Section 1.8, Question 7: An object moving in a straight line travels $s(t)$ kilometers in t hours, where $s(t) = 2t^2 + 4t$.

1. What is the object's velocity when $t = 6$?

2. How far has the object traveled in 6 hours?

3. When is the object traveling at the rate of 6 kilometers per hour?

Answer: Remember that the rate of change of a function $f(x)$ when $x = a$ is $f'(a)$.

Velocity is defined to be the rate of change of displacement.

In this question, the displacement is given by $s(t) = 2t^2 + 4t$.

So, the velocity function is given by

$$v(t) = \frac{d}{dt}[2t^2 + 4t]$$

$$= \frac{d}{dt}[2t^2] + \frac{d}{dt}[4t]$$

$$= 2\frac{d}{dt}[t^2] + \frac{d}{dt}[4t]$$

$$= 2(2t) + 4$$

$$= 4t + 4.$$

So we can answer part 1 by evaluating the velocity function when $t = 6$:

$$v(6) = (4t + 4)|_{t=6} = (4(6) + 4) = (24 + 4) = 28km/h.$$

To answer part 2, we need to find out how far the object has traveled in 6 hours. But the object's displacement is given by the function $s(t) = 2t^2 + 4t$. So, we can answer the question by evaluating the displacement function when $t = 6$:

$$s(6) = (2t^2 + 4t)|_{t=6} = (2(6)^2 + 4(6)) = 2(36) + 24 = 72 + 24 = 96km.$$

Lastly, to answer part 3, we need to know when the object is traveling at the rate of $6km/h$. The *rate of travel* (or motion) of the object is its velocity.

We have already found the velocity function. So, to find out when the velocity is $6km/h$, we can set $v(t) = 6$ and try and solve for t:

$$v(t) = 6$$

$$4t + 4 = 6$$

$$4t = 2$$

$$t = 0.5$$

This tells us that the object is traveling at $6km/h$ exactly when $t = 0.5hr$.

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