

**Assertion -Reason Type (Time: 20 min)**

**Instructions:**

For the following questions, choose the correct answer from the codes (a), (b), (c) and (d) defined as follows:

- a) Statement I is true, Statement II is also true; Statement II is the correct explanation for Statement I.
- b) Statement I is true, Statement II is also true; Statement II is not the correct explanation for Statement I.
- c) Statement I is true, Statement II is false.
- d) Statement I is false, Statement II is also true.

**CHEMISTRY**

1. **Statement I:**  $\text{SiF}_6^{2-}$  is known but  $\text{SiCl}_4^{2-}$  is not known.

**Statement II:** Interaction of F lone pair electrons with Si is stronger than that of chlorine and due to smaller size of F steric repulsion will be less.

**Answer: a**

2. **Statement I:** The bond lengths in  $\text{BF}_3$  are  $1.30 \text{ \AA}$  and are shorter than the sum of the covalent radii.

**Statement II:**  $p\pi-p\pi$  interaction exists and all B-F bonds are equivalent and based on modern explanation, the double bond is delocalized.

**Answer: a**

**MATHEMATICS**

3. If  $f(x) + f(x+3) + f(x+4) + f(x+6) = 10$ ,

$$I = \int_0^T f(x) dx \quad \text{and}$$

$$I_1 = \int_0^{12+6T} f(4x) dx$$

**Statement I:**  $I_1 = 25I$

**Statement II:** Period of  $f(x)$  is 8.

**Answer: d**

4. Consider the circle  $C : x^2 + y^2 + kx + (1+k)y - (k+1) = 0$

**Statement I:** Circle  $C$  passes through two fixed points  $(1, 0)$  and  $(1/2, 1/2)$  for all value of  $k$ .

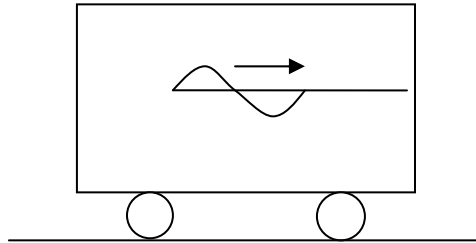
**Statement II:** The minimum value of the radius of a circle  $C$  is when  $k = -\frac{3}{2}$ .

**Answer: b**

**PHYSICS**

5. **Statement I:** A transverse wave is created on a stretched string whose one end is fixed to a car which is moving with a constant velocity  $v$  wrt ground as shown in figure. If the tension in string is  $T$  and its linear mass density is  $\mu$ , then for small amplitude the velocity of wave wrt ground is

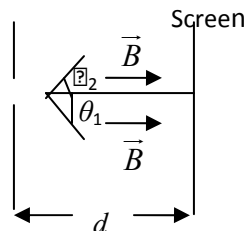
$$v + \sqrt{\frac{T}{\mu}} \text{ towards right.}$$



**Statement II:** For a transverse wave on a string  $V = \sqrt{\frac{T}{\mu}}$  is the speed of wave wrt string where symbols have their usual meaning.

**Answer (a)**

6. **Statement I:** Electrons in an electron beam emerge through a narrow hole, with all electrons having same speed and making small angles with the beam direction. These electrons can be focused, almost to a point on the screen by the application of an appropriate magnetic field as shown, in the space between the screen and electron gun.



**Statement II:** Magnetic field corrects the small angle which the directions of velocities of electrons make with the beam direction and makes all of them move in the direction of the beam.

**Answer: (c)**

**Solution:**

The electrons move in helical paths and the period is  $T = \frac{2\pi m}{qB}$ , same for all electrons

since angle  $\theta_n$  are small,  $\cos \theta_n = 1$ . They all come to same point in one period of helix if  $d = T.v \cos \theta_n = Tv$ .