26.1

7. $a = 30(1-4t)^{1/2}$

$v = \int 30(1-4t)^{1/2}\,dt$

$$\boxed{\begin{aligned} \text{Sub } u &= 1-4t \\ du &= -4dt \\ -\tfrac{1}{4}du &= dt \end{aligned}}$$

$v = \frac{-30}{4}\int u^{1/2}\,du$

$v = \frac{-30}{4}\left(\frac{2}{3}u^{3/2}\right) + C$

$$\boxed{v = -5(1-4t)^{3/2} + C}$$

Sub $v=0$, $t=0$:

$0 = -5(1) + C$

$C = 5$

$$\boxed{v = -5(1-4t)^{3/2} + 5}$$

$v(0.25) = -5(0) + 5$

$= 5$ m/s

(9) $a = -250 \text{ m/s}^2$ (negative because it's <u>deceleration</u>)

$v(0) = 96 \frac{\text{km}}{\text{h}}$

$= 96 \frac{\text{km}}{\text{h}} \times \frac{1000}{1} \frac{\text{m}}{\text{km}} \times \frac{1}{3600} \frac{\text{h}}{\text{s}}$

$\approx 26.6667 \frac{\text{m}}{\text{s}}$

The question is asking us to find the stopping distance.

$v = \int -250 \, dt$

$\boxed{v = -250t + C_1}$

Sub $v = 26.6667$, $t = 0$: $26.6667 = 0 + C_1$

$C_1 = 26.6667$

$\boxed{v = -250t + 26.6667}$

$s = \int (-250t + 26.6667) \, dt$

$\boxed{s = -125t^2 + 26.6667t + C_2}$

Recall $s(0) = 0$ unless otherwise specified.

Sub $s = 0$, $t = 0$: $0 = C_2$

$\boxed{s = -125t^2 + 26.6667t}$

$\rightarrow$

(9) Cont'd

Stopping Time: Set $v(t)=0$

$$0 = -250t + 26.6667$$

$$250t = 26.6667$$

$$t \approx 0.1067$$

Stopping Distance is $s(0.1067)$

$$= -125(0.1067)^2 + 26.6667(0.1067)$$

$$\approx 1.4\text{ m}$$

(15) $a = -4.0t \quad m/s^2$

$v(0) = 32 \quad m/s$

Find the stopping distance.

$$v = \int(-4.0t)\,dt$$

$$\boxed{v = -2.0t^2 + C_1}$$

Sub $v=32$, $t=0$: $\quad 32 = C_1$

$$\boxed{v = -2.0t^2 + 32}$$

$$s = \int(-2.0t^2 + 32)\,dt$$

$$\boxed{s = -\frac{2.0}{3}t^3 + 32t + C_2}$$

Recall $s(0)=0$ unless otherwise specified.

Sub $s=0$, $t=0$: $\quad 0 = C_2$

$$\boxed{s = -\frac{2.0}{3}t^3 + 32t}$$

$\rightarrow$

(15) Cont'd

Stopping Time : Set $v(t) = 0$

$$0 = -2.0t^2 + 32$$

$$2.0t^2 = 32$$

$$t^2 = 16$$

$$t = \pm 4$$

$$t = 4$$

Stopping Distance is $s(4) = \frac{-2.0}{3}(4)^3 + 32(4)$

$$\approx 85 m$$

(25) $\frac{d\theta}{dt} = 16t + 0.50t^2$

Find the angular displacement θ after 10.0 s.

$\theta = \int (16t + 0.50t^2)\,dt$

$\theta = 8t^2 + \frac{0.50}{3}t^3 + C$

Recall $s(0)=0$ unless otherwise specified.
Here displacement is called θ.
Therefore $\theta(0)=0$.

Sub $\theta = 0$, $t=0$: $0 = C$

$$\boxed{\theta = 8t^2 + \frac{0.50t^3}{3}}$$

$\theta(10) \approx 970$ radians

(31) $$\frac{dm}{dt} = \frac{-1}{\sqrt{t+1}}$$

a) Find m if $m(0) = 1000$ g.

b) How long until $m = 0$?

a)
$$\frac{dm}{dt} = -(t+1)^{-1/2}$$

$$m = \int -(t+1)^{-1/2}\,dt$$

Sub $u = t+1$
$du = dt$

$$m = \int -u^{-1/2}\,du$$

$$m = -2u^{1/2} + C$$

$$\boxed{m = -2(t+1)^{1/2} + C}$$

Sub $m = 1000$:
$t = 0$

$$1000 = -2 + C$$

$$C = 1002$$

$$\boxed{m = -2(t+1)^{1/2} + 1002}$$

b) Set $m = 0$:
$$0 = -2(t+1)^{1/2} + 1002$$

$$2\sqrt{t+1} = 1002$$

Square Both Sides :
$$4(t+1) = 1004004$$

$$t+1 = 251{,}001$$

$t = 251{,}000$ or 2.51×10^5 minutes