Q1. The conversion of CO_2 to carbohydrates in the atmosphere by the sun's energy in the presence of chlorophyll and water is an:
(1M)
(a) Endothermic reaction   (b) Reversible reaction
(c) Exothermic reaction   (d) None of these

Q2. Which among the following parts of a woody biomass is soluble in organic and aqueous solvents?   (1M)
(a) Lignin   (b) Extractives
(c) Cellulose   (d) None of these

Q3. Which among the following densities gives the actual volume occupied by a particle in a biomass system?   (1M)
(a) Bulk density   (b) True density
(c) Apparent density   (d) None of these

Q4. In an herbaceous plant-based biomass source, the high moisture content is not suitable for:
(1M)   (a) Thermal conversion to liquid fuel   (b) Fermentation process
       (c) Anaerobic digestion   (d) All of these

Q5. Calculate the higher heating value (kJ/kg) of water hyacinth biomass, if the latent heat of vaporization of water, percentage moisture, percentage hydrogen, and lower heating value of the biomass is found to be 2250 kJ/kg, 7.2%, 16% & 36942 kJ/kg respectively.
(1M)

(a) 37609   (b) 48527
(c) 40020   (d) 45038

Solution: -
Given-
LHV = HHV − latent heat of vaporization of water (kJ/kg) × [(9H/100) – (M/100)]
Therefore HHV=36942 + [{2250}*{(9*16)/100-(7.2/100)}]
HHV=40020 kJ/kg

Q6.   In TGA analysis of biomass, the ash content is determined by supplying_____gas.

(1M)

(a) Helium   (b) oxygen
(c) Nitrogen   (d) Argon

Q7.   Calculate: (2M)
(i) Weight fraction of moisture content of a rice husk on a wet basis (Mwet), consider the weight of biomass before moisture removal is 6.57g and the weight of biomass after moisture removal is 2.49g.

(ii) Weight fraction of moisture content of a rice husk on a dry basis (Mdry), consider the weight of biomass before moisture removal is 9.37g and the weight of biomass after moisture removal is 6.29g.

(a) Mwet=0.69, Mdry=0.55   (b) Mwet=0.53, Mdry=0.41
(c) Mwet=0.65, Mdry=0.43   (d) Mwet=0.62, Mdry=0.49

Solution: -
Part A
Mwet = (weight before moisture removal - weight after moisture removal)/ weight before moisture removal = (6.57-2.49)/6.57 = 0.62
Part B
Mdry = (weight before moisture removal - weight after moisture removal)/ weight after moisture removal = (9.37-6.29)/6.29 = 0.49

Q8.   Determine the percentage fixed carbon of bamboo biomass on a dry and wet basis. Given that the weight of the crucible is 20.69g, the difference in the initial and final weight of biomass after moisture removal was 0.36g, and the initial weight of biomass plus crucible is 24.83g. The %Volatile matter and %Ash are given as 17.29% and 5.61%, respectively.

(2M)

(a) 77.1%, 68.4%   (b) 70.1%, 60.4%
(c) 80.1%, 64.4%   (d) 73.1%, 72.4%

Solution: -
Part A- Given
weight of the crucible is 20.69g & initial weight of biomass plus the crucible is 24.83g, the difference in initial and final weight of biomass after moisture removal was 0.36 g
initial weight of biomass is 24.83-20.69= 4.14g
hence %Moisture in sample= (0.36/4.14) *100= 8.69%
%Volatile matter= 17.29%
%Ash= 5.61%
%Fixed carbon of bamboo biomass on dry basis= 100-(17.29+5.61) = 77.1%

Part B- Given
%Moisture=8.69%
%Volatile matter= 17.29%
%Ash= 5.61%
%Fixed carbon of bamboo biomass on wet basis= 100-(8.69+17.29+5.61) = 68.4%

Indian Institute of Technology Guwahati

Indian Institute of Technology Guwahati

Indian Institute of Technology Guwahati