Folate and B12 Status Assessment Case

Note: Clinical values are reported to one decimal place; please report your final calculations accordingly. Must show calculations and units for full credit.

(1) Folate/folic acid deficiency anemia can be characterized by: (2 points)
   a) High MCV and normal MCHC
   b) normal MCV and low MCHC
   c) Low MCH and high Hct
   d) a and b only
   e) none of the above

(2) Lab tests/indices and specific clinical terms are used to both define the presence of anemia as well as provide morphological characteristics of blood cells which can then be used in ascribing or narrowing down possible cause(s) of the anemia. Match the test/indice or clinical term listed at left to the statements on the right. Note – each indice or term may have more than one letter match. (23 points)

RDW
   A. measure of the ave. size (ave. volume) of a RBC in the sample

U, I, B
   B. indice may be significantly influenced by any change in cell size

Poikilocytosis
   C. measure of the concentration of hemoglobin in whole blood

M
   D. a value used to establish clinical presence of anemia

Chromicity
   E. would be influenced by significant hemolysis of a blood sample

L
   F. value for the proportion of whole blood that are RBCs

Macrocytosis
   G. will ultimately always be altered in anemia

N
   H. indice for the ave. hemoglobin conc. per unit volume RBCs

MCHC
   I. measure of the size variation in a sample population of RBCs

H, E
   J. indicates that there are abnormal gases within the blood sample

Hemoglobin (HgB)
   K. indice for the ave. HgB amount in an ave. RBC

D, E, C, G
   L. term/value indicating the color intensity of RBCs

Microcytosis
   M. indicates there is variation in cell shape within a blood sample

R
   N. indicates the ave. RBC is abnormally large (>100 fL)

Anisocytosis
   O. is never observed or never changes with anemia

U
   P. indicates the presence of different HgB sub-types in the RBCs

MCV
   Q. refers to the presence of lysed cells within the blood sample

A, E, B
   R. indicates the ave. RBC is abnormally small (<80 fL)

Hematocrit (Hct)
   S. Term indicates an abnormal number of white blood cells

D, E, F, B
   T. indicates that the ave. RBC is of normal size (80-100 fL)

MCH
   U. indicates a variation in cell sizes within a blood sample

K, E, B, L
Just over 2 weeks ago (15 days ago), a 38 yr. old male subject presented with complaints of “tiredness” and that he “fatigues easily” with any simple exertion. At that time a blood sample was taken his CBC values were:  RBCs = 3.94 x 10^{12} cells/L  Hct = 41.6%  HgB = 10.3 g/dL  

Based on these values, was he anemic?  (Yes / No)  

Based on:  Low Hct / Low HgB / neither (both Normal)  

Using the values listed above, what were his values for:  

\[
\text{MCV} = \frac{\text{Hct/Rbc} \times 10^5}{3.94 \times 10^{12}} \times 10^{15} = 105.6 \text{ fL} \\
\text{MCH} = \frac{(\text{HgB} \times 10)}{\text{Rbc} \times 10^{12}} = \frac{(10.3 \times 10)}{3.94 \times 10^{12}} \times 10^{12} = 26.1 \text{ pg} \\
\text{MCHC} = \frac{\text{HgB}}{\text{Hct}} \times 100 = \frac{10.3}{0.416} = 24.8 \text{ g/dL} \\
\]

RBC Morphology (circle ALL that apply):  microcytic / normocytic / macrocytic  

[1 pt.each]  
hypochromic / normochromic / hyperchromic

In reviewing his health history, you learn that he is a habitual 2 pack/day smoker. Which of the indices could be affected by this? (Circle only those that could be affected)  

Hct  HgB  MCV  MCH  MCHC  All could be affected

He also reported that he started on a new diet about 2 months ago. Additional blood work just completed provided the following values:

Serum Folate = 5.8 nmol/L  deficiency  RBC Folate = 253 nmol/L  early deficiency

In addition, results indicate significant elevations in his serum methylmalonic acid concentration.

Based on the older and most recent information and data, describe and discuss his current folate and B12 status – including any/all contributing factors.  

He has a serum folate level of 5.8 nmol/L which indicates that he is deficient and his RBC folate shows that he is between the range of early def. and def. His low levels of serum folate and RBC folate levels can due to him being a habitual smoker. Although he is within the normal range for MMA concentration. It is close to the cutoff value of 270nmol/L, which means he has low levels of B12 due to the increase amount of MMA in the body.

A 27 yr. old female has recently (1 week ago) returned after spending 20 months in the Swiss Alps. She has returned early from her assignment, complaining of stress, fatigue and weight loss, and during the last several months, had increased her smoking to about 2 packs per day (up from less than 1 pack per day before she left). As part of her monitoring, the following data have been collected:  

<table>
<thead>
<tr>
<th></th>
<th>HgB (g/dl)</th>
<th>RBC# (x 10^{12})</th>
<th>MCV [± SD] (fL)</th>
<th>Serum Folate (nmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 months ago</td>
<td>13.6</td>
<td>4.41</td>
<td>91.3 [11.22]</td>
<td>20.4</td>
</tr>
<tr>
<td>(prior to going abroad)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 weeks ago</td>
<td>12.4</td>
<td>4.07</td>
<td>96.8 [15.64]</td>
<td>7.6</td>
</tr>
<tr>
<td>8 weeks ago</td>
<td>10.4</td>
<td>3.72</td>
<td>100.4 [15.13]</td>
<td>6.3</td>
</tr>
<tr>
<td>4 weeks ago</td>
<td>8.2</td>
<td>3.44</td>
<td>108.7 [14.88]</td>
<td>5.1</td>
</tr>
<tr>
<td>Current</td>
<td>7.9</td>
<td>3.38</td>
<td>110.3 [13.52]</td>
<td>10.5</td>
</tr>
</tbody>
</table>
What were her Hct values at the indicated time points? (10 pts)

24 mo. ago = 40.3%   
8 wks. ago = 37.3% 

Current = \( \frac{110.3}{10^{15}} \times 3.38 \times 10^{12} \times 100\% = 37.3\% \)

Is she currently anemic? (Yes / No) (1 pt) Based on: low Hct / low Hgb / both normal (1 pt) 

(1 pt) Severity = severe 

Describe her current RBC Morphology (circle all that apply): 
- microcytic / normocytic / macrocytic
- hypochromic / normochromic / hyperchromic

What were her RDW values at the indicated time points (10 Points)

24 mo. ago = 12.3% 
8 wks. ago = 15.1% 

Current = 12.3%

Evaluate her current status taking into account all factors (8 points) (You may attach extra paper if you need more space.)

According to her low Hgb values it indicates that she became anemic and her MCV and MCHC values indicates that her rbc morphology is macrocytic and hyperchromic. Having macrocytic rbc is an indicator that she may be deficient in B12 and folate. Her value for RDW is currently within the normal ranges, meaning there is not much variation in the cell sizes. As she is decreasing in serum folate, she is deficient in folate but not B12, eventhough the MCV values shows that she can be deficient in either one. Her hct is within the normal ranges but it shows that it is decreasing over time which might indicate that she can be turning anemic. Besides that her serum folate level of 10.5 nmol/L indicates that she is in the deficiency stage. Her anemia is mainly caused by folate deficiency, due to smoking, and lack of folic acid in her diet.

(5) You are monitoring a 53 yr. old male who began taking a drug with known Folate antagonist (“antifolate”) properties 8 weeks ago and is now half way through his treatment regimen. (21 points)

His current lab values are:

- MCV = 103.7 fL (SD = 16.3 fL) 
- RBC# = 3.94 x 10^{12} 
- MCH = 32.6 pg.

Serum Folate = 6.5 nmol/L 
RBC Folate = 210.3 nmol/L

Based on these values, complete the questions below (show calculations and units)

(2 pt)What is his Hct value? 
40.9%

(2 pt)What is his Hgb value? 
12.8 g/dL

(2 pt) What is his MCHC value? 
31.4 g/dL

(2 pt)What is his RDW value? 
15.7%
(2 points) Describe his current RBC Morphology (circle all that apply):

- microcytic / normocytic / macrocytic
- hypochromic / normochromic / hyperchromic

Is he currently anemic? (Yes / No) (1 pt)  Based on: low Hct / low Hgb / both normal (1 pt)

Is there evidence that he has been compliant in taking the medication with anti-folate properties? (4 pts)

Yes, both of his serum folate and RBC folate levels are low

Given that his treatment is scheduled to continue for 9 more weeks, should an RBC synthesis stimulating drug (eg. Erythropoietin / ‘Procrit’) be prescribed (briefly discuss why / why not)? (5 pts)

Yes because his Hct value is low (40.9%) which is close to the cut off point, which means that his values of RBC relative to the total blood volume is below normal. A drug like RBC synthesis stimulating would most likely help with his anemia. Because the increase in RBC synthesis will lead to the increase of his Hct and Hgb amount.

(6) Data sets for 3 adult non-pregnant females is presented below. Match the data set to the most logical corresponding nutritional situation as listed below. (9 points)

**Data set 1:** MCV = 97.6 fL  Hgb = 11.8 g/dL  MMA = 71 nmol/L  (3 pt) Situation = C
- RBC Folate = 256 nmol/L  HoloTC = 43 pmol/L  ser Folate = 5.9 nmol/L  Hcy = 17 nmol/L

**Data set 2:** MCV = 97.8 fL  Hgb = 11.8 g/dL  MMA = 277 nmol/L  (3 pt) Situation = A
- RBC Folate = 256 nmol/L  HoloTC = 30 pmol/L  ser Folate = 7.9 nmol/L  Hcy = 17 nmol/L

**Data set 3:** MCV = 103.4 fL  Hgb = 11.8 g/dL  MMA = 71 nmol/L  (3 pt) Situation = B
- RBC Folate = 378 nmol/L  HoloTC = 43 pmol/L  ser Folate = 11.4 nmol/L  Hcy = 11 nmol/L

Situation A = Early B12 Deficiency
Situation B = Recovering from Folate Deficiency Anemia
Situation C = Early Folate Deficiency
Situation D = Early B12 Depletion

(7) 3 non-pregnant 35 yr.old female subjects have the following identical blood data (13 points)

- RBC conc. = 4.0 x 10^{12} /L  MCV = 85 fL  Hgb = 13.1 g/dL  Hct = 38%  RDW = 11.8%

Unique aspects for each subject are:
- Subj. A:  ser Folate = 7-8 nmol/L;  RBC Folate = 340 nmol/L;  (+) Antibodies against IF;  smokes
- Subj. B:  ser Folate = 11-14 nmol/L;  RBC Folate = 420 nmol/L;  Kidney disease
- Subj. C:  ser Folate = 10-12 nmol/L;  RBC Folate = 380 nmol/L;  takes asthma medication

All 3 are about to start an experimental Folate deficient diet. Given the above information, answer and briefly discuss the following questions:
Which subject would you predict to display abnormal RBC indices and/or display clinical Anemia first?
(1 pt)Subject: A (12 pts) Why?

Subject A because his serum folate levels shows that she is borderline deficient in folate. Also her rbc folate levels are the lowest, indicating that she is at early deficiency stage. Her hgb and hct levels are normal but this can be because she smokes because smoking increases Hgb and hct values. Her smoking may also cause her serum folate and rbc folate to decrease. Also the antibodies against IF can block the absorption of B12 vitamin. It seems that subject A appears to have pernicious anemia which is autoimmune.

(8) Data for 6 patients is presented below: (24 points)

<table>
<thead>
<tr>
<th>Patient</th>
<th>s Folate (nmol/L)</th>
<th>RBC Folate (nmol/L)</th>
<th>Homocys (μmol/L)</th>
<th>Hgb (g/dL)</th>
<th>MCV</th>
<th>HoloTC (pmol/L)</th>
<th>s B12 (pmol/L)</th>
<th>s MMA (nmol/L)</th>
<th>RDW (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al (m)</td>
<td>5.7</td>
<td>307</td>
<td>14.8</td>
<td>14.2</td>
<td>93.7</td>
<td>43</td>
<td>357</td>
<td>104</td>
<td>13.4</td>
</tr>
<tr>
<td>Bert (m)</td>
<td>12.5</td>
<td>368</td>
<td>18.3</td>
<td>8.2</td>
<td>108.6</td>
<td>29</td>
<td>123</td>
<td>284</td>
<td>13.4</td>
</tr>
<tr>
<td>Nan (F)</td>
<td>16.8</td>
<td>353</td>
<td>8.4</td>
<td>9.4</td>
<td>103.2</td>
<td>44</td>
<td>298</td>
<td>86</td>
<td>19.2</td>
</tr>
<tr>
<td>Mark (m)</td>
<td>5.8</td>
<td>258</td>
<td>17.2</td>
<td>13.6</td>
<td>96.1</td>
<td>44</td>
<td>306</td>
<td>93</td>
<td>15.8</td>
</tr>
<tr>
<td>Jill (preg)</td>
<td>13.2</td>
<td>398</td>
<td>7.6</td>
<td>8.6</td>
<td>84.5</td>
<td>42</td>
<td>322</td>
<td>124</td>
<td>12.1</td>
</tr>
<tr>
<td>Lucy (F)</td>
<td>9.1</td>
<td>318</td>
<td>12.4</td>
<td>13.4</td>
<td>91.8</td>
<td>32</td>
<td>187</td>
<td>237</td>
<td>12.2</td>
</tr>
</tbody>
</table>

Possible diagnosis:
- Early depletion/depletion stage (Folate)
- Early Deficiency stage (Folate)
- Anemia from Folate deficiency
- Recovering from Folate Deficiency Anemia
- Early depletion/depletion stage (B12)
- Early Deficiency stage (B12)
- Anemia from B12 deficiency
- Recovering from B12 Deficiency Anemia
- Moderately Anemic (but NOT from Folate or B12 deficiency)

Based on all the above data, write the “most consistent” diagnosis (choose from diagnosis listed above) with respect to their lab values next to the patient name. Also, indicate whether each patient should have the following tests done. (24 Points)

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnosis (from choices above)</th>
<th>Test for Intrinsic-Factor Antibodies (IF-Abs) Yes or No</th>
<th>Test for Renal (Kidney) Function Yes or No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al (m)</td>
<td>Early deficiency stage (folate)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Bert (m)</td>
<td>Anemia from b12 deficiency</td>
<td>Yes</td>
<td>Y</td>
</tr>
<tr>
<td>Nan (F)</td>
<td>Recovering from folate deficiency anemia</td>
<td>No</td>
<td>N</td>
</tr>
<tr>
<td>Mark (m)</td>
<td>Early depletion/ depletion stage ( folate)</td>
<td>Yes</td>
<td>Y</td>
</tr>
</tbody>
</table>
Finally, one of the 3 patients is vitamin B₁₂ deficient. Who is it? _____Bert____ (2 pts)

(9) You are monitoring the progress of 3 patients (Bill, Greg, and Joan). Joan is suffering from a chronic folate deficiency anemia. Bill is recovering from surgery after a traumatic motorcycle accident, while Greg is being monitored following the accidental, prolonged ingestion (over a 5 week period) of a potent Folate antagonist almost 2 months ago. (29 points)

You have the data sets below. Unfortunately, the patient codes were not attached. Based on these data sets, deduce which describes the condition and thus identify the likely patient for that data set.

**Data set A:**  
- HgB = 12.3g/dL  
- Hct = 40.3%  
- RBC# = 4.02 x10¹²  
- RDW = 19.5%  

(1 pt) MCV = 100.3 fL  
(1 pt) MCHC = 30.5 g/dL  

(3 pts) Anemia (yes / no)  
Based on: low Hct / low HgB / both normal  

RBC Morphology (circle all that apply): microcytic / normocytic / macrocytic  
- hypochromic / normochromic / hyperchromic (1 pt)

Serum Folate = 13.3 nmol/L  
RBC Folate = 337 nmol/L  
Serum MMA = 87 nmol/L  
Serum Hcyst = 12.7 nmol/L  

(2 pts) Probable patient = Greg

**Data set B:**  
- HgB = 9.2g/dL  
- Hct = 30.4%  
- RBC# = 2.81 x10¹²  
- RDW = 16.3%  

(1 pt) MCV = 108.2 fl  
(1 pt) MCHC = 30.3 g/dL  

(3 pts) Anemia (yes / no)  
Based on: low Hct / low HgB / both normal  

RBC Morphology (circle all that apply): microcytic / normocytic / macrocytic  
- hypochromic / normochromic / hyperchromic (1 pt)

Serum Folate = 4.7 nmol/L  
RBC Folate = 194 nmol/L  
Serum MMA = 293 nmol/L  
Serum Hcyst = 19.3 nmol/L  

(2 pts) Probable patient = Joan

**Data set C:**  
- HgB = 10.7g/dL  
- Hct = 31.4%  
- RBC# = 3.92 x10¹²  
- RDW = 12.7%  

(1 pt) MCV = 80.1 fl  
(1 pt) MCHC = 34.1 g/dL
(3 ptS) Anemia (yes / no) based on low Hct / low HgB / both normal

RBC Morphology (circle all that apply): microcytic / normocytic / macrocytic (1 pt)
    hypochromic / normochromic / hyperchromic (1 pt)

Ser Folate = 15.3 nmol/L  RBC Folate = 457 nmol/L  ser MMA = 71 nmol/L  ser Hcyst = 7.4 nmol/L

(2 pts) Probable patient =

(10) The 3 women below are part of a study examining a new, strict diet. At the start of the study, the following data was collected for each woman:

<table>
<thead>
<tr>
<th></th>
<th>Hct (%)</th>
<th>HgB (g/dL)</th>
<th>RDW (%)</th>
<th>MCV (fL)</th>
<th>(nmol/L) RBC Folate</th>
<th>(nmol/L) Ser. Folate</th>
<th>(nmol/L) Ser Homocyst.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sally</td>
<td>41</td>
<td>13.6</td>
<td>12.7</td>
<td>92</td>
<td>394</td>
<td>15.2</td>
<td>11.2</td>
</tr>
<tr>
<td>Hillary</td>
<td>45</td>
<td>13.2</td>
<td>11.6</td>
<td>87</td>
<td>423</td>
<td>19.4</td>
<td>6.8</td>
</tr>
<tr>
<td>Louise</td>
<td>43</td>
<td>15.4</td>
<td>11.3</td>
<td>82</td>
<td>408</td>
<td>13.2</td>
<td>7.7</td>
</tr>
</tbody>
</table>

The following data was collected on Day 60 of the diet trial:

<table>
<thead>
<tr>
<th></th>
<th>Hct (%)</th>
<th>HgB (g/dL)</th>
<th>RDW (%)</th>
<th>MCV (fL)</th>
<th>(nmol/L) RBC Folate</th>
<th>(nmol/L) Ser. Folate</th>
<th>(nmol/L) Ser Homocyst.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sally</td>
<td>37</td>
<td>12.3</td>
<td>16.6</td>
<td>99</td>
<td>343</td>
<td>12.5</td>
<td>17.8</td>
</tr>
<tr>
<td>Hillary</td>
<td>42</td>
<td>12.2</td>
<td>14.8</td>
<td>96</td>
<td>384</td>
<td>12.1</td>
<td>9.7</td>
</tr>
<tr>
<td>Louise</td>
<td>37</td>
<td>13.4</td>
<td>15.7</td>
<td>94</td>
<td>341</td>
<td>16.3</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Describe any problem or risk of this new diet (4 pts)
Their hct and hgb values are decreasing; which means they can potentially become anemic with the decreasing values. Their rbw values also increased to the level of abnormality for the 3 women, which means there are a lot of variations.

Based on the data, which woman (if any) would you expect to become Anemic first? (1 pt)
Sally.

Why? (Provide data to substantiate your answer) (3 pts)
Because she has the highest level of serum homocyst which is a risk factor for folate/ b12 deficiency. She also has the lowest amount of serum folate levels.

Diet histories indicate that one of the women may have had marginal B12 status at the start of the study and that inadequate (low) B12 intake has likely persisted through this 60 day time. Based on the data, which women is most likely to be the one with chronic, inadequate B12? (1 pt)
Sally
Why? (3 pts)
Since the start of the diet at 60 days she had the highest mcv value which is close to be considered macrocytic. She also started out with the lowest rbc folate level and she is the 2\text{nd} lowest for rbc folate after 60 days. Whereas the other 2 women had normal serum homocyst levels since before the start of the diet.
The technician doing the sample analysis informs you that one of the day 60 serum samples had evidence of hemolysis, but is not sure which patient sample it was. Based on the above, whose day 60 sample is the most likely to have hemolysis? (1 pt)

Louise

Why? (3 pts)

Her serum folate levels increased and is the highest, and rbc hemolysis is a factor that causes serum folate to increase. The other two women serum folate decreased, whereas Louise’s serum folate increased.

(11) You are involved with a 57 yr. old female patient who presented 2 weeks ago with complaints symptomatic for anemia. At that time, blood tests were done as indicated in the table below. Current, follow-up blood test data is also presented. Calculate and insert the blood indice data in the table, and answer the questions that follow. (40 points)

<table>
<thead>
<tr>
<th>Indice</th>
<th>2 wks ago</th>
<th>Current</th>
<th>Indice</th>
<th>2 wks ago</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC # (x10^12/L)</td>
<td>3.22</td>
<td>3.29</td>
<td>MCV (fL)</td>
<td>103.7 fl</td>
<td>99.1 fl</td>
</tr>
<tr>
<td>HgB (g/dL)</td>
<td>9.2</td>
<td>9.0</td>
<td>MCH (pg)</td>
<td>28.6 pg</td>
<td>27.4 pg</td>
</tr>
<tr>
<td>Hct (%)</td>
<td>33.4</td>
<td>32.6</td>
<td>MCHC (g/dL)</td>
<td>27.5 g/dL</td>
<td>27.6 g/dL</td>
</tr>
<tr>
<td>RDW (%)</td>
<td>16.3</td>
<td>16.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(3 pts) 2 wks ago: Anemia (yes / no) based on: low Hct / low HgB / both normal

RBC Morphology: (microcytic / normocytic / macrocytic) (1 pt)
(hypochromic / normochromic / hyperchromic) (1 pt)

(3 pts) Currently: Anemia (yes / no) based on: low Hct / low HgB / both normal

RBC Morphology: (microcytic / normocytic / macrocytic) (1 pt)
(hypochromic / normochromic / hyperchromic) (1 pt)

Blood tests evaluating Folate and vit.B₁₂ were done 2 weeks ago. At that time, she was prescribed daily, oral tablets for BOTH Folate and vit. B₁₂. She is adamant that she has been taking the daily supplements exactly as prescribed. Her 2 week old and current Folate and vit.B₁₂ data are provided below. Fill-in the evaluative data and answer the questions that follow. (8 Points)

<table>
<thead>
<tr>
<th>Test</th>
<th>2 wks ago</th>
<th>Status</th>
<th>Current</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ser. Folate (nmol/L)</td>
<td>10.7</td>
<td>borderline</td>
<td>18.4</td>
<td>Acceptable / normal</td>
</tr>
<tr>
<td>RBC Folate (nmol/L)</td>
<td>203</td>
<td>Deficienct</td>
<td>224</td>
<td>deficienct</td>
</tr>
<tr>
<td>tHcy (μmol/L)</td>
<td>17.7</td>
<td>Deficienct</td>
<td>16.8</td>
<td>deficienct</td>
</tr>
<tr>
<td>Ser. B₁₂ (pmol/L)</td>
<td>126</td>
<td>deficienct</td>
<td>129</td>
<td>deficienct</td>
</tr>
</tbody>
</table>

What is the evidence that she has been compliant in taking the supplements (as she claims)? (4 pts)

Her serum folate levels appear to be acceptable/normal no. All of the values beside serum folate show that she is deficient, but the values are slowly decreasing for tHcy, serum B₁₂, and RBC folate levels are slowly increasing. This indicates that she has been complaint in taking the supplements. Serum folate may be a better indicator since RBC folate is more complex test, which is more prone to errors.
What is your overall interpretation of her condition AND your plan for further TESTS and course of action?  (6 pts)

*Even though most of the values show that she is deficient, but the values are slowly improving. Her serum folate increased and her RBC folate too. Also her serum B12 and tHcy levels are slowly decreasing so even if she is deficient, her condition is slowly getting better.*

(12) In evaluating values and indices during the progression leading to folate deficiency anemia in an adult male, which of the following sequences is/are correct?  (2 pts)

a) low folate intake $\rightarrow$ decrease serum folate $\rightarrow$ decreased RBC folate $\rightarrow$ an RDW = 17.7%

b) a prolonged RBC folate concentration of 260 nmol/L would lead to an elevated MCV

c) acute renal failure as well as liver disease would result in further decreases in serum Folate

d) all of the above

e) a and b only

(13) Which of the following is/are consistent with Folate deficiency anemia in an adult female?  (2 pts)

a) an MCV = 106 fl and a Hct = 30%

b) an MCV = 108 fl and a HgB value = 11.2 g/dL

c) a serum folate concentration = 5.2 nmol/L and an RBC Folate conc. = 213 nmol/L

d) all of the above

e) a and b only

(14) Concerning the inter-relationships and distinctions between folate and vitamin B12, which of the following statements is/are true?  (2 pts)

a) a lack or low amount of B12 can result in a functional folate deficiency because the folate becomes metabolically “trapped” in an inactive form

b) the anemia blood cell indices resulting from either a folate or B12 deficiency can present identically

c) measurement of methylmalonic acid can establish that B12 is the main (primary) nutrient underlying the deficiency if the MMA level is <100 pmol/L

d) all of the above

e) a and b only

(15) Results from a blood smear analysis state a finding of anisocytosis with hypochromacia. Based on these observations, which of the following indice values would you expect?  (2 pts)

a) an RDW of 25.2% with an MCHC = 38 g/dL

b) an MCV = 78 fl and HgB = 10 g/dL

c) an RDW of 20.4% with an MCHC = 27 g/dl

d) a and b only

e) none of the above