\int_0^{10} (x - [x]) dx$  where  $[ \cdot ]$  denotes the greatest integer function?  
(1) 0 (2) 1  
(3) 5 (4) None of these
36. What is the number of solutions of the equation  $81^{\sin^2 x} + 81^{\cos^2 x} = 30; x \in (0, 2\pi)$ ?  
(1) One (2) Eight  
(3) Four (4) None of these
37. If f and g are continuous functions in  $[0, 1]$  satisfying  $f(x) = f(a - x)$  and  $g(x) + g(a - x) = a$  then what is  $\int_0^a f(x)g(x)dx$  equal to?  
(1)  $\int_0^a f(x)dx$  (2)  $\int_0^a f(x)dx$   
(3)  $\frac{a}{2} \int_0^a f(x)dx$  (4) None of the above
38. What is the number of ordered pairs (x, y) satisfying  $|y| = \cos x$  and  $y = \sin^{-1}(\sin x)$  where  $|x| \leq 3\pi$ ?  
(1) 2 (2) 4  
(3) 6 (4) None of these

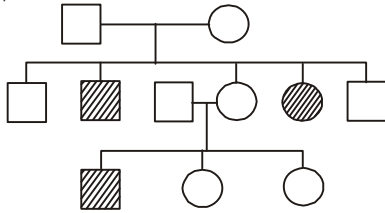
For the next 02 (two) items that follow:

A line  $y = mx$  bisects the area enclosed by the lines  $x = 0, y = 0, x = 1$  and the curve  $y = 3 + 2x - x^2$ .

39. What is the value of m?  
(1)  $11/12$  (2)  $11/3$   
(3)  $22/3$  (4) None of these
40. What is the area of the triangle enclosed by  $y = mx, y = 0$  and  $x = 1$ ?  
(1)  $11/3$  square units (2)  $11/6$  square units  
(3)  $11/12$  square units (4) None of the above

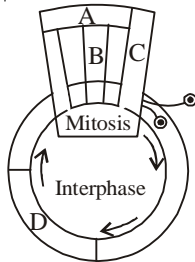
## SECTION C : BIOLOGY

21. Study the pedigree chart given below



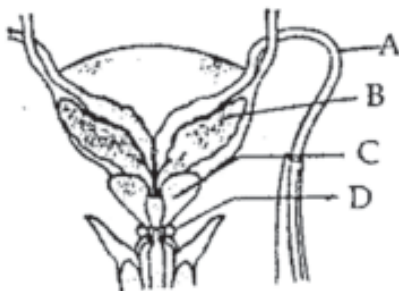
What does it show

- (1) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria
  - (2) Inheritance of a condition like phenylketonuria as an autosomal recessive trait
  - (3) The pedigree chart is wrong as this is not possible
  - (4) Inheritance of a recessive sex-linked disease like haemophilia
22. Given below is a schematic break-up of the phases/stages of cell cycle



Which one of the following is the correct indication of the stage/phase in the cell cycle?

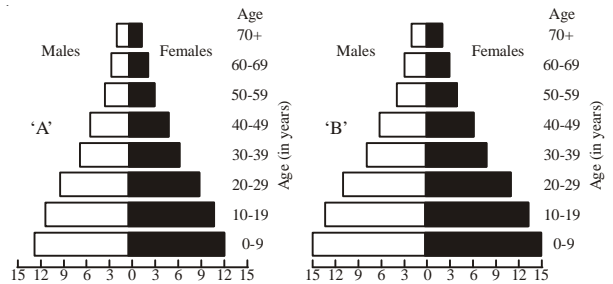
- (1) B-Metaphase (2) C-Karyokinesis
  - (3) D-Synthetic phase (4) A-Cytokinesis
23. Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of names of the parts labelled A, B, C, D



- (1) Ureter (A) Prostate (B) Seminal vesicle (C) Bulbourethral gland (D)
- (2) Vas deferens (A) Seminal vesicle (B) Prostate (C) Bulbourethral gland (D)
- (3) Vas deferens (A) Seminal vesicle (B) Bulbourethral gland (C) Prostate (D)
- (4) Ureter (A) Seminal vesicle (B) Prostate (C) Bulbourethral gland (D)

24. Which one is the wrong pairing for the disease and its causal organism
- (1) Late blight of potato – *Alternaria solani*
  - (2) Black rust of wheat – *Puccinia graminis*
  - (3) Loose smut of wheat – *Ustilago nuda*
  - (4) Root-knot of vegetables-*Meloidogyne sp*

25. A country with a high rate of population growth took measures to reduce it. The figure below shows age-sex pyramids of populations A and B twenty years apart. Select the correct interpretation about them



Interpretations

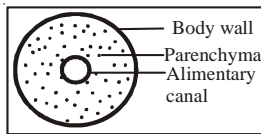
- (1) "A" is more recent and shows slight reduction in the growth rate
  - (2) "B" is earlier pyramid and shows stabilized growth rate
  - (3) "B" is more recent showing that population is very young.
  - (4) "A" is the earlier pyramid and no change has occurred in the growth rate
26. DDT residues are rapidly passed through food chain causing biomagnification because DDT is
- (1) Lipo soluble
  - (2) Moderately toxic
  - (3) Non-toxic to aquatic animals
  - (4) None of these
27. Biochemical Oxygen Demand (BOD) in a river water
- (1) Remains unchanged when algal bloom occurs
  - (2) Increases when sewage gets mixed with river water
  - (3) Gives a measure of salmonella in the water
  - (4) None of these
28. Most of the endangered species are the victims of
- (1) Over-hunting
  - (2) Habitat destruction
  - (3) Competition with introduced species
  - (4) None of these
29. Ribose sugar is present in
- (1) RNA polymerase and ATP
  - (2) RNA and ATP
  - (3) RNA polymerase, RNA and ATP
  - (4) RNA only
30. Which of the following hormones does not contain a polypeptide?
- (1) Insulin (2) Antidiuretic hormone
  - (3) Prostaglandin (4) None of these
31. Drawinism explains all the following except

- (1) Within each species, there are variations.
- (2) Variations are inherited from parents to offspring through genes
- (3) Organisms tend to produce more number of offspring than can survive
- (4) None of these

32. When DNA replication starts

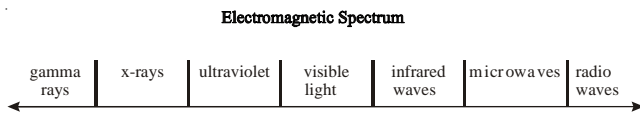
- (1) The leading strand produces Okazaki fragments
- (2) The phosphodiester bonds between the adjacent nucleotides break.
- (3) The hydrogen bonds between the nucleotides of two strands break
- (4) None of these

33. The cross section of the body of an invertebrate is given below. Identify the animal which has this body plan.



- (1) Cockroach
- (2) Round Worm
- (3) Planaria
- (4) Earthworm

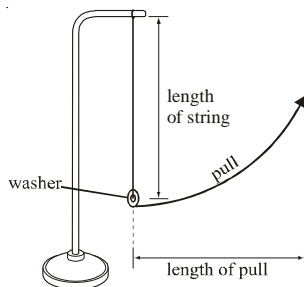
34. A diagram of the electromagnetic spectrum is shown below.



Sunscreen is a lotion used to protect skin from exposure to the Sun. This sunscreen protects a person's skin from wavelengths that are

- (1) longer than radio waves but shorter than x-rays.
- (2) longer than x-rays but shorter than infrared waves.
- (3) longer than microwaves but shorter than infrared waves.
- (4) longer than visible light waves but shorter than radio waves.

35. A student conducted many trials to determine the effect that variables had on the cycle of a pendulum.



**Pendulum Experiment Data**

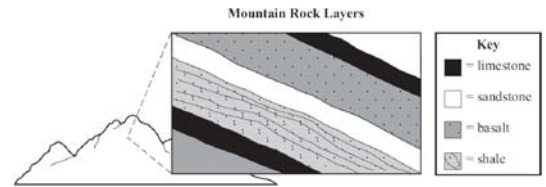
| Trial | Length of String (cm) | Length of Pull (cm) | Number of Washers* | Time of One Cycle (sec) |
|-------|-----------------------|---------------------|--------------------|-------------------------|
| 1     | 40                    | 10                  | 1                  | 1.3                     |
| 2     | 40                    | 20                  | 1                  | 1.3                     |
| 3     | 40                    | 20                  | 2                  | 1.3                     |
| 4     | 55                    | 20                  | 2                  | 1.5                     |
| 5     | 55                    | 20                  | 3                  | 1.5                     |

\*Each washer has a mass of 10 grams.

A change in which variable changed the time of one cycle?

- (1) length of string
- (2) length of pull
- (3) mass of washers
- (4) number of washers

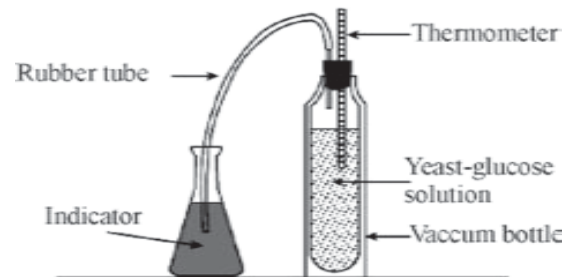
36. The illustration below shows rock layers within a mountain.



Which statement *best* explains the non-horizontal nature of the layers of rocks?

- (1) Igneous rocks ran down a hill.
- (2) Sediments were laid down on a slope.
- (3) Forces of plate tectonics tilted the layers.
- (4) Erosion within a rift valley formed the layers.

37. A student placed a solution of glucose and yeast in a vacuum bottle and sealed it with a two-hole stopper as shown in the diagram below. The temperature of the yeast glucose solution increased gradually with time, and the colour of the indicator was observed and recorded throughout a 2day period.



The purpose of the investigation was most likely to

- (1) study the relationship between temperature and pressure
- (2) demonstrate the release of energy by a chemical process
- (3) show that proteins are produced by yeast
- (4) study autotrophic nutrition in yeast

38. One explanation for the variety of organisms present on Earth today is that over time

- (1) new species have adapted to fill available niches in the environment
- (2) evolution has caused the appearance of organisms that are similar to each other
- (3) each niche has changed to support a certain variety of organism
- (4) the environment has remained unchanged, causing rapid evolution

39. Which statement does *not* identify a characteristic of antibodies?

- (1) They are produced by the body in response to the presence of foreign substances.
- (2) They may be produced in response to an antigen.
- (3) They are nonspecific, acting against any foreign substance in the body.
- (4) They may be produced by white blood cells.

40. The diagram below represents chromosomes in a zygote.

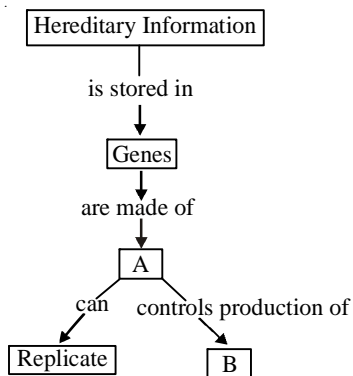


Which diagrams best illustrate the daughter cells that result from normal mitotic cell division of this zygote?

- (1) (2) (3) (4)

### ETG INTERACTIVE SECTION

Base your answers to questions 41 and 42 on the diagram below, which provides information related to heredity.



41. The type of molecule in box A serves as a template. This means
  - (1) It serve as complete genome
  - (2) It serve as a pattern
  - (3) It serve as sugar molecule
  - (4) None of these
42. Which molecules are represented by box B?
  - (1) bases
  - (2) proteins
  - (3) amino acids
  - (4) None of these

A scientist was growing yeast (*Saccharomyces cerevisiae*) in a simple nutrient solution, using  $^{14}\text{C}$ -labelled glucose as its only energy source. She noted that for each mole of glucose that was completely oxidised, the cells consumed 6 moles of  $\text{O}_2$  and produced 36 moles of ATP. (Ans. Q's 43 to 45)

43. The radioactivity of what carbon compound(s) did she measure to be able to say that the glucose was completely oxidized?

- (1)  $\text{CO}_2$
- (2)  $\text{CH}_4$
- (3) Ethanol
- (4) None of these

44. What is the name of the process that she was studying?
 

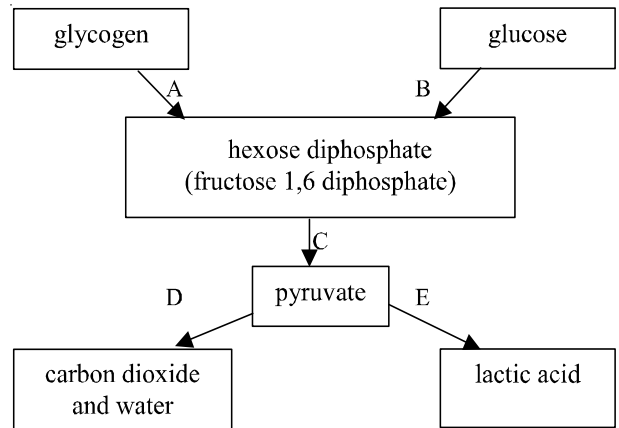
- (1) Respiration
- (2) Detoxification
- (3) Fermentation
- (4) Denitrification

She then moved her culture to an anaerobic environment and continued to study what happened to the radioactive glucose. She found that the cells continued to grow, utilising glucose as the energy source. Now, no oxygen was consumed and the yield of ATP was only 2 moles per mole glucose oxidised.

45. Which compound or compounds will become labelled by  $^{14}\text{C}$  under these conditions?

- (1)  $\text{CO}_2$
- (2) Ethanol
- (3) Both (1) and (2)
- (4) None of these

The diagram represents certain pathways in mammalian respiration. (Ans. Q's 46 to 49)



Select the letter of the chemical pathway in the diagram that applies to each of the following:

46. The pathway that involves the reoxidation of NADH without ATP formation.
  - (1) D
  - (2) E
  - (3) A
  - (4) None of these
47. The pathway that occurs exclusively within mitochondria.
  - (1) E
  - (2) A
  - (3) D
  - (4) None of these
48. The pathway that involves hydrolysis of a polymer.
  - (1) A
  - (2) E
  - (3) D
  - (4) None of these
49. The pathway that involves synthesis of ATP outside the mitochondria.
  - (1) D
  - (2) C
  - (3) E
  - (4) None of these
50. The microorganism responsible for major alcoholic fermentation are
  - (1) *Pseudomonas* spp.
  - (2) *Lactobacillus* spp.
  - (3) *Saccharomyces* spp.
  - (4) All of the above



END OF THE EXAM