Q1. Read the following statements carefully and select the appropriate option.

1. Mechanics problem can be solved using vectorial methods.
2. Variational methods can be used to solve mechanics problems.

a) Both statements, 1 and 2 are correct
b) Statement 1 is correct but not statement 2
c) Statement 2 is correct but not statement
d) Both statements, 1 and 2 are incorrect

Q2. What is the key difference between finite variable optimization and calculus of variations?

a) There is no difference
b) In finite variable optimization, variables are finite in number whereas in calculus of variations unknown is a function
c) Finite variable optimization is approximate but calculus of variations is accurate
d) In finite variable optimization objective function is linear whereas in calculus of variations objective function is nonlinear

Q3. What is the solution to the brachistochrone problem?

a) Straight line
b) Catenary
c) Cycloid
d) Cardioid

Q4. Read the following statements carefully and select the appropriate option.

1. Water is necessary for human life.
2. Water is sufficient for human life.

a) Both statements, 1 and 2 are correct
b) Statement 1 is correct but not statement 2
c) Statement 2 is correct but not statement 1
d) Both statements, 1 and 2 are incorrect

Q5. If $\int f(x)h(x)dx = 0$, and $h(0) = h(L) = 0$ but $h(x)$ is arbitrary, then

a) $f(x) = h(x)$
b) $f(x) = -h(x)$
c) $f(x) = 0$
d) $f(x)$ cannot be determined

Q6. What is an isoperimetric problem?

a) Calculus of variations problem to maximize perimeter
b) A general calculus of variations problem to find perimeter of an isometric shape
c) Calculus of variations problem to maximize perimeter with additional constraints
d) Calculus of variations problem with constant perimeter constraint

Q7. Which of the following represents Euler-Lagrange equation for $F(y'(x), y(x), x)$?

a) $\frac{\partial F}{\partial y} - \frac{d}{dx}\left(\frac{\partial F}{\partial y'}\right) = 0$
b) $\frac{\partial F}{\partial y} - \frac{d}{dx}\left(\frac{\partial F}{\partial y}\right) = 0$
c) $\frac{\partial F}{\partial y} = 0$
d) $\frac{\partial F}{\partial x} = 0$

Q8. How do we repesent length of a curve, y(x), as a functional in a 2D plane?

a) $\int y dx$
b) $\int y dx - \int x dy$
c) $\int \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$
d) $\int \sqrt{1 + y^2}\, dx$

Q9. What is the equivalent for minimum potential energy principle in dynamics ?

a) Principle of virtual work
b) D'Lambert principle
c) Fermat's principle
d) Hamiltons principle

Q10. What is the maximum value of the function f(x)=2x-x^2 ?

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