Started on	Tuesday, 2 March 2021, 9:00 AM
State	Finished
Completed on	Tuesday, 2 March 2021, 10:00 AM
Time taken	1 hour
Grade	**12.50** out of 30.00 (**42**%)

Question 1

Complete

Mark 0.00 out of 2.00

A person running a DSC analysis forgot to note down the mass of polymer which he had put in the sample pan. He however observed a shift in baseline from 4.22 mCal/sec to 8.80 mCal/sec when the sample was heated at a rate of 10°C/min. He found the specific heat capacity of the sample, from literature, to be equal to 2.74 Cal/°C g. Can you calculate how much sample did he put in the sample pan?

Comment:

Question 2

Complete

Mark 0.00 out of 2.00

Polycarbonate (Tg = 147°C), which is used as transparent glass in many applications including automobile head light cover, upon storage at 155°C loses its transparency. Provide your explanation for this occurrence

Comment:

Question 3

Complete

Mark 0.00 out of 2.00

It is known that vinyl acetate (CH2=CH-O-CO-CH3) degrades at 350°C by releasing acetic acid (CH3COOH). Determine the vinyl acetate content of ethylene-vinyl acetate copolymer if its TGA analysis showed a 44% loss in mass at 350°C

Comment:

Question 4

Incorrect

Mark -0.50 out of 1.00

Select the incorrect statement

Select one:

- a. No Answer
- b. The number of chain ends will be higher in a branched polymer than a linear polymer of same monomer having identical molecular weight
- c. A branched polymer should have lower Tg than a linear polymer of same monomer having identical molecular weight ✗
- d. A branched polymer will not show isothermal volume recovery as a linear polymer of same monomer having identical molecular weight
- e. A branched polymer should have more free volume than a linear polymer of same monomer having identical molecular weight

Your answer is incorrect.

The correct answer is: A branched polymer will not show isothermal volume recovery as a linear polymer of same monomer having identical molecular weight

Question 5

Complete

Mark 1.00 out of 2.00

The Tg of a linear polymer with Mn = 2500 is 120°C while for the same linear polymer with Mn = 10000, the Tg is 150°C. Calculate the Tg of a branched polymer having Mn = 6000 and average number of branches = 6

Tg = Tg inf - yK/M

393 = Tg inf - 2K/2500 eq1

423 = Tg inf - 2K/10000 eq2

eq2 - eq1 gives,

K = 50000 ; Tg inf = 433K

Tg = 433 - 6*50000/6000

= 433-50

=383K

Comment:
y is equal to 8.

Question 6

Complete

Mark 2.00 out of 2.00

Give your best estimate for the weight fraction of plasticizer required to lower the Tg of PVC to 30°C. It is given that Tg of PVC is 83°C and that of plasticizer is -85°C

1/tg=w1/tg1+(100-w1)/tg2

1/202=w1/188+(1-w1)/356

w1=0.195

Comment:
Correct Answer

Question 7

Complete

Mark 2.00 out of 2.00

Write two salient features each of Kinetic and Thermodynamic Theories of Glass Transition

Kinetic theory:

1. The kinetic theory defines Tg and the temperature at which the relaxation time for the segmental motions in the main polymer chain is of the same order of magnitude as the time scale of the experiment.

2. When a material is cooled from a temperature above its Tg with different rates, we observe different Tg for different rates of cooling. Tg increases with higher rate of cooling.

Thermodynamic theory:

1. In infiniteky slow experiments a glassy phase will eventually emerge whose entropy is negligiblly higher than that of the crystal.

2. This theory introduces the notion of equilibrium and the requirements of a true second order transition.

Comment:

Question 8

Complete

Mark 2.00 out of 2.00

The glass transition temperature (Tg) for polyethylene is -100^{0}C. Select a polymer that has Tg lower than polyethylene and another that has Tg higher than polyethylene. Justify your answers of why the polymers selected by you have Tg lower or higher than polyethylene

Polypropylene will have higher Tg since the additional methyl group increases the bulkiness and makes the rotation difficult.

Hence increasing the Tg.

Polydimethylsiloxane(PDMS) will have lower Tg since it has a backbone which allows easier rotation hence decreasing Tg.

Comment:

Question 9

Complete

Mark 0.00 out of 2.00

A 250 mg hydrated sample of Na2HPO4 decreases to a mass of 145.7 mg after heating to 100 °C in TGA. What is the number of water of hydration in Na2HPO4? Given that molar mass of hydrated Na2HPO4 is 215.9

Comment:

Question 10

Complete

Mark 0.00 out of 2.00

Assuming that RMS end-to-end distance is an approximation to the diameter of the spherical, coiled polymer in dilute solution, calculate the volume occupied by one molecule of polystyrene (mol wt. 106 g/mol) in a theta solvent at 25°C. Given that, C-C bond length = 1.54 nm, Tetrahedral bond angle = 109.5°, Steric parameter (σ) for polystyrene at 25°C = 2.1

<r^2> = (sigma)^2*n*L^2*(1-cos(theta))/(1+cos(theta))

(<r^2>)^0.5=d

V=(4/3*pi*d^3)/8

V=50.09 nm^3

Comment:
Incorrect Answer

Question 11

Complete

Mark 0.00 out of 2.00

For a 25 mg sample of polycaprolactone (specific heat 1.34 J/g), the heat of crystallization and melting observed in a DSC thermogram are 50 mJ/mg and 75 mJ/mg, respectively. Calculate the mass of crystalline component below Tc and % crystallinity for this sample

Comment:

Question 12

Incorrect

Mark -0.50 out of 1.00

The number of vibrational degrees of freedom in C6H5NH2 is

Select one:

- a. 36
- b. 40
- c. No Answer
- d. 39 ✗
- e. 37

Your answer is incorrect.

The correct answer is: 36

Question 13

Complete

Mark 2.00 out of 2.00

Calculate the expected change in Tg from WLF equation, if the time frame of an experiment is increased by a factor of 200

log at/T-Tg = -17.44/51.6 = -0.338

=>-2.3/T-tg = -0.338

=>T-Tg = 2.3/0.338 = 6.8K = 7K

Tg will be raised by 7K

Comment:

Question 14

Correct

Mark 1.00 out of 1.00

Select the correct statement

Select one:

- a. Glass transition is a state at which vibrational entropy is never zero ✓
- b. Glass transition is accompanied by a freeze in vibrational motion
- c. Glass transition can be taken as a first order thermal transition if a plot between thermal expansion coefficient and temperature is made
- d. No Answer
- e. Crystallization of a thermally stressed polymer may increase the glass transition temperature

Your answer is correct.

The correct answer is: Glass transition is a state at which vibrational entropy is never zero

Question 15

Correct

Mark 1.00 out of 1.00

RMS radius of gyration for a freely jointed chain having RMS end-to-end distance of 82 nm is

Select one:

- a. 33.5 nm ✓
- b. 200.8 nm
- c. No Answer
- d. 176.3 nm
- e. 29.4 nm

Your answer is correct.

The correct answer is: 33.5 nm

Question 16

Complete

Mark 2.00 out of 2.00

A mixture of $CaCO_3$ and CaO is analyzed using TGA. The curve indicated a mass change from 145.3 mg to 115.4 mg between 600-700°C. Calculate the percentage of $CaCO_3$ in the sample

let $CaCO_3$ = x mg

CaO = 145.3-x mg

100mg $CaCO_3$ -> 56 mg CaO

x mg $CaCO_3$ -> 56x/100 mg

(145.3 - x) + 56x/100 = 115.4

=> x = 67.954 mg

%$CaCO_3$ in the sample = 67.954/145.3 mg = 46.76%

Comment:
Correct Answer

Question 17

Correct

Mark 1.00 out of 1.00

Differential scanning calorimetry (DSC) is a technique to measure

Select one:

- a. Impact energy
- b. Specific heat ✓
- c. Electrical conductivity
- d. No Answer
- e. Thermal expansion

Your answer is correct.

The correct answer is: Specific heat

Question 18

Incorrect

Mark -0.50 out of 1.00

Following statement is incorrect for polystyrene

Select one:

- a. It is one of common transparent polymers ✗
- b. It is tough at room temperature
- c. It has glass transition higher than polypropylene
- d. It exists in all possible tacticity forms
- e. No Answer

Your answer is incorrect.

The correct answer is:
It is tough at room temperature

◀ Impartus

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