

18. We use the functional notation  $x(t)$ ,  $v(t)$  and  $a(t)$  and find the latter two quantities by differentiating:

$$v(t) = \frac{dx(t)}{dt} = -15t^2 + 20 \quad \text{and} \quad a(t) = \frac{dv(t)}{dt} = -30t$$

with SI units understood. These expressions are used in the parts that follow.

(a) From  $0 = -15t^2 + 20$ , we see that the only positive value of  $t$  for which the particle is (momentarily) stopped is  $t = \sqrt{20/15} = 1.2$  s.

(b) From  $0 = -30t$ , we find  $a(0) = 0$  (that is, it vanishes at  $t = 0$ ).

(c) It is clear that  $a(t) = -30t$  is negative for  $t > 0$

(d) The acceleration  $a(t) = -30t$  is positive for  $t < 0$ .

(e) The graphs are shown below. SI units are understood.

