2022 IUT Admission Test(SOCIE)

<Multiple choice Types> There is only one correct answer per each question. Mark your answer choice on the OMR answer sheet.

For each correct answer, you will get the points indicated next to each question number.

No penalty point is applied to an incorrect answer.

, 4. , 5.

1. [1 point]

Since R_2 and R_3 are connected in parallel, the equivalent resistance of this parallel connection can be found: $\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{1\ \Omega} + \frac{1}{1\ \Omega} = \frac{2}{1\ \Omega}$.

therefore $R_p = 0.5\ \Omega$.

Now R_1 and R_p are connected in series, the equivalent resistance of this series connection is $R_{eq} = R_1 + R_p = 2\ \Omega + 0.5\ \Omega = 2.5\ \Omega$

Answer) **2.5 Ω**

2. [1 point]

The wavelength (λ) and the frequency (f) of light is related as $\lambda f = c$, where c is the speed of electromagnetic waves. Therefore, the wavelength is

$$\lambda = \frac{c}{f} = \frac{(3.0\times10^8\ \mathrm{m/s})}{(2.0\times10^9\ \mathrm{Hz})} = 0.15\ \mathrm{m}$$

Answer) **0.15 m**

3. [2 points]

The net force in the horizontal direction is

$F_{\neq t} = F - \mu_k N = ma = 2\ \mathrm{kg}\times3\ \mathrm{m/s^2} = 6\ \mathrm{N}$,

where μ_k is the coefficient of kinetic friction and N is the normal force. Since the net force in the vertical direction is zero, $N = mg = 20$ N.

Therefore, the coefficient of kinetic friction is

$$\mu_k = \frac{10\ \mathrm{N} - 6\ \mathrm{N}}{20\ \mathrm{N}} = 0.2$$

Answer) **0.2**

4. [2 point]

According to the conservation of mechanical energy, the potential energy at the top (mgh) should be same as the kinetic energy at the bottom ($\frac{1}{2}mv^2$). That is, $mgh = \frac{1}{2}mv^2$.

Therefore $v = \sqrt{2gh} = \sqrt{2\times10\ \mathrm{m/s^2}\times5\ \mathrm{m}} = 10\ \mathrm{m/s}$

Answer) **10 m/s**

5. [3 point]

The electric force between two charges with charges $+q$ is $\frac{1}{4\pi\epsilon_0}\frac{q^2}{l^2}$. The angle between two forces arising from other two charges is 60°. Therefore the vector sum of the two forces with the same magnitude of $\frac{1}{4\pi\epsilon_0}\frac{q^2}{l^2}$ is $\frac{\sqrt{3}}{4\pi\epsilon_0}\frac{q^2}{l^2}$.

Answer) $\frac{\sqrt{3}}{4\pi\epsilon_0}\frac{q^2}{l^2}$

6. [3 point]

The original amount of charge accumulated in the first capacitor is $Q_0 = CV = 3\times10^{-6}\,\mathrm{F}\times12\,\mathrm{V} = 36\,\mu\mathrm{C}$. When the first capacitor ($C_1 = 3\ \mu\mathrm{F}$) is connected to the second capacitor ($C_2 = 6\ \mu\mathrm{F}$), the charge flows out of the first capacitor untill the electric potential of the two capacitors become equivalent.

Since $V = Q/C$, $\frac{Q_1}{C_1} = \frac{Q_2}{C_2}$. Therefore $Q_2 = 2Q_1$.

And due to the charge conservation law, sum of the charges in two capacitors should be same as the original charge: $Q_1 + Q_2 = Q_0$. Therefore, $Q_1 + Q_2 = Q_1 + 2Q_1 = 3Q_1 = Q_0 = 36\ \mu\mathrm{F}$. Thus we find $Q_1 = 12\ \mu\mathrm{F}$.

Answer) **12 μC**