ASSIGNMENT 6

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# Base Formula Class (Parent)
class Formula:
    def calculate(self):
        raise NotImplementedError("Subclasses must implement this method")



# Formula 1: Oil Formation Volume Factor
# Bo = Vreservoir / Vsurface
class OilFormationVolumeFactor(Formula):
    def __init__(self, Vreservoir, Vsurface):
        self.Vreservoir = Vreservoir
        self.Vsurface = Vsurface

    def calculate(self):
        try:
            Bo = self.Vreservoir / self.Vsurface
            return f"Oil Formation Volume Factor (Bo) = {Bo:.3f}"
        except ZeroDivisionError:
            return "Error: Surface volume cannot be zero."


# Formula 2: Solution Gas Oil Ratio
# Rs = Vgas / Voil
class SolutionGOR(Formula):
    def __init__(self, Vgas, Voil):
        self.Vgas = Vgas
        self.Voil = Voil

    def calculate(self):
        try:
            Rs = self.Vgas / self.Voil
            return f"Solution Gas Oil Ratio (Rs) = {Rs:.3f}"
        except ZeroDivisionError:
            return "Error: Oil volume cannot be zero."


# Formula 3: Permeability
# K = (Q * u * L) / (A * dP)
class Permeability(Formula):
    def __init__(self, Q, u, L, A, dP):
        self.Q = Q
        self.u = u
        self.L = L
        self.A = A
        self.dP = dP

    def calculate(self):
        try:
            K = (self.Q * self.u * self.L) / (self.A * self.dP)
            return f"Permeability (K) = {K:.6f} Darcy"
        except ZeroDivisionError:
            return "Error: Area or Pressure drop cannot be zero."


# Formula 4: Porosity
# φ = Vpore / Vbulk
class Porosity(Formula):
    def __init__(self, Vpore, Vbulk):
        self.Vpore = Vpore
        self.Vbulk = Vbulk

    def calculate(self):
        try:
            phi = self.Vpore / self.Vbulk
            return f"Porosity (φ) = {phi:.3f}"
        except ZeroDivisionError:
            return "Error: Bulk volume cannot be zero."


# Formula 5: Darcy’s Law
# Q = (k * A * dP) / (u * L)
class DarcyLaw(Formula):
    def __init__(self, k, A, dP, u, L):
        self.k = k
        self.A = A
        self.dP = dP
        self.u = u
        self.L = L

    def calculate(self):
        try:
            Q = (self.k * self.A * self.dP) / (self.u * self.L)
            return f"Flow Rate (Q) = {Q:.6f} m³/s"
        except ZeroDivisionError:
            return "Error: Viscosity or Length cannot be zero."


# Formula 6: Gas Compressibility Factor
# Z = (P * V) / (n * R * T)
class GasCompressibility(Formula):
    def __init__(self, P, V, n, T):
        self.P = P
        self.V = V
        self.n = n
        self.T = T
        self.R = 8.314  # J/mol·K

    def calculate(self):
        try:
            Z = (self.P * self.V) / (self.n * self.R * self.T)
            return f"Gas Compressibility Factor (Z) = {Z:.3f}"
        except ZeroDivisionError:
            return "Error: n or T cannot be zero."


# Polymorphism function
def show_result(formula_obj):
    print(formula_obj.calculate())
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# Menu-driven Program
def main():
    while True:
        print("\n--- Petroleum Engineering Formula Calculator ---")
        print("1. Oil Formation Volume Factor (Bo = Vreservoir / Vsurface)")
        print("2. Solution Gas Oil Ratio (Rs = Vgas / Voil)")
        print("3. Permeability (K = (Q*u*L) / (A*dP))")
        print("4. Porosity (φ = Vpore / Vbulk)")
        print("5. Darcy's Law (Q = (k*A*dP) / (u*L))")
        print("6. Gas Compressibility Factor (Z = PV/nRT)")
        print("7. Exit")

        choice = input("Choose a formula (1-7): ")

        if choice == "1":
            try:
                Vr = float(input("Enter reservoir volume (m³): "))
                Vs = float(input("Enter surface volume (m³): "))
                obj = OilFormationVolumeFactor(Vr, Vs)
                show_result(obj)
            except ValueError:
                print("Invalid input. Please enter numbers.")

        elif choice == "2":
            try:
                Vg = float(input("Enter gas volume (m³): "))
                Vo = float(input("Enter oil volume (m³): "))
                obj = SolutionGOR(Vg, Vo)
                show_result(obj)
            except ValueError:
                print("Invalid input. Please enter numbers.")

        elif choice == "3":
            try:
                Q = float(input("Enter flow rate Q (m³/s): "))
                u = float(input("Enter viscosity u (Pa·s): "))
                L = float(input("Enter length L (m): "))
                A = float(input("Enter area A (m²): "))
                dP = float(input("Enter pressure drop dP (Pa): "))
                obj = Permeability(Q, u, L, A, dP)
                show_result(obj)
            except ValueError:
                print("Invalid input. Please enter numbers.")

        elif choice == "4":
            try:
                Vp = float(input("Enter pore volume (m³): "))
                Vb = float(input("Enter bulk volume (m³): "))
                obj = Porosity(Vp, Vb)
                show_result(obj)
            except ValueError:
                print("Invalid input. Please enter numbers.")

        elif choice == "5":
            try:
                k = float(input("Enter permeability k (Darcy): "))
                A = float(input("Enter area A (m²): "))
                dP = float(input("Enter pressure drop dP (Pa): "))
                u = float(input("Enter viscosity u (Pa·s): "))
                L = float(input("Enter length L (m): "))
                obj = DarcyLaw(k, A, dP, u, L)
                show_result(obj)
            except ValueError:
                print("Invalid input. Please enter numbers.")

        elif choice == "6":
            try:
                P = float(input("Enter pressure P (Pa): "))
                V = float(input("Enter volume V (m³): "))
                n = float(input("Enter moles of gas (mol): "))
                T = float(input("Enter temperature T (K): "))
                obj = GasCompressibility(P, V, n, T)
                show_result(obj)
            except ValueError:
                print("Invalid input. Please enter numbers.")

        elif choice == "7":
            print("Exiting program. Goodbye!")
            break
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        else:
            print("Invalid choice. Please select between 1 and 7.")


if __name__ == "__main__":
    main()
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