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Hack the North Test Test [22]

Answer the following questions **in the box provided**. Complete solutions and sentences must be shown for full marks.

1. When $2x^4 + 3x^3 + ax^2 + bx + 7$ is divided by $x - 1$ the remainder is 15. When it is divided by $x + 2$ the remainder is -3. Determine the values of a and b. [5]

Let $f(x) = 2x^4 + 3x^3 + ax^2 + bx + 7$

$f(1) = 15$

$15 = 2(1)^4 + 3(1)^3 + a(1)^2 + b(1) + 7$

$15 = 12 + a + b$

① $3 = a + b$

$f(-2) = -3$

$-3 = 2(-2)^4 + 3(-2)^3 + a(-2)^2 + b(-2) + 7$

$-3 = 15 + 4a - 8b$

$-18 = 4a - 2b$

② $-9 = 2a - b$

① + ② $3 = a + b$

$-9 = 2a - b$

$-6 = 3a$

$-2 = a$

sub $a = -2$ into ①

$3 = -2 + b$

$5 = b$

$\therefore a = -2, b = 5$

2. Calculate the number of moles of 2.35g of calcium nitrate. [3]

$m_{Ca(NO_3)_2} = 2.35_g$

$M_{Ca(NO_3)_2} = 164.10\ g/mol$

$n = ?$

$Ca(NO_3)_2$

$n_{Ca(NO_3)_2} = \frac{m_{Ca(NO_3)_2}}{M_{Ca(NO_3)_2}}$

$= \frac{2.35_g}{164.10\ g/mol}$

$n_{Ca(NO_3)_2} = 0.0143\ mol$

$\therefore$ there are 0.0143 mol in 2.35g of calcium nitrate.

3. Explain, in terms of the energy of its molecules, why the temperature of a pure substance does not change during melting. [3]

During melting, all the energy supplied is absorbed and used to increase the potential energy (intermolecular forces) between the molecules, breaking apart the lattice structure and bonds in the solid while the kinetic energy is not affected.

Since temprature is directly proportional to average kinetic energy, no change in kinetic energy means no change in temperature.

4. State Newton's Third Law of Motion and provide an example of an application of the third law. [2]

Newton's Third Law states that for every action force, there is an equal and opposite reaction force.

Pushing off the wall when you swim, you apply force to the wall and the wall pushes back on you causing your system to become unbalanced and you accelerating away from the wall. Your force on the wall has little impact because of the size of the system of the wall (which is technically equal of the Earth).

5. Give the full electron configuration of the selenium atom ($_{34}$Se). [1]

$_{34}Se: 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

6. Give the full electron configuration of this ion and explain why this electron arrangement is stable. [2]

$_{34}Se^{2-}: 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

Full s and p valence subshells (like Noble gas Kr) and also has octect valence electrons in outer most energy level, thus stable.

7. Identify one other major variable that must be controlled in order to study the relationship between temperature and volume. [1]

Number of moles / Amount of gas (n)

8. Write the equation of the transformed function of y = |x| if it has been horizontally dilated by a factor of 6, vertically dilated by a factor of 5, reflected in the x-axis, horizontally translated 3 units to the left and vertically translated 7 units down. [5]

$$y = -5\left|\frac{1}{6}(x+3)\right| - 7$$