201 §3.4 #s 3, 4, 7, 10, 14, 15, 19

#s 1-6 Give $s = s(t)$ as function of body moving on a coordinate line as function, in meters of t = time, in seconds.

(a) Find displacement and average velocity for given interval

(b) Find SPEED and acceleration @ endpoints

(c) When, if ever, does it change direction?

(3) $s = -t^3 + 3t^2 - 3t, \quad 0 \le t \le 3$

(a) $s(3) - s(0) = -(3)^3 + 3(3)^2 - 3(3) - 0$

$= -27 + 27 - 9 = \boxed{-9 \text{ m}}$

(b) $\dfrac{s(3)-s(0)}{3-0} = -\dfrac{9}{3} = \boxed{-3 = v_{AV}}$

(6) Speed @ endpts?

$v(t) = -3t^2 + 6t - 3 \longrightarrow$

$|v(0)| = \boxed{3 \text{ m/s}}$ & $|v(3)| = |-3(3)^2 + 6(3) - 3|$

$= |-27 + 18 - 3| = |-12| = \boxed{12} \text{ m/s}$

$a(t) = -6t + 6 \longrightarrow$

$a(0) = 6 \text{ m/s}^2$

$a(3) = -6(3) + 6 = -18 + 6 = \boxed{-12 = a(3) \text{ m/s}^2}$

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(3) (c) $v(t) = -3t^2 + 6t - 3 \overset{\text{SET}}{=} 0$

$\Rightarrow 3(-t^2 + 2t - 1) = 0$

$\Rightarrow t^2 - 2t + 1 = 0$

$\Rightarrow (t-1)^2 = 0$

$\Rightarrow t = 1$ sec is when it changes direction (starts moving in "negative direction")

(4) (a) $s(t) = \frac{1}{4}t^4 - t^3 + t^2 \quad t \in [0, 3]$

$s(3) - s(0) = \frac{1}{4}(3)^4 - (3)^3 + 3^2 - 0$

$= \frac{81}{4} - 27 + 9$

$= \frac{81 - 108 + 36}{4} = \frac{-18}{4} = \boxed{-\frac{9}{2} = -4.5 \text{ m}}$

= Displacement

(b) $\frac{s(3) - s(0)}{3 - 0} = \frac{-\frac{9}{2}}{3} = \left(-\frac{9}{2}\right)\left(\frac{1}{3}\right) = \boxed{-\frac{3}{2}}$

$= -1.5 \text{ m/s}$

= Avg Velocity.

(b) Speed @ endpts

$|v(0)| = 0$

$|v(3)| = \frac{d}{dt}\left[\frac{1}{4}t^4 - t^3 + t^2\right]\Big|_{t=3} = \left(t^3 - 3t^2 + 2t\right)\Big|_{t=3}$

$= \left|3^3 - 3(3)^2 + 2(3)\right| = \boxed{6 = |v(3)|}$

201 § 3.4 #s 7, 10, 14, 15, 19

(4) cont'd

(b) acceleration @ endpts

$$a(t) = \frac{d}{dt}(v(t)) = v'(t) = 3t^2 - 6t + 2$$

$$\Rightarrow \boxed{a(0) = 2 \text{ m/s}^2} =$$

$$a(3) = 3(3)^2 - 6(3) + 2 = 27 - 18 + 2 \neq 11 \text{ m/s}^2$$

$$= a(3)$$

(7) Particle motion along s-axis

$$s = t^3 - 6t^2 + 9t \text{ in m.}$$

(a) find a(t) when v(t) = 0

$$v(t) = 3t^2 - 12t + 9 \overset{\text{SET}}{=} 0 \Rightarrow$$

$$3(t^2 - 4t + 3) = 0 \Rightarrow$$

$$(t-3)(t-1) = 0 \Rightarrow$$

$$t = 1, \; t = 3$$

$$a(t) = 6t - 12 \Rightarrow$$

$$a(1) = 6 - 12 = -6 \text{ m/s}^2$$

$$a(3) = 6(3) - 12 = 6 \text{ m/s}^2$$

201 § 3.4 #s 10, 14, 15

(10) Rock thrown straight up @ $v_0 = 24$ m/s reaches height $h(t) = 24t - .8t^2$ m in t sec.

(a) Find $v(t)$ & $a(t)$

$v(t) = s'(t) = 24 - 1.6t$

$a(t) = s''(t) = v'(t) = -1.6$

(b) How long to its highest pt?

$v(t) \overset{\text{SET}}{=} 0 \Rightarrow$

$24 - 1.6t = 0$

$24 = 1.6t$

$\frac{24}{1.6} = \boxed{t = 15 \text{ s}}$

(c) How high does it get?

$s(15) = 24(15) - .8(15)^2 = \boxed{180 \text{ m}}$

(d) How long to reach $\frac{1}{2}$ its max height?

$s(t) \overset{\text{SET}}{=} 90 \Rightarrow$

$24t - .8t^2 = 90 \Rightarrow$

$.8t^2 - 24t + 90 = 0$

$8t^2 - 240t + 900 = 0$

$4t^2 - 120t + 450 = 0$

$2t^2 - 60t + 225 = 0$

$a = 2, b = -60, t = 225$

$b^2 - 4ac = (-60)^2 - 4(2)(225)$

$= 1800$

$t = \frac{60 \pm \sqrt{1800}}{2(2)}$

$\approx \frac{60 \pm 42.426406871}{4}$

≈ 25.606601712

or

$\boxed{4.393398282}$

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(10) (e) How long is ball aloft?

$s(t) \overset{SET}{=} 0$

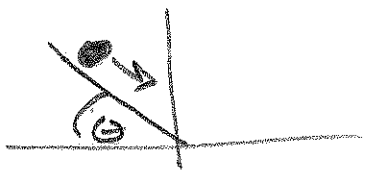
$24t - .8t^2 = 0$

$t(24 - .8t) = 0$

$t = 0$ or $24 = .8t$

$30 = \frac{24}{.8} = t$ = 30s

(14) $v = 9.8 \sin\theta\, t$ m/s ∴ eq'n for ball on ramp, falling

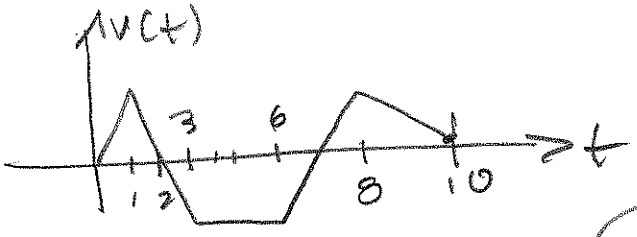


(a) $v = 9.8\left(\sin\frac{\pi}{2}\right)t$

$= 9.8t$ m/s

(b) Free-fall ⇒ acceleration = 9.8 m/s²

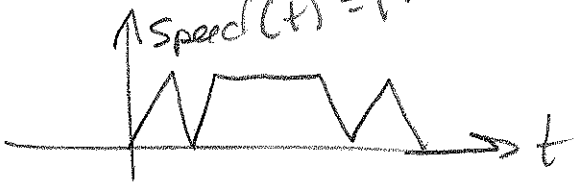
(15)



(a) Body reverses direction @ $t = 2, 8$

(b) Constant speed $\forall\, t \in [3, 6]$

(c) Graph of SPEED:



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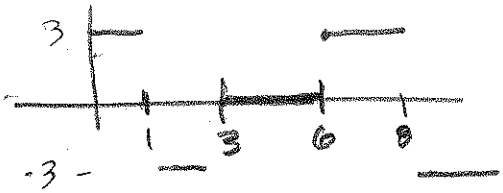
(d) Graph acceleration, where the line of



(19) $s = 490\,t^2$, s in cm, t in s.

Just to look @, mainly