Q1. If x^* is a global minima, then $\left.\frac{df}{dx}\right|_{x=x^*}(x-x^*)$ for any x would be

a) Positive in sign
b) Negative in sign
c) Zero
d) Either positive or negative but not zero

Q2. Why is necessary condition for a minimum not sufficient?
a) Same necessary condition will also satisfy a maximum.
b) Higher order terms in the Taylor series expansion were neglected in deriving necessary condition.
c) For a problem, multiple points that are minimum can satisfy the same necessary condition.
d) All of the above

Q3. Which of the following statements is true about global minima?
a) Necessary condition for local minima is same as that of global minima.
b) Every global minima is a local minima.
c) There is no operationally useful definition to find global minima
d) All of the above

Q4. The extremizer of the function, $f(x,y,z) = x^2 + 3y^2 + 3z^2 + 2xy + 2xz$ is

a) x=0, y=1, z=2
b) x=0, y=0, z=0
c) x=1, y=0, z=2
d) x=1, y=2, z=0

Q5. Principal minors of the Hessian of the function $f(x,y,z)$ given in question 4 are
a) 2, 6, 12
b) -2, 6, 12
c) 2, -6, 24
d) 2, 8, 24

Q6:: Extremum of $f(x,y,z)$ obtained in question 4 is a

a) Maximum
b) Minimum
c) Saddle point
d) Cannot be determined

Q7. Which of the following statements is not true about constrained minimization problem?

a) Checking positive-definiteness of Hessian as a sufficiency condition is an overkill.
b) Sufficiency condition using bordered Hessian makes sure that sufficiency is checked in feasible space only.
c) If Hessian in not positive-definite, it can be concluded that a point is not a local minimum.
d) None of the above

Q8. Find the minimum value of the function, $f(x,y)=(x-2)^2+8(y-1)^2$ such that

$$\begin{aligned} g_1 &= x+4y-3\le 0 \\ g_2 &= y-x\le 0 \end{aligned} \quad ?$$

a) 0
b) 1
c) 2
d) 3

Q9. Find the Lagrange multiplier corresponding to the constraint, g_1 , in the solution of Question 8?

a) 0
b) 1
c) 2
d) 3

Q10:: Which all constraints are active in the optimization problem given in question 8?

a) g_1
b) g_2
c) Both
d) Neither

Q11:: Why is the Lagrange multiple corresponding to the inequality constraint, $g\le 0$, non-negative when the objective function, f(x) is minimized?

a) To ensure feasibility of g
b) To ensure constrained minimum value of f
c) To satisfy $\nabla f+\mu\nabla g=0$
d) All of the above

Q12:: What purpose do complementarity conditions serve in KKT conditions?

a) They transform inequality condition to an equality form.
b) They help distinguish active and inactive inequalities.
c) Both (a) and (b)
d) Neither (a) and (b)

Q13:: Which of the following geometric interpretations of KKT conditions is not true?

a) The gradient vector of the objective function is a linear combination of the gradient vector of equality constraints and active inequality constraints.
b) If there is only a linear equality constraint in a problem involving two variables, the constraint is tangential to the contour of the objective function at the minimum point.
c) If the normal vectors of equality/active inequality constraints are coincident at a minimum point, then KKT conditions do not apply.
d) The gradient vectors of the objective function and all equality and active inequality constraints are linearly independent.

Q14:: Obtain the minimizer graphically for the optimization problem : Maximize x_1 , such that $x_2 - (1 - x_1)^3 \leq 0, x_1 \geq 0, x_2 \geq 0.$

a) $x_1 = 1, x_2 = 0$
b) $x_1 = 0, x_2 = 1$
c) $x_1 = 0.24, x_2 = 0.24$
d) $x_1 = 0, x_2 = 0$

Q15:: Check if the solution obtained in question 14 satisfy KKT conditions?

a) It satisfies KKT conditions.
b) KKT conditions are not satisfied, so the obtained graphical solution cannot be true.
c) KKT conditions are not applicable as constraint qualification is not satisfied for the problem.
d) It is not possible to check KKT conditions for this problem.