SECTION -2
PART-A
[SINGLE CORRECT CHOICE TYPE]

Q.1 to Q.6 has four choices (A), (B), (C), (D) out of which **ONLY ONE** is correct.

Q.1 Consider a hypothetical condition in which charge is uniformly distributed in whole space. If net flux passing through the surface of imaginary cube of edge a is ϕ, then flux passing through the surface of imaginary sphere of radius a will be :

(A) ϕ (B) $\frac{4\pi}{3}\phi$ (C) $\frac{4}{3}\phi$ (D) $\frac{3}{4\pi}\phi$

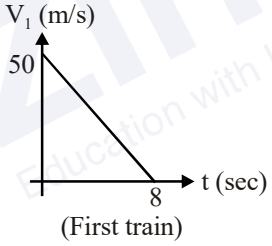
Q.2 A charge particle of charge 2×10^{-9} C moves 10 m in the direction of uniform electric field of magnitude 5×10^{6} N/C. Change in its electric potential energy will be

(A) –0.1 J (B) +0.1 J (C) 1 J (D) –10 J

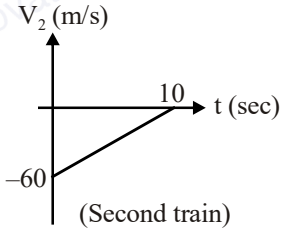
Q.3 n identical point charges are kept symmetrically on the periphery of the circle $x^2 + y^2 = R^2$ in xy-plane. The resultant electric field at (0, 0, R) is E_1 and at (0, 0, 2R) is E_2, the ratio of E_1/E_2 is :

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

Q.4 Two trains are moving in opposite direction on same track. When their separation was 600 m their drivers notice the mistake and start slowing down to avoid collision. Graphs of their velocities as function of time is as shown, find separation between the drivers when first train stops :



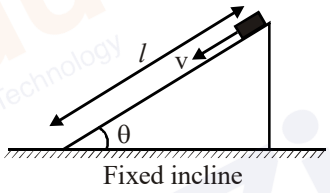
(First train)



(Second train)

(A) 100 m (B) 160 m (C) 112 m (D) 124 m

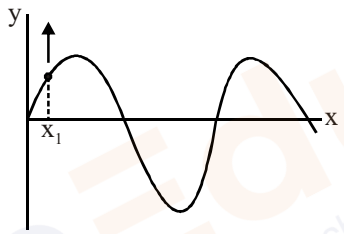
Q.5 A small block is given a velocity v along the incline in the downward direction at the highest point on an inclined plane, then block moves with constant velocity. After reaching at lowest point, block is given same speed v up the incline. Find time taken by the block to again reach the lowest point.



Fixed incline

(A) $\frac{2l}{v}$ (B) $\frac{l}{2v}$ (C) $\frac{l}{g\sin\theta}$ (D) it will not return

Q.6 The diagram shows snapshot of a wave at time t = 0. The particle at $x = x_1$ is moving upward at that instant. Direction of propagation of wave is



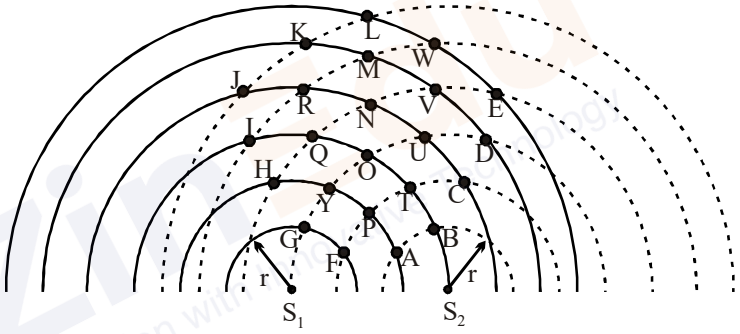
(A) +y (B) –y (C) +x (D) –x

[PARAGRAPH TYPE]

Q.7 to Q.12 has four choices (A), (B), (C), (D) out of which **ONLY ONE** is correct.

Paragraph for question nos. 7 to 9

Two coherent in phase point sources of wave S_1 and S_2 produce wave of wavelength 2 cm. Each circular arc represents wavefront and is separated from next arc by a distance 1 cm. Both the waves propagate through the medium and interfere with each other. Bold circular lines denote wavefront of source S_1 and dotted circular lines denote wavefront of source S_2. Answer the following questions.



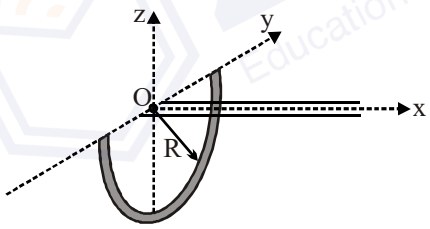
Q.7 The point(s) where constructive interference occurs
(A) G only (B) P and A (C) G and F (D) T and U

Q.8 The points of destructive interference will occur at
(A) F and R (B) G and P (C) G and F (D) F and P

Q.9 How many of the points shown in the figure represent constructive interference ?
(A) 10 (B) 12 (C) 13 (D) 14

Paragraph for question nos. 10 to 12

There is a fixed semicircular ring of radius R, lying in y-z plane, with centre of arc at origin and it is uniformly charged with charge +Q. There is a long hollow pipe of very small radius, inner surface of pipe is smooth and it is made of insulated material. Pipe is fixed along x-axis from origin. A small ball with charge +q and mass m is projected from O in pipe with negligible velocity, ball can smoothly move in pipe. Whole arrangement lies in gravity free space.



Q.10 The maximum acceleration of ball in pipe is

(A) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{mR^2}$ (B) $\frac{1}{12\sqrt{3}\pi\varepsilon_0}\frac{Qq}{mR^2}$ (C) $\frac{1}{6\sqrt{3}\pi\varepsilon_0}\frac{Qq}{mR^2}$ (D) None of these

Q.11 The kinetic energy of particle when its acceleration is maximum is

(A) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{R}\left(1-\sqrt{\frac{2}{3}}\right)$ (B) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{R}\left(\frac{1}{2}\right)$

(C) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{R}\left(\frac{1}{\sqrt{2}}\right)$ (D) None of these

Q.12 Normal reaction exerted by pipe on ball when ball is moving in pipe is

(A) z-axis always (B) –z axis always

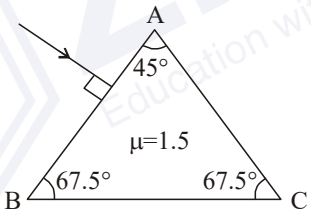
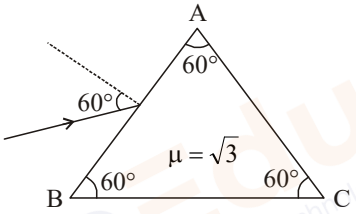
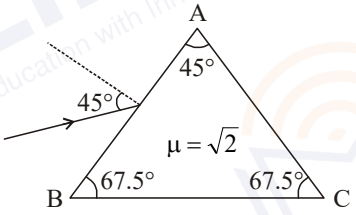
(C) initially along y-axis and then along z-axis (D) y-axis always

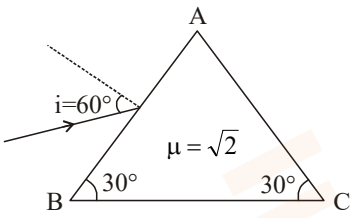
PART–B

[MATRIX TYPE]

Q.1 has **four** statements (A, B, C,D) given in **Column-I** and **five** statements (P, Q, R, S,T) given in **Column-II**. Any given statement in **Column-I** can have correct matching with one or more statement(s) given in **Column-II**.

Q.1 Assume that in each case, the ray after refraction from left face strikes face AC. Out side medium is air ($\mu = 1$)

Columnn-I		**Column-II**	
(A)		(P)	At surface AC TIR will take place
(B)		(Q)	At surface AC light will be refracted into air.
(C)		(R)	Ray refracted at AB will be parallel to base BC

(D) 

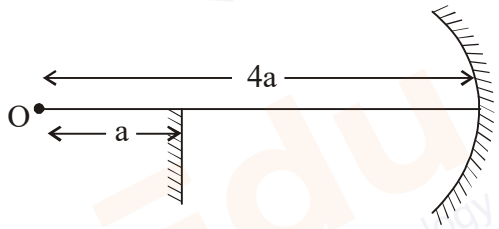
(S) Ray refracted at AB will not be parallel to BC

(T) Ray refracted at AB strikes AC normally.

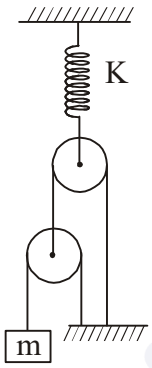
PART-C
[INTEGER TYPE]

Q.1 to Q.5 are "Integer Type" questions. (The answer to each of the questions **are upto 4 digits**)

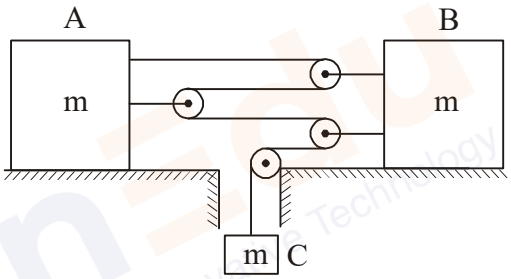
Q.1 The diagram shows a mirror system. If after two reflections the image and the object O coincide with each other, then find the value of radius of curvature of the concave mirror in meter. Take a = 3m.



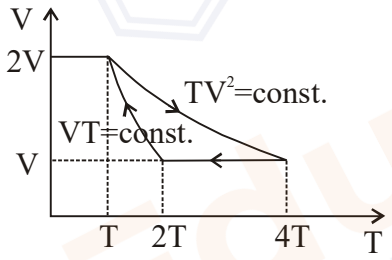
Q.2 A block of mass m is connected with two ideal pulley and a massless spring of spring constant K as shown in figure. A block is slightly displaced from its equilibrium position. If the time period of oscillation is $\mu\pi\sqrt{\frac{m}{K}}$. Then find the value of μ.



Q.3 All the surface are frictionless then acceleration of the block B is 2g /n. Find n.



Q.4 Figure shows the VT diagram for helium gas in a cyclic process. Find the ratio of maximum and minimum pressure.



Q.5 Four point charges +q, +q, +q and –q are placed on the four corner of tetrahedral (regular tetrahedron) of edge length 'a' (each). Electric potential energy of system is $n\left(\frac{kq^2}{a}\right)$. Find n