FINAL JEE–MAIN EXAMINATION – FEBRUARY, 2021

(Held On Wednesday 24th February, 2021) TIME : 9 : 00 AM to 12 : 00 NOON

PHYSICS

TEST PAPER WITH ANSWER & SOLUTIONS

SECTION-A

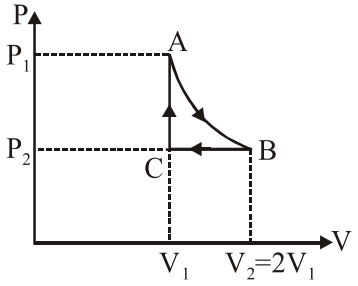
1. n mole a perfect gas undergoes a cyclic process ABCA (see figure) consisting of the following processes.

$A \to B$: Isothermal expansion at temperature T so that the volume is doubled from V_1 to $V_2 = 2V_1$ and pressure changes from P_1 to P_2.

$B \to C$: Isobaric compression at pressure P_2 to initial volume V_1.

$C \to A$: Isochoric change leading to change of pressure from P_2 to P_1.

Total workdone in the complete cycle ABCA is :



(1) 0 (2) $nRT\left(\ln 2+\frac{1}{2}\right)$

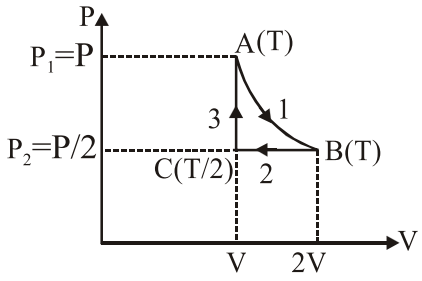
(3) nRTln2 (4) $nRT\left(\ln 2-\frac{1}{2}\right)$

Official Ans. by NTA (4)

Sol. $W_{Isothermal} = nRT\ln\left(\frac{v_2}{v_1}\right)$

$W_{Isobaric} = P\Delta V = nR\Delta T$

$W_{Isochoric} = 0$



$W_1 = nRT\ln\left(\frac{2V}{V}\right) = nRT\ln 2$

$W_2 = nR\left(\frac{T}{2}-T\right) = -nR\frac{T}{2}$

$W_3 = 0$

$\Rightarrow W_{net} = W_1 + W_2 + W_3$

$W_{net} = nRT\left(\ln 2-\frac{1}{2}\right)$

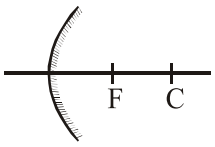
2. The focal length f is related to the radius of curvature r of the spherical convex mirror by:

(1) $f = +\frac{1}{2}r$ (2) $f = -r$

(3) $f = -\frac{1}{2}r$ (4) $f = r$

Official Ans. by NTA (1)

Sol. For convex mirror, focus is behind the mirror.



$\Rightarrow f = +\frac{r}{2}$

3. In a Young's double slit experiment, the width of the one of the slit is three times the other slit. The amplitude of the light coming from a slit is proportional to the slit-width. Find the ratio of the maximum to the minimum intensity in the interference pattern.

(1) 1 : 4 (2) 3 : 1 (3) 4 : 1 (4) 2 : 1

Official Ans. by NTA (3)

Sol. Amplitude $\propto$ Width of slit

$\Rightarrow A_2 = 3A_1$

$$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1}+\sqrt{I_2}}{|\sqrt{I_1}-\sqrt{I_2}|}\right)^2$$

$\because$ Intensity $I \propto A^2$

$$\Rightarrow \frac{I_{max}}{I_{min}} = \left(\frac{A_1+A_2}{|A_1-A_2|}\right)^2$$

$$= \left(\frac{A_1+3A_1}{|A_1-3A_1|}\right)^2$$

$$= \left(\frac{4A_1}{2A_1}\right)^2 = 4:1$$