



Points: 30

Time: 3 Hours

Science for Sustainable Food and Agriculture

Theoretical Test

Answer Sheet

December 5, 2023

DO NOT turn to the next page before the "START" signal



Points: 30

Time: 3 Hours

P1. [0.5 pt] Calculate the speed of the durian fruit at the instant when it reaches the ground, disregarding air resistance.

Answer: The calculated speed of the durian fruit is

Calculation:



Points: 30

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P2. [1.0 pt] Determine the average impulsive force exerted on the durian fruit when it hits the ground, assuming that the durian does not bounce after the collision.

Answer: The average impulsive force exerted on the durian fruit is,

direction

Calculation:



Points: 30

Time: 3 Hours

P3. [1.5 pt] **Answer:**

(a) The magnitude of the acceleration of the durian fruit during the catch is,
direction

(b) The magnitude of the force the picker uses to catch the durian fruit is

Calculation:



Points: 30

Time: 3 Hours

P4. [1.0 pt] **Answer:**

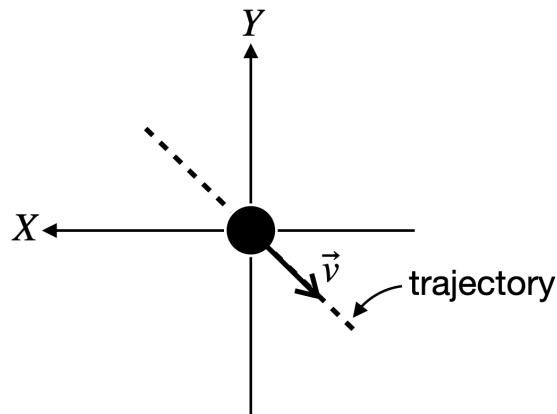
(a) The magnitude of the acceleration of the durian fruit during the catch is

(b) The magnitude of the net force exerts on the durian fruit during the catch is

Calculation:

P5. [2.0 pt] Answer:

(a) The diagram of the durian fruit during the trajectory is



(b) The magnitude of the force is and the angle Φ is

Calculation:



Points: 30

Time: 3 Hours

P5 (b) continue



Points: 30

Time: 3 Hours

P6. [2.0 pt] **Answer:** The tension in the plastic rope is

Calculation:



Points: 30

Time: 3 Hours

P7. [1.0 pt] Calculate the sound intensity level of the impact sound.

Answer: The sound intensity level of the impact sound is

Calculation:



Points: 30

Time: 3 Hours

P8. [1.0 pt] Determine the distance from the impact point at which the sound intensity level of the impact reaches 60 dB

Answer: The calculated distance from the impact point is

Calculation:

C-1.1) (2.5pt) The mangostin molecule contains atoms of three elements. Mangostin vapour is 14.65 times denser than gaseous nitrogen. Pure mangostin with a mass of 1.000 g was burned in excess oxygen gas to produce only water and carbon dioxide. The water is collected in an absorber and the mass change of this absorber is equal to 0.570 g. The carbon dioxide is collected in a separate absorber filled with 100.00 cm³ of 2.00 M sodium hydroxide solution (NaOH). A volume of 25.00 cm³ of this solution was titrated with 2.00 M hydrochloric acid solution (HCl) using 5 drops of methyl orange as indicator (pH range 3.2-4.4). A titration volume of 25.00 cm³ of HCl solution was consumed. The same volume of the solution was titrated with 2.00 M HCl solution using phenolphthalein as indicator (pH range 8.3-10.0) required 17.70 cm³ of HCl solution. Write the formula of mangostin. ($K_{a1} = 4.2 \times 10^{-7}$, $K_{a2} = 4.8 \times 10^{-11}$)

Answer:

Reaction of CO₂ in the absorber :

Formula of mangostin =

Calculation:

C-2.1) (2pt) Ethanethiol can react with hydrogen peroxide to produce diethyl disulfide and water. How many liters of diethyl disulfide will be produced via ethionine pathway from the reaction of 100.0 g of Monthong pulp with hydrogen peroxide at 160.00°C and 0.5000 atm (1 atm = 1.013×10^5 Pa)? Also provide the balanced chemical equation and report your answer in correct significant figures. Assume that diethyl disulfide behaves as an ideal gas under this condition.

Answer: The volume of diethyl disulfide =

Calculation:



Points: 30

Time: 3 Hours

C-2.2) (1.5pt) If 5.00×10^{-4} L of gaseous diethyl disulfide is detected at 160.00°C and 0.5000 atm from 100.0 g of Krathum pulp, what is the percent conversion of sulfur from the pulp into diethyl disulfide? Report your answer to correct significant figure and show your calculation in detail. Assume that diethyl disulfide is the only gaseous organosulfur compound detected from Krathum pulp, and that it behaves as an ideal gas under this condition.

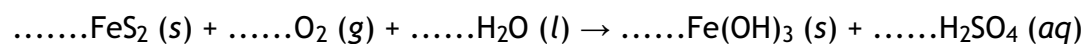
Answer: % conversion of sulfur =

Calculation:

C-3.1) (1pt) Pyrite is a mineral form of iron disulfide found in soil, and contains the disulfide ion (S_2^{2-}). It reacts with oxygen causing the soil to acidify.

Answer:

Fill the blank to complete the given equation.



Show the balancing method used.



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C-3.2) (1.8pt) 5.0 L of solution has been prepared by treatment of 1 kg of soil which previously contained 2.4 g of pyrite which was completely oxidized to form sulfuric acid. What is the pH of the solution? The pH depends on only sulfuric acid. Assume that sulfuric acid does not react with other components of the soil such as $\text{Fe}(\text{OH})_3$. (H_2SO_4 dissociates completely in the 1st degree, and K_{a2} of $\text{H}_2\text{SO}_4 = 1.0 \times 10^{-2}$)

Answer: The pH of the solution is

Calculation:



Points: 30

Time: 3 Hours

C-3.3) (0.7pt) One of the liming materials is CaCO_3 which is generally used to neutralize soil acidity. In this case, what is the minimum mass in grams of CaCO_3 required to neutralize the solution from C-3.2? (Round your answer to two decimal places)

Answer: Grams of CaCO_3 required is

Calculation:

C-3.4) (0.5pt) The lattice energy of calcium carbonate $\text{CaCO}_3(\text{s})$ is 2804 kJ/mol and the heat of hydration (ΔH_{hydr} of $\text{Ca}^{2+}(\text{g})$) = -1579 kJ/mol and heat of hydration (ΔH_{hydr} of $\text{CO}_3^{2-}(\text{g})$) = -1389 kJ/mol. Use these data to calculate the heat of solution (kJ/mol) of calcium carbonate. Show your calculation method.

Use (s), (l), (g), and (aq) for solid, liquid, gas, and aqueous states respectively.

Answer:

Step	Equation	Energy change
Thermochemical equation of lattice energy:		
Thermochemical equation of hydration:		
Thermochemical equation of solution:		

Part III: Biology

Question B1:

I	II	III	Expected outcome (A-F)	
			IV	V
1				
2				
3				

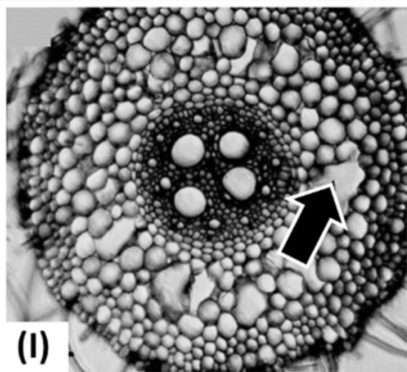
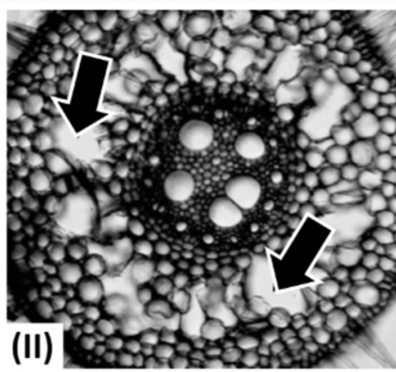
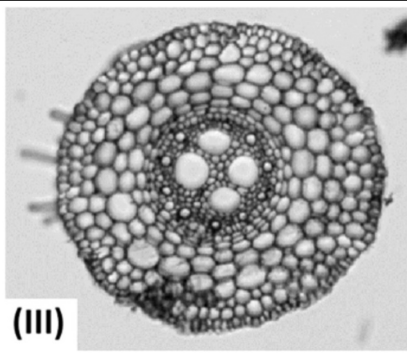
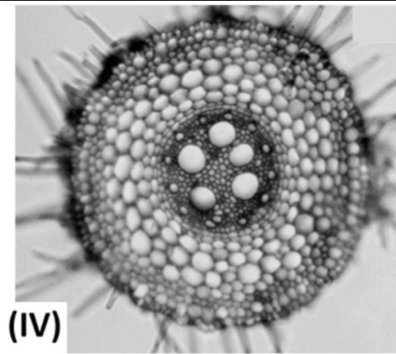
Question B2:

Question	Answer														
	A	B	C	D	E	F	G	H	I	J	P	Q	R	S	T
1															
2	(The number of the correct TT)														
3															
4															
5	(The number of the correct TT)														
6															
7	(The number of the correct TT)														
8															

Question B3:

Question	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1.																
2.																
3.																
4.																
5.																
6.																
7.																

Question B4:

P \ Q		□ A □ B		□ A □ B	
		□ 1	 (I)	 (II)	
□ 2					
□ 1	 (III)	 (IV)			
□ 2					

Question B5:

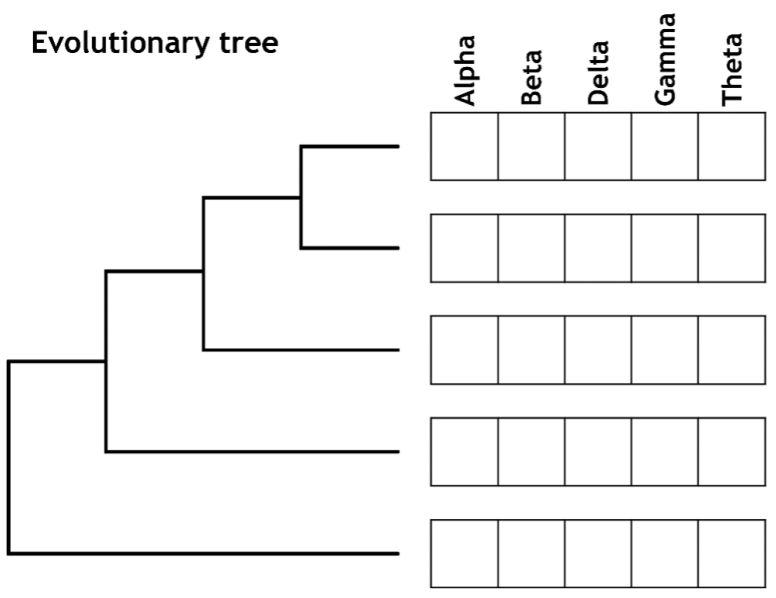


Table B5B

Question	Alpha	Beta	Delta	Gamma	Theta
1.					
2.					

Question B6:

Statement	Is it likely?		Potential cause or effect?	
	Yes	No	Cause	Effect
1.				
2.				
3.				
4.				
5.				
6.				