SOF
SCIENCE OLYMPIAD FOUNDATION

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SOF NATIONAL SCIENCE OLYMPIAD

Total Questions : 50

Time : 1 hr.

PATTERN & MARKING SCHEME			
Section	(1) Physics & Chemistry	(2) Achievers Section	(3) Mathematics or Biology
No. of Questions	25	5	20
Marks per Ques.	1	3	1

SYLLABUS

Section – 1 : *Physics* : Electricity and Magnetism, Electromagnetic Induction, Alternating current, Electromagnetic waves, Optics, Modern Physics, Semiconductor Electronics, Communication Systems.

Chemistry : Solid State, Solutions, Electrochemistry, Chemical Kinetics, Surface Chemistry, General Principles and Processes of Isolation of Elements, p-Block Elements (Group 15 to 18), d- & f-Block Elements, Coordination Compounds, Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers, Aldehydes, Ketones and Carboxylic Acids, Amines, Biomolecules, Polymers, Chemistry in Everyday Life.

Section – 2 : Higher Order Thinking Questions - Syllabus as per Section – 1.

Section – 3 : Relations and Functions, Inverse Trigonometric Functions, Matrices and Determinants, Continuity and Differentiability, Application of Derivatives, Integrals, Application of Integrals, Differential Equations, Vector Algebra, Three Dimensional Geometry, Probability, Linear Programming. **OR**

Section – 3 : Reproduction, Genetics and Evolution, Biology in Human Welfare, Biotechnology, Ecology.

PHYSICS AND CHEMISTRY

1. A ray of light passes from vacuum into a medium of refractive index μ, the angle of incidence is found to be twice the angle of refraction. Then the angle of incidence is
   (A) $\cos^{-1}(\mu/2)$
   (B) $2\cos^{-1}(\mu/2)$
   (C) $2\sin^{-1}\mu$
   (D) $2\sin^{-1}(\mu/2)$

2. A capacitor of capacitance C_0 is charged to a potential V_0 and isolated. A small capacitor of capacitance C is then charged from C_0, discharged and charged again, the process being repeated n times. Due to this, potential of the larger capacitor is decreased to V. The value of C is

   (A) $C_0\left[\dfrac{V_0}{V}\right]^{1/n}$
   (B) $C_0\left[\left(\dfrac{V_0}{V}\right)^{1/n}-1\right]$

   (C) $C_0\left[\left(\dfrac{V_0}{V}\right)-1\right]^{n}$
   (D) $C_0\left[\left(\dfrac{V_0}{V}\right)^{n}-1\right]$

3. A ray of light in a liquid of refractive index 1.4, approaches the boundary surface between the liquid and air at an angle of incidence whose sine is 0.8. Which of the following statements is correct about the behavior of the light ?
   (A) It is impossible to predict the behavior of the light ray on the basis of the information supplied.

   (B) The sine of the angle of refraction of the emergent ray will be less than 0.8.
   (C) The ray will be internally reflected.
   (D) The sine of the angle of refraction of the emergent ray will be greater than 0.8.

4. A metal X is prepared by the electrolysis of fused chlorides. It reacts with hydrogen to form a colourless solid from which hydrogen is released on treatment with water. The metal is
   (A) Al   (B) Ca   (C) Cu   (D) Zn

5. A 0.008 M solution of M_2SO_4 is isotonic with a 0.02 M solution of glucose at the same temperature. The apparent degree of dissociation is
   (A) 0.5   (B) 0.75   (C) 1   (D) 0.25

6. When a compound 'X' is reacted with PCl_5 and then with NH_3, it gives 'Y'. When 'Y' is treated with Br_2 and KOH, it produces 'Z'. 'Z' on treatment with $NaNO_2$ and HCl at 0°C and then on warming with water produces *ortho*-cresol. Compound 'X' is
   (A) *o*-toluic acid
   (B) *o*-chlorotoluene
   (C) *o*-bromotoluene
   (D) *m*-toluic acid.

7. A long straight wire carries a current i. A particle having a positive charge q and mass m, kept at distance x_0 from the wire is projected towards it with speed v as shown in the given figure. The closest distance of approach of charged particle to the wire is

(A) $x_{min} = x_0 e^{-2\pi mv/\mu_0 qi}$

(B) $x_{min} = x_0 e^{mv/\mu_0 qi}$

(C) $x_{min} = x_0 e^{-\pi mv/\mu_0 qi}$
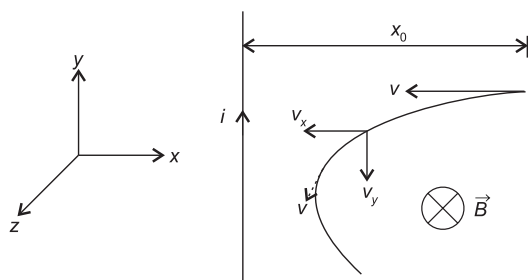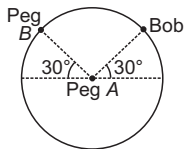
(D) $x_{min} = x_0 e^{-mv/\mu_0 q2i}$

8. Observe the given graph carefully.
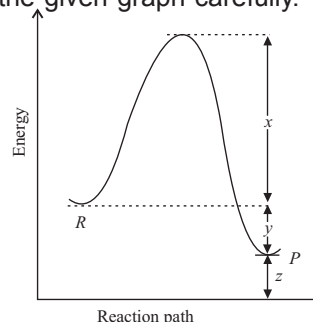
The activation energy of the backward reaction, heat of reaction and threshold energy of the reaction respectively are

(A) $x - y$, y and $x + y - z$

(B) $x + y + z$, $y + z$ and z

(C) $x + y$, y and $x + y + z$

(D) $x + y$, y and $x - y - z$.

MATHEMATICS

9. If $\sqrt{(1 - x^6)} + \sqrt{(1 - y^6)} = a(x^3 - y^3)$ and

$\dfrac{dy}{dx} = f(x, y)\sqrt{\left(\dfrac{1 - y^6}{1 - x^6}\right)}$, then

(A) $f(x, y) = \dfrac{y}{x}$

(B) $f(x, y) = \dfrac{y^2}{x^2}$

(C) $f(x, y) = \dfrac{2y^2}{x^2}$

(D) $f(x, y) = \dfrac{x^2}{y^2}$

10. For non-zero vectors $\vec{a}, \vec{b}, \vec{c}$;
$(\vec{a} \times \vec{b}) \cdot \vec{c} = |\vec{a}|\,|\vec{b}|\,|\vec{c}|$ holds iff

(A) $\vec{a} \cdot \vec{b} = 0, \vec{b} \cdot \vec{c} = 0$

(B) $\vec{b} \cdot \vec{c} = 0, \vec{c} \cdot \vec{a} = 0$

(C) $\vec{c} \cdot \vec{a} = 0, \vec{a} \cdot \vec{b} = 0$

(D) $\vec{a} \cdot \vec{b} = \vec{b} \cdot \vec{c} = \vec{c} \cdot \vec{a} = 0$

BIOLOGY

9. The allele for pea comb (P) in chickens is completely dominant to the allele for single comb (p). The alleles for black feather colour (B), and white feather colour (B′) show codominance, so that BB′ individuals possess blue feathers. If chickens heterozygous for both pairs of genes are mated, what proportion of offspring are expected to be pea combed and white feathered?
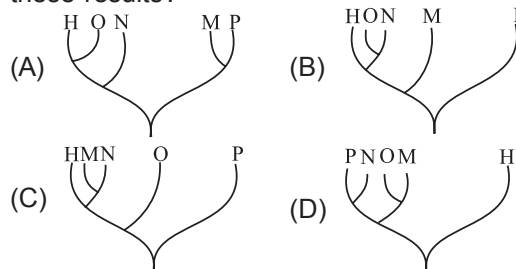
(A) 9/16   (B) 3/16   (C) 1/16   (D) 2/16

10. Human blood, when mixed with antibodies present in human blood, give maximum precipitation.

If another animal's blood is mixed with antibodies present in human blood, the percentage of precipitation indicates evolutionary relationship with that animal. The following experimental results were obtained :

Species: Human (H) - 100%; M - 37%; N - 75%; O - 79%; P - 17%

Which phylogenetic tree would best represent these results?

(A)

(B)

(C)

(D)