1. 10 points. Balance a ration for growing pigs (14% protein, 5% Ca, and 45% P). The grain in the ration should have 30% wheat and 70% corn. Fixed ingredients include mineral and vitamin premix at 1.2% of the ration, distillers grain at 5% of the ration.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>CP, %</th>
<th>Ca, %</th>
<th>P, %</th>
<th>Lysine, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>8.8</td>
<td>.03</td>
<td>.30</td>
<td>.20</td>
</tr>
<tr>
<td>Wheat</td>
<td>10.5</td>
<td>.06</td>
<td>.35</td>
<td>.45</td>
</tr>
<tr>
<td>Distillers grain</td>
<td>28.8</td>
<td>.05</td>
<td>.30</td>
<td>.60</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>51</td>
<td>.46</td>
<td>.75</td>
<td>2.90</td>
</tr>
<tr>
<td>Mineral/vitamin premix</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Limestone</td>
<td>35.6</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>23.35</td>
<td>18.21</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

1. Provide the equation for balancing the ration for crude protein. \[ y = \frac{5BM}{(93.8 - y) - x} \]

\[ \frac{14}{14} = (93.8 - x)(.0931) + 5(.286) + x(.51) \]

2. After balancing the ration for Ca and P, you find that you need .9% dicalcium phosphate and 1.1% limestone. Complete the final step of formulation and give the complete ration.

\[ \text{Fixed} = 5 + 1.2 + 1.1 + .9 = 8.2 \]

\[ x = \frac{5BM}{(91.8 - x) - y} \]

\[ 14 = (91.8 - x)(.0931) + 5(.286) + x(.51) \]

\[ 14 = 8.55 - .0931x + 1.149 + .51y \]

\[ 14 = 9.99 + .417x \]

\[ x = 9.62 \%
\]

\[ y = 82.78 \%
\]

3. Does this ration have sufficient lysine to meet the pig's requirement of .75%? Show your work!

\[ (57.5x .002) + (24.65x .0045) + (5x .0066) + (9.62x .026) \]

\[ .115 + .111 + .03 + .279 \]

\[ = .535 \]

Not enough lysine.
2. 12 points. Formulate a ration for 1430 pound dairy cows giving 99 pounds of 3.5% fat milk. The cows have a DM intake of 53 pounds per day. Balance for the requirements of NE\textsubscript{i}, CP, Ca and P (calculate the requirements of these as concentrations based on the DM intake just like you did on the last exercise). \textbf{You do not need to rebalance as your last formulation step.} Fix corn silage at 18% and beet pulp at 8% of ration DM. Other ingredients to formulate include corn, alfalfa hay, soybean meal, limestone and dicalcium phosphate. Provide the ration on a DM basis and then convert to an as fed basis. After you arrive at your final ration, calculate the undegraded intake protein content of your ration.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>DM%</th>
<th>NE\textsubscript{i}, Mcal/kg</th>
<th>CP, %</th>
<th>Ca, %</th>
<th>P, %</th>
<th>UIP, % of CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>88</td>
<td>2.1</td>
<td>10.4</td>
<td>.05</td>
<td>.31</td>
<td>40</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>89</td>
<td>1.4</td>
<td>20</td>
<td>.17</td>
<td>.3</td>
<td>15</td>
</tr>
<tr>
<td>SBM</td>
<td>92</td>
<td>2.0</td>
<td>54</td>
<td>.3</td>
<td>.7</td>
<td>30</td>
</tr>
<tr>
<td>Corn silage</td>
<td>36</td>
<td>1.6</td>
<td>7</td>
<td>.25</td>
<td>.2</td>
<td>40</td>
</tr>
<tr>
<td>Beet pulp</td>
<td>94</td>
<td>1.7</td>
<td>10</td>
<td>.6</td>
<td>.1</td>
<td>50</td>
</tr>
<tr>
<td>Limestone</td>
<td>100</td>
<td></td>
<td></td>
<td>37.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dical</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.35</td>
</tr>
</tbody>
</table>

\[
\text{CP} = 7 \times \text{SBM} (74-x) = \text{Corn}
\]

\[
17.5 = (74-x)(.104) + x(.54) + 18(.07) + 8(.10)
\]

\[
17.5 = 7.696 + .54x + 1.24 + .8
\]

\[
x = 17.75 = \text{SBM}
\]

\[
\text{Corn} = 56.25
\]

\[
P = 7 \times \text{Dical} (56.25-x) = \text{Corn}
\]

\[
.42x = (56.25-x)(.0031) + (17.75)(.007) + 18(.002) + 8(.001) + x(.19)
\]

\[
.42x = .174 - .0031x + .124 + .036 + .008 + .19x
\]

\[
.42x = 3.92 + 1.969x
\]

\[
\text{Dical} = .42\% \\
\text{Corn} = 55.83\%
\]

---

\( x \Rightarrow \text{otherside} \)
2b. 5 points. The dairy ration that you have formulated has enough fiber (ADF) to meet the cows' requirement but may not have sufficient "effective fiber". Distinguish between total ration fiber and effective fiber. Identify the two ingredients in your ration which deliver fiber but not necessarily effective fiber to the ration; explain your answer.

The total ration fiber is the sum of fiber that is physically digested and lignin. The effective fiber is just the fiber that is actually chewed and broken down in the rumen. The corn silage and beet pulp are commonly fiber to the diet, but it may not be the total effective fiber. The corn silage may contain a higher amount of starch, which may be a reason.

4. Fish questions.

3 points. Fish require the same nutrients for the same metabolic functions as mammals, except for four differences. List three of those differences.

- Different FA required
- Different AA's required
- Need less energy than mammals to no heat or burn less

3 points. Give two reasons fish have lower energy requirements than mammals.

- Do not have to exert energy against gravity
- Do not have to exert energy for urea synthesis

4 points. What is metabolizable energy for fish (give the equation)? Why does ME for fish offer little advantage over digestible energy in formulating rations?

\[ ME = DE - Urea - Gas \]

Little difference between ME and DE for fish because very little energy is lost to urea and gas.

3 points. What is phytate phosphorus and why is it an important environmental issue?

A compound which can be used as a supplement, but causes health problems in high concentrations.

6. 3 points. What molecular form of trace minerals is most highly bioavailable? What molecular form is very unavailable (and therefore should not be in animal feeds)?

Sulfate form is most highly bioavailable, oxide form is much less bioavailable. Replaced or carbonate.

7. 3 points. What mineral is terribly antagonistic to copper and causes some copper toxicity problems? The ratio of copper to this mineral should be greater than what?

Mo, ratio should be greater than 7

8. 2 points. List two constituents of drinking water which may cause nutritional disorders (therefore may want to test for these).

- Sulfides and Chlorides
- Nitrates
9. 4 points. In most states what agency dictates policy for feed tag labels? List three things which must appear on feed tags.

10. 3 points. How is true digestibility more accurate than apparent digestibility (give at least two)?

11. 8 points. Diagram the Net Energy System. Now, using this diagram, describe why this system is particularly important (more accurate) in assigning an energy value to a forage compared with the TDN system.

12. 4 points. In addition fecal nitrogen (crude protein) loss, biological value (BV) also measures urinary nitrogen loss. If two diets with different sources of crude protein are fed to ruminant animals, one diet will have a greater biological value than the other. State two reasons why:

- amino acid composition: if unbalanced, more N will be lost to urea
- ammonia for rumen microbes: if not enough is present, the bugs will not be as effective

13. 6 points. A salesman comes to your operation and tells you that the product that he/she is selling will increase the digestibility of starch in grain. You ask Dr. Hunt and he says this is indeed true. What is the expected performance response (fill in the cells below with go up, go down, or stay the same) when animals are fed a diet regulated by: 1) chemostatic mechanisms, and 2) physical fill?

<table>
<thead>
<tr>
<th>Diet type:</th>
<th>Feed intake</th>
<th>Daily gain</th>
<th>Feed:gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemostatic regulated</td>
<td>same down</td>
<td>go up</td>
<td>go down</td>
</tr>
<tr>
<td>Physical fill regulated</td>
<td>go up</td>
<td>stay same</td>
<td>go down</td>
</tr>
</tbody>
</table>

14. 2 points. Specifically, what determines the net energy-maintenance requirement of an animal?

\[ \text{metabolic body weight (kg)^{0.75}} \]
15. 3 points. What does IFN stand for. Give two criteria that it uses to categorize feeds.

International Feed Number = Identification grade

16. 3 points. **Describe** the mechanism by which legume have a greater protein content than grass forages.

Legumes are able to incorporate nitrogen by use of rhizobium bacteria in nodules of the roots

17. 2 points. What is a DFM and how does a DFM work?

- 2 Degradable Feed Direct Feed Microbes

18. 2 points. If an alfalfa hay sample has a rather high ADIN value, what might you suspect about this hay? It is less digestible fiber, and would probably be from a middle cutting of alfalfa or a题材 heat-damaged hay

19. 3 points. You submit a timothy hay and an alfalfa hay sample to a lab for analysis. The NDF and ADF content of the alfalfa is much lower than the timothy hay, yet the energy value of the timothy is greater than the alfalfa. Describe how can this be??

While the alfalfa may have less fiber than the timothy, the timothy hay fiber is of better quality than the legume fiber, and so more energy can be extracted from it

20. 2 points. Why are grazing animals not very productive when grazing tall fescue during the summer months? Be specific. The presence of a mold in the fescue causes an inability of the animals to regulate their body heat well, causing them to overheat. The animals then spend more time in the shade to counteract this instead of grazing.

21. 2 points. During field drying, what level of dry matter must be reached for respiratory and gaseous losses to cease? 15-16% DM

- 2 50-55% DM

22. 2 points. Bleaching will reduce the content of this class of nutrients in hay.

Vitamins (specifically A, and E)

23. 3 points. Name an excellent perennial legume species for grazing. Why is this a good species for grazing? White clover propagates by stolons and so is more hardy than other legumes.

- Also Birds foot Trefoil (L. Bubum)

24. 4 points. What is generally a safe moisture level to harvest hay? What organic acid is found in commercial products to permit harvesting of hay at a moisture level greater than this? What is a disadvantage of this hay additive?

- 2 16% moisture, can add propionic or acetic acid to allow earlier harvesting, but may reduce palatability and thus intake of the feed

- Cost and corrosiveness are disadvantages