

**MATHEMATICS**

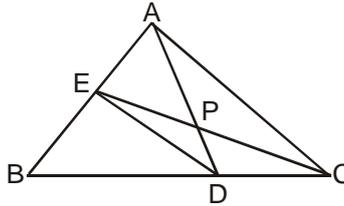
1. If  $a$  and  $b$  are any two real numbers with opposite signs, which of the following is the greatest ?  
 (A)  $(a-b)^2$                       (B)  $(|a| - |b|)^2$                       (C)  $|a^2 - b^2|$                       (D)  $a^2 + b^2$
2. The sum of the infinite series :  

$$\frac{1}{10} + \frac{2}{10^2} + \frac{3}{10^3} + \dots + \frac{n}{10^n} + \dots$$
  
 (A)  $\frac{1}{9}$                       (B)  $\frac{10}{81}$                       (C)  $\frac{1}{8}$                       (D)  $\frac{17}{22}$
3. The number  $(1024)^{1024}$  is obtained by raising  $(16)^{16}$  to the power  $n$ . What is the value of  $n$  ?  
 (A) 64                      (B)  $64^2$                       (C)  $64^{64}$                       (D) 160
4. The smallest value the expression  $x^2 + 6x + 8$  attains on the set  $\{x \in \mathbb{R} \mid x^2 - 2x - 8 \leq 0\}$  is  
 (A) 0                      (B) -1                      (C) 8                      (D) 3
5. Let  $P_1$  be the set of all prime numbers, i.e.,  $P_1 = \{2, 3, 5, 7, 11, \dots\}$ , Let  $P_n = \{np \mid p \in P_1\}$ , i.e., the set of all prime multiples of  $n$ . Then which of the following sets is non empty ?  
 (A)  $P_1 \cap P_{23}$                       (B)  $P_7 \cap P_{21}$                       (C)  $P_{12} \cap P_{20}$                       (D)  $P_{20} \cap P_{24}$
6. The number of integers  $a$  such that  $1 \leq a \leq 100$  and  $a^a$  is a perfect square is :  
 (A) 50                      (B) 53                      (C) 55                      (D) 56
7. On a card, the following three statements are found :  
 (1) On this card exactly one statement is false.  
 (2) On this card exactly two statements are false.  
 (3) On this card exactly three statements are false.  
 The number of false statements on the card is exactly  
 (A) 0                      (B) 1                      (C) 2                      (D) 3
8. In triangle ABC, with  $\angle A = 90^\circ$ , the bisectors of the angles B and C meet at P. The distance from P to the hypotenuse is  $4\sqrt{2}$ . The distance AP is :  
 (A) 8                      (B) 4                      (C)  $8\sqrt{2}$                       (D)  $4\sqrt{2}$

9. In a rhombus one of the diagonals is twice the other diagonal. Let A be the area of the rhombus in square units. Then each side of the rhombus is :

(A)  $\sqrt{A}$                       (B)  $\frac{1}{2}\sqrt{2A}$                       (C)  $\frac{1}{2}\sqrt{5A}$                       (D)  $\frac{1}{4}\sqrt{4A}$

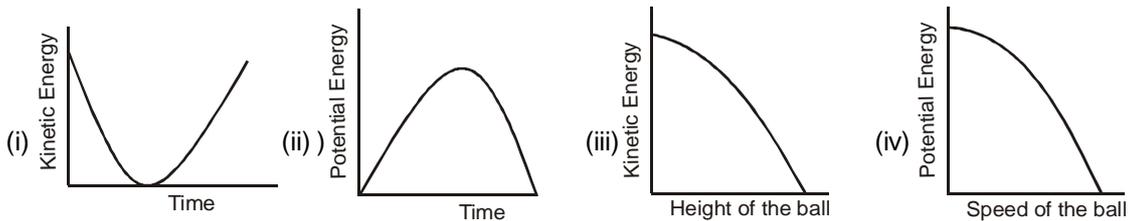
10. In the following figure, AE = EB, BD = 2DC What is the ratio of the areas of PED and ABC ?



(A)  $\frac{1}{4}$                       (B)  $\frac{1}{6}$                       (C)  $\frac{1}{9}$                       (D)  $\frac{1}{12}$

### PHYSICS

11. A ball is thrown vertically upwards with a certain initial velocity. Assume that there is no resistance due to air. Among the graphs below, the graph that is not an appropriate representation of the motion of the ball is :



(A) A                      (B) B                      (C) C                      (D) D

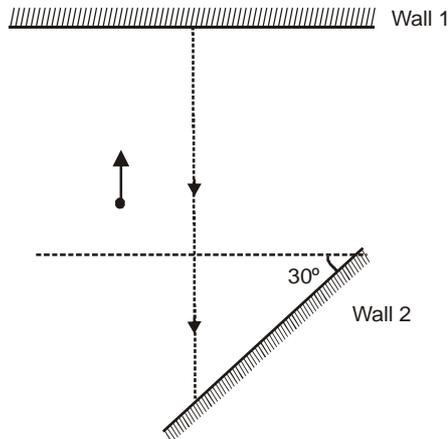
12. An electron of mass  $m_e$  initially at rest takes time  $t_1$  to move a distance  $s$  in a uniform electric field in the same field environment, a proton of mass  $m_p$  initially at rest takes time  $t_2$  to move the same distance (in the opposite direction). Ignoring gravity, the ratio  $t_2/t_1$  is :

(A) 1                      (B)  $\left(\frac{m_e}{m_p}\right)^{1/2}$                       (C)  $\frac{m_p}{m_e}$                       (D)  $\left(\frac{m_p}{m_e}\right)^{1/2}$

13. A simple camera with a converging lens of 60 mm focal length is focused on very far objects. To focus the camera on a nearby object 1.5 m away, the distance between the film and lens will have to be:

- (A) decreased by 2.5 mm  
 (B) increased by 2.5 mm  
 (C) kept fixed as before. but aperture increased by a factor of 2.5  
 (D) kept fixed as before, hut aperture decreased by a factor of 2.5

14. A molecule of gas in a container hits one wall (1) normally and rebounds back. It suffers no collision and hits the opposite wall (2) which is at an angle of  $30^\circ$  with wall 1.



Assuming the collisions to be elastic and the small collision time to be the same for both the walls, the magnitude of average force by wall 2. ( $F_2$ ) provided to the molecule during collision satisfy :

- (A)  $F_1 > F_2$  (B)  $F_1 < F_2$   
 (C)  $F_1 = F_2$ , both non-zero (D)  $F_1 = F_2 = 0$
15. A stone dropped from the window of a stationary train hits the ground and comes to rest. An identical stone is dropped from the window when the same train is moving with speed  $v$  and it comes to rest on the ground. Assume that in each case, the entire energy lost in impact goes into heating the stone. Then
- (A) The first stone is slightly more heated than the second.  
 (B) The second stone is slightly more heated than the first.  
 (C) Both the stones will be raised to the same slightly higher temperature.  
 (D) The second stone will be slightly more heated than the first only if its horizontal speed during fall is more than the final vertical speed.
16. A negatively charged particle initially at rest is placed in an electric field that varies from point to point. There are no other fields. Then :
- (A) the particle moves along the electric line of force passing through it.  
 (B) the particle moves opposite to the electric line of force passing through it.  
 (C) the direction of acceleration of the particle is tangential to the electric line of force at every instant.  
 (D) the direction of acceleration of the particle is normal to the electric line of force at every instant.
17. There is a steady water flow in a horizontal tube in which one part has cross sectional area  $A_1$  and the other part has cross sectional area  $A_2$ . Assume that water is incompressible. If  $A_1/A_2 = 16$ , the ratio of the speed  $u_1$  in part 1 and the speed  $u_2$  in part 2, i.e.  $u_1/u_2$  is :
- (A)  $\frac{1}{16}$  (B) 4 (C)  $\frac{1}{4}$  (D) 1
18. Positive point charges of magnitude  $q$  are placed at all the twelve 'hour' positions of a clock of radius  $r$ . The clock is mounted on a wall in the normal way. The charge at the position '6' is removed. The resulting electric field at the centre of the clock is :
- (A) 0 (B)  $\frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$  in the horizontal direction.  
 (C)  $\frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$  vertically upward. (D)  $\frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$  vertically downward

19. The pair of quantities that do not have the same dimensions is :  
 (A) Latent heat, specific heat  
 (B) Gravitational force, Coulomb force  
 (C) Kinetic energy of a freely falling body, potential energy of a compressed spring  
 (D) Coefficient of friction, number of molecules in a container.
20. A block of wood is floating on oil with half of its volume submerged. If the density of oil is  $840 \text{ kg m}^{-3}$ , the relative density of wood (relative to water) is :  
 (A) 0.84 (B) 0.42 (C) 0.21 (D) 1.00

## CHEMISTRY

21. The volume of 0.5 M aqueous NaOH solution required to neutralize 10 ml of 2 M aqueous HCl solution is:  
 (A) 20ml (B) 40ml (C) 80ml (D) 120ml
22. The compound that can be purified by sublimation is :  
 (A) Ammonium Sulphate (B) Calcium Carbonate  
 (C) Calcium Oxide (D) Aluminium Chloride
23. Penicillin was discovered by :  
 (A) Alexander G. Fleming (B) Emil Fisher  
 (C) Robert B. Woodward (D) van't Hoff
24. Among butane, 1-butene, 1-butanol and butanal, the compound which is most polar is  
 (A) butane (B) 1-butene (C) 1-butanol (D) butanal
25. Among ethanol, dimethyl ether, methanol, and propanal, the isomers are :  
 (A) ethanol, dimethyl ether, methanol and propanal  
 (B) ethanol and methanol  
 (C) ethanol, dimethyl ether, and methanol  
 (D) ethanol and dimethyl ether
26. Among Li, Be, N and F, the element having the largest atomic radius, is :  
 (A) Li (B) Be (C) N (D) F
27. The proof of oxidizing action of hydrogen peroxide in acid solution is in the formation of :  
 (A)  $\text{O}_2$  (B)  $\text{H}_2\text{O}$   
 (C) both  $\text{H}_2\text{O}$  and  $\text{O}_2$  (D) both  $\text{H}_3\text{O}^+$  and  $\text{O}_2$
28. A gel toothpaste is a mixture of a :  
 (A) liquid in a solid (B) solid in a gas (C) liquid in a liquid (D) gas in a solid
29.  $3.01 \times 10^{23}$  molecules of elemental Sulphur will react with 0.5 mole of oxygen gas completely to produce  
 (A)  $6.02 \times 10^{23}$  molecules of  $\text{SO}_3$  (B)  $6.02 \times 10^{23}$  molecules of  $\text{SO}_2$   
 (C)  $3.01 \times 10^{23}$  molecules of  $\text{SO}_3$  (D)  $3.01 \times 10^{23}$  molecules of  $\text{SO}_2$
30. The pair of metals which will produce hydrogen gas in reaction with acid is :  
 (A) Mg, Cu (B) Mg, Ag (C) Zn, Pb (D) Cu, Zn

## BIOLOGY

31. A cancer which is not a tumor is :  
(A) Lymphoma                      (B) Leukemia                      (C) Prostate cancer                      (D) Oral cancer
32. The phase of the cell cycle in which DNA synthesis takes place is :  
(A) G1 phase                      (B) S phase                      (C) G2 phase                      (D) G0 phase
33. You have a tube containing  $10^2$  bacteria. You have taken out  $10^2$  bacteria. How many bacteria are left in the tube ?  
(A) approximately  $10^7$       (B) approximately  $10^6$       (C) approximately  $10^5$       (D) approximately  $10^9$
34. Association in which both the organisms get benefited is :  
(A) Commensalism      (B) Mutualism                      (C) Ammensalism                      (D) Parasitism
35. You are part of a scientific expedition that has ventured deep into the Amazon rain forest. You spot a tree with branches spread over a large area. What can you conclude about the root structure of the tree?  
(A) It is dicotyledonous  
(B) It is monocotyledonous  
(C) It may be either monocotyledonous or dicotyledonous  
(D) There is no correlation between foliage and root structure
36. Alleles are :  
(A) Different forms of the same protein                      (B) Two different genes  
(C) Different forms of the same gene                      (D) Two different proteins
37. If a person's spinal cord is injured which of the following functions might be affected ?  
(A) Talking                      (B) Seeing                      (C) Sneezing                      (D) Hearing
38. The amount of  $\text{CO}_2$  plant is greater at night than during the day because :  
(A) The rate of respiration is higher at night.  
(B) More  $\text{CO}_2$  is produced because it is colder during the night.  
(C) Photosynthesis during the day uses up some of the  $\text{CO}_2$  produced by respiration.  
(D) More glucose is available for respiration during the night
39. Osmosis takes place between two solutions separated by a semipermeable membrane because.  
(A) Water molecules move from the more dilute solution to the less dilute solution  
(B) Solute molecules move from the less dilute solution to the more dilute solution  
(C) Water molecules move from the less dilute solution to the more dilute solution  
(D) Solute molecules move from the more dilute solution to the less dilute solution
40. Arteries do not have valves but veins do, because :  
(A) Arteries have a narrower lumen than veins  
(B) Arteries have thicker walls than veins  
(C) Arteries carry oxygenated blood whereas veins carry deoxygenated blood  
(D) Valves prevent backflow of blood in veins

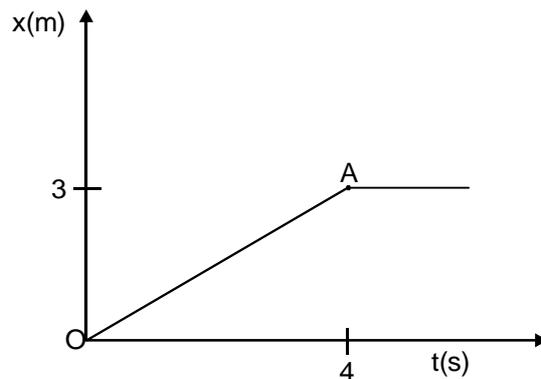
PART - B (5 Mark)

## MATHEMATICS

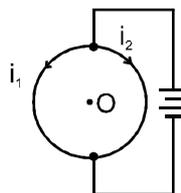
1.  $ab$  and  $cd$  are two 2 – digit natural numbers and  $4b + a = 13k_1$  and  $5d - c = 17k_2$ , where  $k_1$  and  $k_2$  are natural numbers. Then find the largest number that will always divide product of  $ab$  and  $cd$ .
2. An operation defined as the product of non zero digits of  $x$ . e.g. An operation  $\odot$  defined as the product of non zero digits of  $x$ . e.g.  $\odot_{25} = 2 \times 5 = 10$ , then find the sum of all the possible  $\odot_n$  where  $n$  is a two digit number formed by the digits 1, 2, 3, 4, 5, 6,7, 8, and 9.
3. A ray of light originating at the vertex  $A$  of a square  $ABCD$  passes through the vertex  $B$  after getting reflected by  $BC$ ,  $CD$  and  $DA$  in that order. If  $\theta$  is the angle of the initial position of the ray with  $AB$  then find the value of  $\sin\theta$ .

## PHYSICS

4. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is  $4/3$  and the fish is 12 cm below the surface, then find the radius of the circle.
5. Figure shows the position-time graph of particle of mass 4 kg. What is the



- (a) force on the particle for  $t < 0$ ,  $t < 4$  s,  $0 < t < 4$  s ?
  - (b) Impulse at  $t = 0$  and  $t = 4$  s ? (Consider one dimensional motion only)
6. Any two ends of a circular conducting wire are connected by a cell. Find the magnetic field at the centre  $O$ .



## CHEMISTRY

7. The electronic configuration of some elements are given below :
- (i)  $1s^2, 2s^2, 2p^6, 3s^1$
  - (ii)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^1, 4s^2$
  - (iii)  $1s^2, 2s^2, 2p^4$
  - (iv)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
  - (v)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
  - (vi)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
  - (vii)  $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
- out of these
- (a) which is an alkaline earth metal ?
  - (b) which has the lowest chemical reactivity ?
  - (c) which belongs to group 15 of the periodic table ?
  - (d) which is a transition element ?
  - (e) which is a halogen ?
  - (f) which belongs to second period ?
  - (g) which forms unipositive ion in its compounds ?
8. What is meant by the term bond order ? Calculate the bond order of :  $N_2$ ,  $O_2$ ,  $O_2^+$  and  $O_2^-$ .
9. The enthalpy of combustion of graphite is 393.3 kJ. Calculate
- (a) the amount of graphite needed to produce 196.7 kJ of heat.
  - (b) the number of moles of  $CO_2$  formed when 196.7 kJ of heat is produced.
  - (c) the volume of oxygen required as S.T.P. to burn 24.0 g of graphite in this process.

## BIOLOGY

10. (A) Give the reasons for the following :
- (i) The wall of trachea is supported by cartilagenous rings.
  - (ii) The lung alveoli are covered with blood capillaries.
  - (iii) The glottis is guarded by epiglottis.
- (B) Write the technical term for the following :
- (i) An organism whose cells don't have well organised muscles.
  - (ii) Sum total of chemical processes taking place in cell
11. **Answer the following question :**
- (i) If one ripened fruit is kept in a basket of raw fruits which causes ripening of raw fruits also. Name the hormone responsible for it.
  - (ii) Which nitrogenous waste product is most toxic & which one is least toxic in animals ?
  - (iii) Which type of cell is found in bacteria and blue green algae ?
  - (iv) Which chemical molecule carries hereditary inform
  - (v) Which substance is used to remove chlorophyll from a green leaf during photosynthesis experiments?
12. Answer the following questions -
- (i) Name the hormone responsible for inducing rooting in callus or stem cuttings\_\_\_\_\_ .
  - (ii) Name the hormone which induces cell division in plants\_\_\_\_\_.
  - (iii) Name the plant hormone which promotes closing of stomata during water scarcity \_\_\_\_\_ .
  - (iv) Name the animal hormone that stimulates maturation of lymphocytes\_\_\_\_\_ .
  - (v) Name the hormone that stimulates reabsorption of water from collecting tubules of nephron\_\_\_\_\_.