

ES 203 EXAM #1**Instructions**

Answer four of the six questions below.

Please show your work, label your steps carefully, and include relevant units. Write neatly for full credit. If we can't understand what you have done, we can't give you credit for it.

Useful Facts

- The Redfield ratios can be expressed as (P₁S_{0.6} N₁₆C₁₀₆O₁₁₀ H₂₆₃).
- Molecular weights

Element	Molecular Weight (approx) (g/mol)
H	1
C	12
N	14
O	16
P	31

- Fate of runoff at various levels of imperviousness. All values are expressed as a percentage of incident precipitation.

Percent impervious surfaces	Runoff	Evapo-transpiration	Shallow Infiltration	Deep Infiltration
0	10	40	25	25
10 to 20%	20	38	21	21
35 to 50%	30	35	20	15
75 to 90%	55	30	10	5

- Storm return intervals for Androscoggin County, Maine.

Return Interval	24 Hour Storm (in)	24 Hour Storm (cm)
1	2.5	6.35
2	3	7.62
5	3.9	9.906
10	4.6	11.684
25	5.4	13.716
100	6.5	16.51
500	7.8	19.812

Question 4: Nutrients

The city of Lewiston is interested in the effects of increased development on Noname pond. The consulting firm Austin-Bohlen LLC was hired to prepare a preliminary analysis. Predicted land use in the watershed in the year 2025 is given in the first column of the following table. Subsequent columns show nutrient loading rates from each land use.

	Predicted (2025) Land Use	Estimated Phosphorus Loading Rate	Estimated Nitrogen Loading Rate	Annual P Load From Runoff	Annual N Load From Runoff
Land Use Category	Ha	kg Ha ⁻¹ Yr ⁻¹	kg Ha ⁻¹ Yr ⁻¹	Kg/yr	Kg/yr
Extractive	3	0.6	10		30.0
Field or Pasture	12.5	0.81	5.2		65.0
Forested	233.3	0.2	2.5		583.4
Low Density Residential	137.8	0.21	1.5		206.7
Medium Density Residential	74	0.43	1.6		118.4
Wetland	24.6	-0.25	0		0.0
Pond	58.7				
Total	543.9				1003.5

1. Determine predicted year 2025 annual phosphorous delivery rates from runoff to Noname pond based on these data (fill in the above table).
2. Would nitrogen or phosphorus be more likely to limit phytoplankton growth in Noname pond in 2025? How do you know?
3. The phosphorus stock in the lake has a turnover time of 2 years. Assuming runoff from the watershed is the only significant source of phosphorus to the lake, how much phosphorus will be in the Noname pond P stock in 2025?

