Name: _____ Date: _____ Block: _____

MICROSCOPE REVIEW PROBLEMS (LIFE SCIENCES 11)

Unit Conversions

1) Complete the following unit conversions.

a. 289 mm to cm 28.9 cm
b. 19.88 cm to m 0.1988 m
c. 9.6 µm to mm 0.0096 mm
d. 5899022 nm to cm 0.5899022 cm
e. 980.22 µm to m 0.00098022 m
f. 0.0082 m to mm 8.2 mm
g. 29607 nm to µm 29.607 µm
h. 890000 nm to cm 0.089 cm
i. 87000 µm to m 0.087 m
j. 0.025 cm to µm 250 µm
k. 0.00051 mm to µm 0.51 µm
l. 0.0000012 µm to nm 0.0012 nm

Total Microscope Magnification

2)

a. On our microscopes, what is the magnification of a Low power objective lens? Medium? High?

4x, 10x, 40x

b. If an ocular lens (eyepiece) with a magnification of 16x was inserted into our microscopes, what would the total magnification be on Low power? Medium? High?

64x, 160x, 640x

3) Complete the following table.

Eyepiece	Objective	Total Magnification
10x	4x	40x
15x	Medium power	150 x
5x	Low power	20 x
10x	10x	100x
10x	High power	400x

Field Number and Field of View

4) What is the relationship between field number, field of view, and magnification of the objective? Write the formula.

$$\text{field of view} = \frac{\text{field number}}{\text{objective magnification}}$$

5) By looking at an eyepiece, how do you determine the field number?

is the second number (usually next to the magnification)

6) Complete the following table.

Eyepiece	Eyepiece A	Eyepiece B	Eyepiece C
			
Eyepiece magnification	15 x	10x	10 x
Field Number	16 mm	22 mm	18 mm
Field of View on Low Power	4 mm	5.5 mm	4.5 mm
Field of View on Medium Power	1.6 mm	2.2 mm	1.8 mm
Field of View on High Power	0.4 mm	0.55 mm	0.45 mm

7) Estimate the size of the following. Eyepieces A, B, and C can be found in the previous question.

a. A cell that takes up 1/5 of a field of view on medium power with Eyepiece C.

$fov = \frac{fn}{mag} = \frac{18mm}{10.} = 1.8mm$ | $1.8mm \times \frac{1}{5} = 0.36\,mm$

b. A hair that takes up 1/3 of a field of view on high power with Eyepiece B.

$fov = \frac{fn}{mag} = \frac{22mm}{40} = 0.55mm$ | $0.55mm \times \frac{1}{3} = 0.18\,mm$

8) A student is looking at a slide with onion epidermis cells. If there are 70 cells lined up along the middle of the field of view, and the field of view is 3500 µm, what is the length of an average cell?

$3500\,\mu m \times \frac{1}{70} = 50\,\mu m$

Drawing Magnification

9) An amoeba on a mural is drawn to be 1.7 m in length. If the drawing magnification is 1800x, what is the actual size of the amoeba in mm? In µm? nm?

$D = A \times M$

$A = \frac{D}{M} = \frac{1.7m}{1800} = 0.00094\,m \rightarrow 0.94\,mm \rightarrow 940\,\mu m \rightarrow 940{,}000\,nm$

10) Suppose the actual height of the elephant pictured on your textbook cover is 3.3 m. What magnification was the elephant drawn at?

$A = 3.3m$

$D = 20cm$

$M = ?$

$M = \frac{D}{A} = \frac{20cm}{3.3m} = \frac{0.2m}{3.3m} = 0.061\times$

$(20cm)\left(\frac{m}{100cm}\right) = 0.2m$

If the drawing is larger than the actual object, drawing magnification is greater than 1.

If the drawing is smaller than the actual object, drawing magnification is less than 1.

11) The HIV virus is round and measures 100 nm in diameter. Draw the HIV virus at a drawing magnification of 36,000 x. Label it with a horizontal, straight label.

$A = 100nm$

$M = 36{,}000$

$D = A \times M = 100nm \times 36000 = 3600000\,nm$

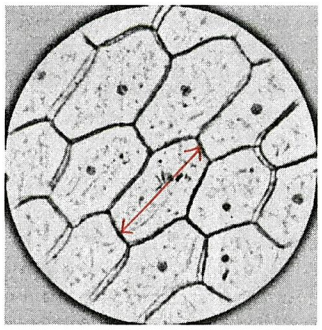
Convert to mm: $(3600000\,nm)\left(\frac{mm}{1000000\,nm}\right) = 3.6\,mm$

HIV virus (magnified 36,000x)

Mixing Things Up

12)

a. To the right is a drawing of plant cells viewed under a compound microscope. Estimate the actual size of one plant cell in the image, assuming it is viewed under low power using an eyepiece with a field number of 20 mm. Show all your work.



$fov = \frac{fn}{mag_{obj}} = \frac{20mm}{4} = 5\,mm$

actual length $= \left(\frac{1}{2.5}\right)(5\,mm) = 2\,mm$

I estimated that approx. 2.5 of the plant cells would fit.

b. Suppose the actual width of one of the plant cells shown is 1.5 mm. Calculate the magnification of the drawing.

$A = 1.5mm$

$M = ?$

$D = 8mm$

$M = \frac{D}{A} = \frac{8mm}{1.5mm} = 5.3\times$

13) A microscope's objective lenses have the following magnification values: 5x on low, 15x on medium, 50x on high. The field of view under low power is 7 mm. Determine the field of view of this microscope under medium power, in both mm and µm.

$fov = \frac{fn}{mag_{obj}}$

$fn = fov \times mag = (7mm)(5) = 35\,mm$

$fov = \frac{fn}{mag_{obj}} = \frac{35mm}{15} = 2.3\,mm$

$2.3\,mm \rightarrow 2300\,\mu m$

14) A specimen is 40 µm long. The specimen fits across the field of view 10 times under high power. Calculate the field ~~diameter~~ number of this microscope.

$fov = 10 \times 40\,\mu m = 400\,\mu m$

$fn = fov \times mag = 400\,\mu m \times 40 = 16000\,\mu m \rightarrow 16\,mm$