(1) What is the fourth derivative of $\sin(x)$?
   (a) $\cos(x)$.
   (b) $-\cos(x)$.
   (c) $\sin(x)$.
   (d) $-\sin(x)$.

(2) Which of the following best explains why the function
   \[ f(x) = \begin{cases} 
   x^3 & x \geq 2 \\
   x^4 & x < 2 
   \end{cases} \]
   is not continuous at 2?
   (a) Despite the wording of the question, $f$ is in fact continuous at 2.
   (b) $f(2)$ is not defined.
   (c) $\lim_{x \to 2} f(x)$ does not exist.
   (d) $f(2)$ is defined and $\lim_{x \to 2} f(x)$ exists, but $f(2)$ is not equal to $\lim_{x \to 2} f(x)$.

(3) Let $f(x) = (7x - 7)/|x - 1|$. Which of the following best explains why the limit $\lim_{x \to 1} f(x)$ does not exist?
   (a) Despite the wording of the question, the limit does in fact exist.
   (b) When we try to compute the limit, we get
   \[
   \lim_{x \to 1} \frac{7x - 7}{|x - 1|} = \frac{0}{0},
   \]
   which is not defined.
   (c) The left and right limits
   \[
   \lim_{x \to 1^-} f(x) \text{ and } \lim_{x \to 1^+} f(x)
   \]
   both exist, but are not equal.
   (d) The derivative of $|x|$ is not continuous at zero.

(4) After $t$ seconds, the height of a spaceship is given by
   \[ h(t) = 10t^5 - 6t^6 \]
   meters. Complete the following sentences using the words first, second, increasing, decreasing, positive, and negative.
   (a) After one second, the height of the spaceship is ____________. We know this because the ____________ derivative of $h(t)$ is ____________.
   (b) After one second, the rate of change of the height of the spaceship is ____________. We know this because the ____________ derivative of $h(t)$ is ____________. 
(1) To calculate the fourth derivative, we simply differentiate four times:
\[ \frac{d}{dx} \sin(x) = \cos(x), \quad \frac{d^2}{dx^2} \sin(x) = -\sin(x) \]
\[ \frac{d^3}{dx^3} \sin(x) = -\cos(x), \quad \frac{d^4}{dx^4} \sin(x) = \sin(x). \]

The correct answer is (c).

(2) \( f(x) \) is continuous at 2 if and only if \( f(2) \) is defined, \( \lim_{x \to 2} f(x) \) exists and \( f(2) = \lim_{x \to 2} f(x) \). \( f(2) = 2^3 = 8 \) is defined.
\[ \lim_{x \to 2^-} f(x) = \lim_{x \to 2} x^4 = 16 \]
\[ \lim_{x \to 2^+} f(x) = \lim_{x \to 2} x^3 = 8. \]

The left and right limits are different, so the limit does not exist. The correct answer is (c).

(3) Calculating left and right limits, we get
\[ \lim_{x \to 1^-} f(x) = \lim_{x \to 1^-} \frac{7x - 7}{-(x - 1)} = \lim_{x \to 1^-} \frac{7(x - 1)}{-(x - 1)} = -7 \]
\[ \lim_{x \to 1^+} f(x) = \lim_{x \to 1^+} \frac{7x - 7}{x - 1} = \lim_{x \to 1^+} \frac{7(x - 1)}{x - 1} = 7. \]

The left and right limits are different, so \( \lim_{x \to 1} f(x) \) does not exist; the correct answer is (c). About the other answers. Option (b) is nonsense: Many limits we evaluate will be of the form 0/0 if we just substitute (e.g. the limit in the definition of the derivative is always of this form), dealing with this is the whole point of limits! Option (d) is a true statement, but is irrelevant to the question.

(4) Calculating the first and second derivatives, we have
\[ h'(t) = 50t^4 - 36t^5, \quad h''(t) = 200t^3 - 180t^4 \]
and so
\[ h'(1) = 14, \quad h''(1) = 20. \]

(a) After one second, the height of the spaceship is increasing. We know this because the first derivative of \( h(t) \) is positive.

(b) After one second, the rate of change of the height of the spaceship is increasing. We know this because the second derivative of \( h(t) \) is positive.