Q.1 For a matrix $[M]=\begin{bmatrix} \frac{3}{5} & \frac{4}{5} \\ x & \frac{3}{5} \end{bmatrix}$, the transpose of the matrix is equal to the inverse of the matrix, $[M]^T=[M]^{-1}$. The value of x is given by

(A) $-\frac{4}{5}$ (B) $-\frac{3}{5}$ (C) $\frac{3}{5}$ (D) $\frac{4}{5}$

Q.2 The divergence of the vector field $3xz\,\hat{i}+2xy\,\hat{j}-yz^2\,\hat{k}$ at a point (1,1,1) is equal to

(A) 7 (B) 4 (C) 3 (D) 0

Q.3 The inverse Laplace transform of $\frac{1}{(s^2+s)}$ is

(A) $1+e^t$ (B) $1-e^t$ (C) $1-e^{-t}$ (D) $1+e^{-t}$

Q.4 If three coins are tossed simultaneously, the probability of getting at least one head is

(A) 1/8 (B) 3/8 (C) 1/2 (D) 7/8

Q.5 If a closed system is undergoing an irreversible process, the entropy of the system

(A) must increase
(B) always remains constant
(C) must decrease
(D) can increase, decrease or remain constant

Q.6 A coolant fluid at 30 °C flows over a heated flat plate maintained at a constant temperature of 100 °C. The boundary layer temperature distribution at a given location on the plate may be approximated as $T=30+70\exp(-y)$ where y (in m) is the distance normal to the plate and T is in °C. If thermal conductivity of the fluid is 1.0 W/mK, the local convective heat transfer coefficient (in W/m^2K) at that location will be

(A) 0.2 (B) 1 (C) 5 (D) 10

Q.7 A frictionless piston-cylinder device contains a gas initially at 0.8 MPa and 0.015 m^3. It expands quasi-statically at constant temperature to a final volume of 0.030 m^3. The work output (in kJ) during this process will be

(A) 8.32 (B) 12.00 (C) 554.67 (D) 8320.00

Q.8 In an ideal vapour compression refrigeration cycle, the specific enthalpy of refrigerant (in kJ/kg) at the following states is given as :

Inlet of condenser : 283
Exit of condenser : 116
Exit of evaporator : 232

The COP of this cycle is

(A) 2.27 (B) 2.75 (C) 3.27 (D) 3.75