14. When viewing Slide C in Activity 1, the student was able to discern 2 distinct lines with how many of the objective lenses?

F. 1
G. 2
H. 3
J. 4

15. Which of the following equations correctly calculates R (in nm) for Objective Lens 2, using light with a wavelength of 425 nm ?

A. $R = 425 \div 2(0.10)$
B. $R = 425 \div 2(0.25)$
C. $R = 0.10 \div 2(425)$
D. $R = 0.25 \div 2(425)$

16. Another student calculated the R of a fifth objective lens as described in Activity 3. He determined that for this fifth objective lens, R = 1,830 nm. Accordingly, the NA of this lens was most likely closest to which of the following values?

F. 0.15
G. 0.25
H. 0.35
J. 0.45

17. Activity 1 and Activity 2 differed in that in Activity 1:

A. 4 different slides were used.
B. 4 different objective lenses were used.
C. the wavelength of the light was varied.
D. the object sizes were greater than the image sizes.

Passage III

A student performed 3 activities with a microscope that had 4 objective lenses.

Activity 1

The student viewed 4 slides (A, B, C, and D) through each objective lens. Each slide had 2 thin lines painted on it. For each objective lens, the student determined whether she could see the lines as separate or whether they blurred into 1 image. The results appear in Table 1.

Table 1

Slide	Objective Lens: 1	2	3	4
A	|	|	|	|
B	|	|	|	||
C	|	|	||	||
D	|	||	||	||

Note: || indicates lines appeared separate; | indicates lines blurred together.

Activity 2

The student was given a prepared slide with a line on it that was 0.1 mm in length. This length was defined as the *object size*. Next, she viewed the slide with each objective lens, estimating how long the line appeared. This estimated length was called the *image size*. Finally, she calculated the magnification (M) associated with each objective lens from the following formula:

$$M = \text{image size} \div \text{object size}.$$

The data appear in Table 2.

Table 2

Objective Lens	Image size (mm)	M
1	4	40
2	10	100
3	20	200
4	40	400

Activity 3

The *numerical aperture* (NA) of each objective lens was printed on the microscope. NA determines how much detail can be seen and is related to *resolution* (R). R is defined as the smallest distance separating 2 objects such that the objects appear separate. Thus an objective lens with a small R shows a sample more clearly than does an objective lens with a large R. R is calculated from the following formula:

$$R = \lambda \div 2(NA)$$

where λ is the wavelength of the light, in nanometers (nm), used to view the objects.

The student calculated R for each objective lens, assuming a λ of 550 nm. The data appear in Table 3.

Table 3

Objective Lens	NA	R (nm)
1	0.10	2,750
2	0.25	1,100
3	0.40	688
4	0.65	423

12. If the student had viewed the slide used in Activity 2 through a fifth objective lens and the image size with this objective lens was 30 mm, the M associated with this objective lens would have been:

F. 30.
G. 100.
H. 300.
J. 1,000.

13. Based on the results of Activity 2, the combination of which of the following lines and objective lenses would result in the greatest image size?

A. A 0.7 mm line viewed through Objective Lens 1
B. A 0.6 mm line viewed through Objective Lens 2
C. A 0.5 mm line viewed through Objective Lens 3
D. A 0.4 mm line viewed through Objective Lens 4

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