BEST 2024

TIME : 80 Min. **BOOKLET : A**

BOTHRA ENTRANCE AND SCHOLARSHIP TEST

Class XI Studying Moving to Class XII

Physics, Chemistry & Biology

INSTRUCTIONS FOR CANDIDATE

1. The Answer Sheet is provided to you separately which is a machine readable Optical Mark Recognition (OMR). You have to mark your answers in the **OMR** by darkening bubble, as per your answer choice, by using black & blue ball point pen.
2. Total Questions to be Attempted 60. (Physics-20), (Chemistry-20), (Biology-20).
3. Marking Scheme:
   a. If darkened bubble is RIGHT answer: 4 Marks.
   b. If no bubble is darkened in any question: No Mark.
   c. If darkened bubble is WRONG answer: –1 Mark (Minus One Mark).
4. Think wisely before darkening bubble as there is negative marking for wrong answer.
5. If you are found involved in cheating or disturbing others then your OMR will be cancelled.
6. Do not put any stain on **OMR** and hand it over back properly to the invigilator.

Bothra CLASSES

PHYSICS

(Single correct option +4, -1)

1. Which of the following physical quantities has neither dimensions nor unit ?

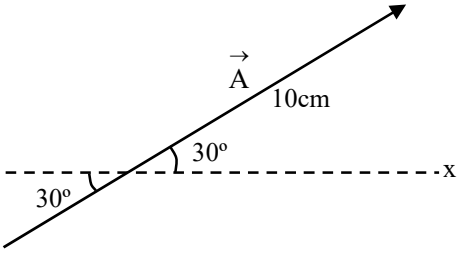
   (a) angle (b)Luminous intensity

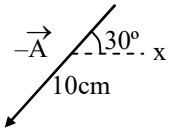
   (c) coefficient of friction (d) current

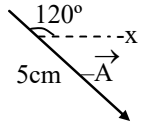
2. The frequency of vibrations of a mass m suspended from a spring of spring constant k is given by $\nu = cm^x k^y$, where c is a dimensionless constant. The values of x and y are respectively.

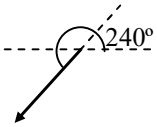
   (a) $\frac{1}{2}, \frac{1}{2}$ (b) $-\frac{1}{2}, -\frac{1}{2}$ (c) $\frac{1}{2}, -\frac{1}{2}$ (d) $-\frac{1}{2}, \frac{1}{2}$

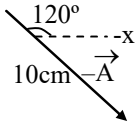
3. Vector $\vec{A}$ is shown in the figure. Negative of vector $\vec{A}$ is given by –



(a) 

(b) 

(c) 

(d) 

4. In the relation y = r sin (ωt – kx) the dimensions of $\frac{\omega}{k}$ are–

   (a) $[M^0 L^0 T^0]$ (b) $[M^0 L^1 T^{-1}]$ (c) $[M^0 L^0 T^1]$ (d) $[M^0 L^1 T^0]$

5. A projectile thrown with initial velocity $(a\hat{i} + b\hat{j})$ and its range is twice the maximum height attained by it then –

   (a) b = a/2 (b) b = a (c) b = 2a (d) b = 4a

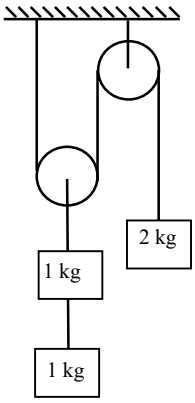
6. A particle is projected such that the horizontal range and vertical height are the same. Then the angle of projection is-

   (a) π/4 (b) $\tan^{-1}(4)$ (c) $\tan^{-1}(1)$ (d) π/3

7. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, the force exerted by the rope on the block is -

   (a) $\frac{Pm}{M+m}$ (b) $\frac{Pm}{M-m}$ (c) P (d) $\frac{PM}{M+m}$

8. The system of blocks and pulley as shown is released from rest. Then



(a) blocks remain at rest
(b) 2 kg block will move up
(c) 2 kg block will move down
(d) None of these

9. A body in equilibrium will not have -
(a) velocity (b) momentum (c) acceleration (d) All of the above

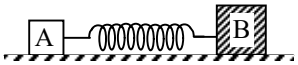
10. A block starts moving up a fixed inclined plane of inclination 60° with a velocity of 20 m/s and stops after 2 sec. The approximate value of coefficient of friction is ($g = 10\ m/s^2$)
(a) 3 (b) 3.3 (c) 0.27 (d) 0.33

11. If a body of mass m is moving on a rough horizontal surface of coefficient of kinetic friction μ, the net electromagnetic force exerted by surface on the body is –
(a) $mg\sqrt{1+\mu^2}$ (b) μmg (c) mg (d) $mg\sqrt{1-\mu^2}$

12. A particle of mass 0.5 kg is displaced from position $\vec{r}_1$ (2, 3, 1) to $\vec{r}_2$ (4, 3, 2) by applying a force of magnitude 30 N which is acting along $(\hat{i}+\hat{j}+\hat{k})$. The work done by the force is -
(a) $10\sqrt{3}$ J (b) $30\sqrt{3}$ J (c) 30 J (d) none of these

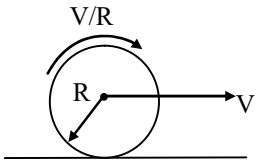
13. A particle is moving in a circular path and its acceleration vector is making an angle of 30° with the velocity vector, then the ratio of centripetal acceleration to its tangential acceleration is –
(a) $\frac{1}{2}$ (b) $\frac{\sqrt{3}}{2}$ (c) $\frac{1}{\sqrt{3}}$ (d) $\sqrt{3}$

14. Two blocks A and B of mass m and 2m are connected by a massless spring of force constant k. They are placed on a smooth horizontal plane. Spring is stretched by an amount x and then released. The relative velocity of the blocks when the spring comes to its natural length is –



(a) $\left(\sqrt{\frac{3k}{2m}}\right)x$ (b) $\left(\sqrt{\frac{2k}{3m}}\right)x$ (c) $\sqrt{\frac{2kx}{m}}$ (d) $\sqrt{\frac{3km}{2x}}$

15. A disc is performing pure rolling on a smooth stationary surface with constant angular velocity as shown in figure. At any instant, for the lower most point of the disc.



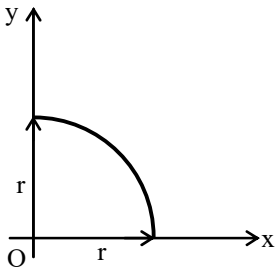
(a) Velocity is v, acceleration is zero

(b) Velocity is zero, acceleration is zero

(c) Velocity is v, acceleration is $\frac{v^2}{R}$

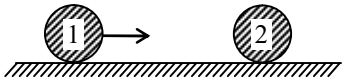
(d) Velocity is zero, acceleration is nonzero

16. The coordinates of centre of mass of the following quarter circular arc is -



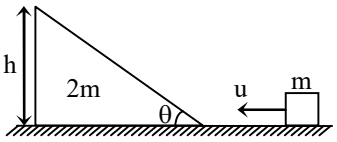
(a) $\left(\frac{r}{2},\frac{r}{2}\right)$ (b) $\left(\frac{2r}{3},\frac{2r}{3}\right)$ (c) $\left(\frac{2r}{\pi},\frac{2r}{\pi}\right)$ (d) $\left(\frac{4r}{\pi},\frac{4r}{\pi}\right)$

17. Ball 1 collides with an another identical ball 2 at rest as shown in figure. For what value of coefficient of restitution e, the velocity of second ball becomes two times that of 1 after collision ?



(a) 1/3 (b) ½ (c) 1/4 (d)1/6

18. A block of mass m is pushed towards a movable wedge of mass 2m and height h with a velocity u. All surfaces are smooth. The minimum value of u for which the block will reach the top of the wedge is –



(a) $2\sqrt{gh}$ (b) $\sqrt{3gh}$ (c) $\sqrt{6gh}$ (d) $\sqrt{\frac{3}{2}gh}$

19. A uniform chain has a mass m and length λ. It is held on a frictionless table with one sixth of its length hanging over the edge. The work done is just pulling the hanging part back on the table is -

(a) $mg\frac{\ell}{72}$ (b) $\frac{mg\ell}{36}$ (c) $\frac{mg\ell}{12}$ (d) $\frac{mg\ell}{6}$

20. An open knife edge of mass M is dropped from a height h on a wooden floor. If the blade penetrates a distance s into the wood, the average resistance offered by the wood to the blade is:

(a) Mg (b) $Mg\left(1+\frac{h}{s}\right)$ (c) $Mg\left(1-\frac{h}{s}\right)$ (d) $Mg\left(1+\frac{h}{s}\right)^2$

CHEMISTRY

(Single correct option +4, -1)

1. Carbon occurs in nature as a mixture of carbon 12 and carbon 13. The average atomic mass of carbon is 12.011. What is the percentage abundance of carbon-12 in nature?

(a) 90.5% (b) 85.6% (c) 95.6% (d) 98.9%

2. A compound contains 4.07% H, 24.27%C and 71.65% Cl. Its molar mass is 98.96 gm. What is its empirical formula?

(a) CH_3Cl (b) C_2H_4Cl (c) C_2H_5Cl (d) CH_2Cl

3. A solution contains 1 mole of alcohol and 4 moles of water. The mole fraction of water and alcohol will be

(a) $\frac{1}{4}$ and $\frac{3}{4}$ (b) $\frac{1}{3}$ and $\frac{2}{3}$ (c) $\frac{1}{5}$ and $\frac{4}{5}$ (d) $\frac{4}{5}$ and $\frac{1}{5}$

4. The density of 3M solution of NaCl is 1.25 gm/ml. Calculate the molality of the solution.

(a) 2.0 m (b) 2.3 m (c) 3.0 m (d) 2.79 m

5. There are two common oxides of sulphur, one of which contains 50% oxygen by weight, the other almost exactly 60%. The weights of sulphur which combine with 1 g of O_2 (fixed) are in the ratio of-
(a) 1 : 1 (b) 2 : 1 (c) 2 : 3 (d) 3 : 2

6. K.E. of the electron is 4.55×10^{-25} J. Its de Brogile wavelength (approximately) is-
(a) 4700 Å (b) 8300 Å (c) 7275 Å (d) 7400 Å

7. Which of the following statements is not true?
(a) Lyman spectral series of hydrogen atom lies in the ultraviolet region of electromagnetic radiation.
(b) Balmer spectral series of hydrogen atom lies in the visible region of electromagnetic radiation.
(c) Pashen spectral series of hydrogen atom lies in the visible region of electromagnetic radiation.
(d) Brackett spectral series of hydrogen atom lies in the infrared region of electromagnetic radiation.

8. For a given value of azimuthal quantum number l, the number of allowed values of magnetic quantum number m, is given by
(a) $\ell + 1$ (b) $\ell + 2$ (c) $2\ell + 1$ (d) $2\ell + 2$

9. Which of the following sets of quantum numbers is not allowed?
(a) $n = 2, \ell = 0, m = +1$ (b) $n = 2, \ell = 1, m = +1$ (c) $n = 2, \ell = 0, m = 0$ (d) $n = 2, \ell = 1, m = -1$

10. Which of the following has maximum number of unpaired electrons ?
(a) Mg^{2+} (b) Ti^{3+} (c) V^{3+} (d) Fe^{2+}

11. The electronic configuration of an element is $1s^2$, $2s^2 2p^6$, $3s^2 3p^3$. What is the atomic number of the element which is just below the above element in the periodic table
(a) 34 (b) 49 (c) 33 (d) 31

12. An element with atomic number 20 is placed in which period of the periodic table?
(a) 4 (b) 3 (c) 2 (d) 1

13. Which one is the correct order of the size of the iodine species?
(a) $I > I^+ > I^-$ (b) $I > I^- > I^+$ (c) $I^+ > I^- > I$ (d) $I^- > I > I^+$

14. The electron affinities of N, O, S and Cl are as
(a) $N < O < S < Cl$ (b) $O < N < Cl < S$ (c) $O \approx Cl < N \approx S$ (d) $O < S < Cl < N$

15. Which of the following transitions involves maximum amount of energy?
(a) $M^-(g) \longrightarrow M(g)$ (b) $M(g) \longrightarrow M^+(g)$ (c) $M^+(g) \longrightarrow M^{+2}(g)$ (d) $M^{+2}(g) \longrightarrow M^{+3}(g)$

16. Two elements X and Y have following electronic configurations, X = $1s^2$, $2s^2$, $2p^6$, $3s^2 3p^6$, $4s^2$ and Y = $1s^2$, $2s^2 2p^6$, $3s^2 3p^5$. The compound formed by combination of X and Y is;
(a) XY_2 (b) X_5Y_2 (c) X_2Y_5 (d) XY_5

17. Which oxide of nitrogen is isoelectronic with CO_2?
(a) NO_2 (b) N_2O (c) NO (d) N_2O_2

18. Which of the following shows iso-structural species?
(a) NH_4^+ and NH_2^- (b) CH_3^- and CH_3^+
(c) SO_4^{2-}, PO_4^{3-} and BF_4^- (d) NH_4^+ and NH_3

19. Which of the following molecules will not show zero dipole moment?
(a) CH_4 (b) CCl_4 (c) CO_2 (d) $CHCl_3$

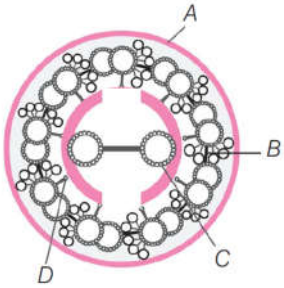
20. The diamagnetic molecules are
(a) B_2, C_2, N_2 (b) O_2, F_2, N_2 (c) F_2, C_2, N_2 (d) B_2, O_2^{2-}, N_2

BIOLOGY

(Single correct option +4, -1)

1. Omnis cellula-e-cellula, (all cells arise from pre-existing cells). Who gave this concept and modified the cell theory?
(a) Schleiden and Schwann
(b) Virchow
(c) Robert Brown
(d) Leeuwenhoek
2. A specialised differentiated form of cell membrane of prokaryotes is
(a) ribosome
(b) mesosome
(c) microvilli
(d) vacuoles
3. Lipids are arranged within the membrane with
(a) polar heads towards innerside and the hydrophobic tails towards outerside
(b) Both heads and tails towards outerside
(c) heads towards outerside and tails towards inside
(d) Both heads and tails towards innerside
4. According to Singer and Nicolson concept, cell membrane is
(a) solid
(b) quasifluid
(c) fluid
(d) solidified sheath

5. Identify *A* to *D* in the diagrammatic representation of internal structure of cilia.

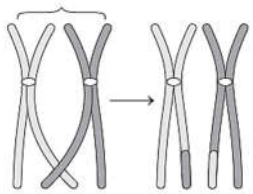


(a) A–Interdoublet bridge, B–Central microtubule, C–Plasma membrane, D–Radial spoke
(b) A–Plasma membrane, B–Central microtubule, C–Interdoublet bridge, D–Radial spoke
(c) A–Plasma membrane, B–Interdoublet bridge, C–Central microtubule, D–Radial spoke
(d) A–Plasma membrane, B–Interdoublet bridge, C–Radial spoke, D–Central microtubule

6. During which phase(s) of cell cycle, amount of DNA in a cell remains at 4C level if the initial amount is denoted as 2C?
(a) G_0 and G_1 (b) G_1 and S (c) Only G_2 (d) G_2 and M

7. Which of the following options gives the correct sequences of events during mitosis ?
(a) Condensation→ nuclear membrane disassembly→ crossing over → segregation→ telophase
(b) Condensation→ nuclear membrane disassembly→ arrangement at equator→ centromere division→ segregation→ telophase
(c) Condensation→ crossing over→ nuclear membrane disassembly→ segregation→ telophase
(d) Condensation→ arrangement at equator→ centromere division→ segregation→ telophase

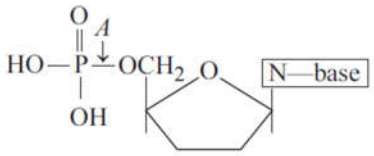
8. Given below is the representation of a certain event at a particular stage of a type of cell division. Which is this stage?



(a) Prophase-I during meiosis (b) Prophase-II during meiosis
(c) Prophase of mitosis (d) Both prophase and metaphase of mitosis

9. Arrange the following events of meiosis in correct sequences.
I. Crossing over. II. Synapsis.
III. Terminalisation of chiasmata. IV. Disappearance of nucleolus.
(a) II, I, IV and III (b) II, I, III and IV
(c) I, II, III and IV (d) II, III, IV and I

10. Meiosis in diploid organisms results in
    (a) production of gametes (b) reduction in the number of chromosomes
    (c) introduction of variation (d) All of the above
11. A fatty acid has a carboxyl group attached to *R* group. The *R* group could be a/an
    (a) methyl
    (b) ethyl
    (c) higher number of —CH_2 groups (1 to 19 carbons)
    (d) All of the above
12. Which of the following secondary metabolites are used as drugs?
    (a) Vinblastin and curcumin (b) Anthocyanin
    (c) Gums and cellulose (d) Abrin and ricin
13. In the given structure '*A*' represents



    (a) ester bond (b) ionic bond (c) phosphate bond (d) glycosidic bond
14. Identify, whether the given conditions are anabolic or catabolic.
    I. Glucose ⟶ Lactic acid
    II. Amino acids ⟶ Proteins
    (a) I–Catabolic; II–Catabolic (b) I–Anabolic; II–Catabolic
    (c) I–Catabolic; II–Anabolic (d) I–Anabolic; II–Anabolic
15. Amino acids have both an amino group and a carboxyl group in their structure. Which amongst the following is an amino acid?
    (a) Formic acid (b) Glycerol (c) Glycolic acid (d) Glycine
16. Organisms which circulate water from their surroundings through their body cavities to facilitate the cells to exchange nutrients and waste substances are
    (a) coelenterates (b) sponges (c) Both (a) and (b) (d) None of these
17. In birds and mammals, the oxygenated and deoxygenated blood is received by
    (a) left and right atria
    (b) left and right ventricles
    (c) left atria and right ventricle
    (d) left atria and left ventricle

18. ECG is graphical representation of
    (a) rate of heartbeat
    (b) volume of blood pumped
    (c) ventricular contraction
    (d) electrical activities of heart
19. Neural signals through the sympathetic nerves (ANS) can increase the rate of heartbeat by
    (a) increasing heart output
    (b) increasing the strength of ventricular contraction
    (c) Both (a) and (b)
    (d) increasing the contraction of atrium
20. Blood pressure in the mammalian aorta is maximum during
    (a) systole of the left atrium
    (b) diastole of the right ventricle
    (c) systole of the left ventricle
    (d) diastole of the right atrium