Velocity, Acceleration and other Rates of change

1) A ball is hit straight up into the air. Its height h metres after t seconds is given by $h = 60t - 5t^2$
(a) Find an expression for the velocity v of the ball.
(b) Find (i) the height and (ii) the velocity of the ball after 4 seconds
(c) Find (i) the height and (ii) the velocity of the ball after 8 seconds. What does the sign of the velocity indicate?
(d) Find the time at which the velocity of the ball is zero. What happens at this time in the ball's flight?
(e) Find the time when the ball hits the ground again.
(f) Find the acceleration of the ball. What causes this acceleration?

2) An object is moving so that its distance s from a point O after t seconds is given by $s = 12t^2 - t^3$ (for $0 \le t \le 12$)
(a) Find an expression for the velocity of the object.
(b) Find an expression for the acceleration of the object.
(c) Find the time at which the acceleration is zero. What does this tell you about the velocity?
(d) What is the maximum velocity reached by the object
(e) Find the times at which the velocity is zero. What does this tell you about the distance?
(f) Find the maximum distance of the object from its stating point O.
(g) Draw graphs showing (i) distance against time, (ii) velocity against time and (iii) acceleration against time for this object.
[Not detailed graphs – in each case, make a table of values for $t = 0$, 4, 8, and 12, and make use of the previous answers.]

3) The population (P thousand) of ants in a colony after x days is given by $P = x^2 + 4x$. Find the rate at which the population is increasing after 5 days.

4) The temperature T of an object after x minutes is given by $T = 20 + 2x - x^2$.
Find the rate at which the temperature is changing after 5 minutes. What does the sign of your answer tell you?

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