K1. If \( xy = 1 \) and \( x \) is greater than 0, which of the following statements is true?

A. When \( x \) is greater than 1, \( y \) is negative.
B. When \( x \) is greater than 1, \( y \) is greater than 1.
C. When \( x \) is less than 1, \( y \) is less than 1.
D. As \( x \) increases, \( y \) increases.
E. As \( x \) increases, \( y \) decreases.
K2. In how many ways can one arrange on a bookshelf 5 thick books, 4 medium sized books and 3 thin books so that the books of the same size remain together?

A. $5! \times 4! \times 3! = 103680$

B. $5! \times 4! \times 3! = 17280$

C. $(5! \times 4! \times 3!) \times 3 = 51840$

D. $5 \times 4 \times 3 \times 3 = 180$

E. $2^{12} \times 3 = 12288$
K3. The acceleration of an object moving in a straight line can be determined from

A. the slope of the distance-time graph
B. the area below the distance-time graph
C. the slope of the velocity-time graph
D. the area below the velocity-time graph
K4. The value of \( \lim_{h \to 0} \frac{\sqrt{2+h} - \sqrt{2}}{h} \) is

A. 0

B. \( \frac{1}{2\sqrt{2}} \)

C. \( \frac{1}{2} \)

D. \( \frac{1}{\sqrt{2}} \)

E. \( \infty \)
K5. Which of the following graphs has these features:
\( f'(0) > 0, \ f'(1) < 0, \) and \( f''(x) \) is always negative?

A. \[
\begin{array}{c}
y \\
\end{array}
\]

B. \[
\begin{array}{c}
y \\
\end{array}
\]

C. \[
\begin{array}{c}
y \\
\end{array}
\]

D. \[
\begin{array}{c}
y \\
\end{array}
\]

E. \[
\begin{array}{c}
y \\
\end{array}
\]
K6. The line $l$ in the figure is the graph of $y = f(x)$.

\[ \int_{-2}^{3} f(x) \, dx \] is equal to

A. 3
B. 4
C. 4.5
D. 5
E. 5.5

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K8. Which one of the following conics is represented by the equation 
\((x – 3y)(x + 3y) = 36\)?

A. Circle  
B. Ellipse  
C. Parabola  
D. Hyperbola
K18. In the $\triangle ABC$ the altitudes $BN$ and $CM$ intersect at point $S$. The measure of $\angle MSB$ is $40^\circ$ and the measure of $\angle SBC$ is $20^\circ$. Write a PROOF of the following statement:

"$\triangle ABC$ is isosceles."

Give geometric reasons for statements in your proof.
L3. A radio-active element decomposes according to the formula,

\[ y = y_0 e^{-kt} \]

where \( y \) is the mass of the element remaining after \( t \) days and \( y_0 \) is the value of \( y \) for \( t = 0 \).

Find the value of the constant \( k \) for an element whose half-life (i.e. time to decompose half of the material) is 4 days.

A. \( \frac{1}{4} \log_e 2 \)

B. \( \log_e \frac{1}{2} \)

C. \( \log_2 e \)

D. \( (\log_e 2)^{\frac{1}{4}} \)

E. \( 2e^4 \)
L17. For what real value of $k$ will the equation below describe a circle with radius 3?

$$x^2 + y^2 + 2x - 4y + k = 0$$

Show all your work.