

TBM 2E, 20.3.2014

E, P, BGL

$$\textcircled{1} \quad s(t) = \frac{1}{2}at^2 + v_0t + h_0 \\ = -5t^2 + v_0t + h_0 \quad ; \quad h_0 = 60 \text{ m}$$

$$s(t) = -5t^2 + v_0t + 60$$

$$s(t=2.4 \text{ s}) = 0 = -5 \cdot (2.4)^2 + v_0 \cdot 2.4 + 60$$

$$5 \cdot (2.4)^2 - 60 = v_0 \cdot 2.4$$

$$\frac{5 \cdot (2.4)^2 - 60}{2.4} = v_0$$

$$\frac{28.8 - 60}{2.4} = \frac{-31.2}{2.4} = \underline{\underline{-13 \text{ m/s}}}$$

oder: 60m in 2.4s ;

$$\text{Mittlere Geschw. } \bar{v} = \frac{60 \text{ m}}{2.4 \text{ s}} = 25 \text{ m/s}$$

v zu Beginn: v_0

v bei Aufschlag: $v_0 + a \cdot 2.4 \text{ s} = v_0 + 24$

$$\frac{v_0 + v_0 + 24}{2} = 25$$

$$\frac{2v_0 + 24}{2} = v_0 + 12 = 25$$

$$\underline{\underline{v_0 = 13 \text{ m/s}}}$$

$$(2) \quad h = 16.2 \text{ m}, \quad s = 87.3 \text{ m}$$

Freier Fall aus 16.2m Höhe:

$$s = \frac{1}{2} a t^2$$

$$16.2 = 5 t^2$$

$$\frac{16.2}{5} = 3.24 = t^2 \quad \sqrt{\quad}$$

$$\underline{\underline{t = 1.8 \text{ s}}}$$

in 1.8s 87.3m weit:

$$v = \frac{s}{t} = \underline{\underline{48.5 \text{ m/s}}}$$

(3)

a) $v = 1 \text{ m/s};$

$$E_{\text{pot}} = E_{\text{kin}}$$

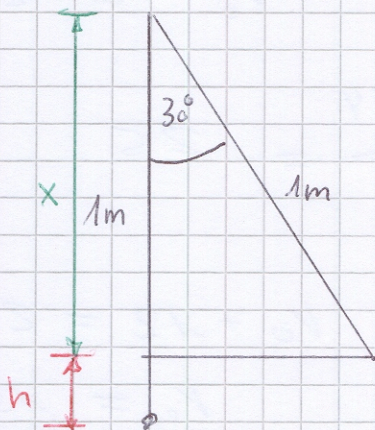
$$mgh = \frac{1}{2} m v^2$$

$$h = \frac{v^2}{2g} = \frac{1^2}{20} = 0.05 \text{ m}$$

$$h = \text{halbe Höhe} \Rightarrow H = \underline{\underline{10 \text{ cm}}}$$

$$v = \sqrt{2gh} = \sqrt{20 \cdot 0.1} = \sqrt{2} = \underline{\underline{1.41 \text{ m/s}}}$$

b)



$$h = 1 \text{ m} - x$$

$$\cos 30^\circ = \frac{x}{1} = x$$

$$x = \frac{\sqrt{3}}{2} \approx 0.866 \text{ m}$$

$$h = 1 - x \approx 0.134 \text{ m} \quad (0.13397)$$

$$v = \sqrt{2gh} = \underline{\underline{4.16479}}$$

$$v = \sqrt{2gh} = \sqrt{2 \cdot 10 \cdot 0.134} = \underline{\underline{1.637 \text{ m/s}}} \approx \underline{\underline{4.162 \text{ m/s}}}$$

$$(4) \quad m_{\text{tot}} = 90 \text{ kg} ; F_{\text{Brems}} = 720 \text{ N}, s = 20.25 \text{ m}$$

$$a) \quad a = \frac{F}{m} = \frac{720 \text{ N}}{90 \text{ kg}} = 8 \text{ m/s}^2$$

$$v = \sqrt{2as} = \sqrt{2 \cdot 8 \cdot 20.25} = \underline{\underline{18 \text{ m/s}}}$$

$$E_{\text{kin}} = E_{\text{pot}} \Rightarrow h = \frac{v^2}{2g} = \underline{\underline{16.2 \text{ m}}}$$

$$b) \quad E = \frac{1}{2}mv^2 = \frac{1}{2} \cdot 90 \cdot 18^2 = \underline{\underline{14.58 \text{ kJ}}}$$

Dauer des Bremsvorgangs:

$$s = \frac{1}{2}at^2$$

$$\sqrt{\frac{2s}{a}} = t = 2.25 \text{ s}$$

$$\text{oder: } \bar{v} = 9 \text{ m/s} = \frac{1}{2}v_{\text{max}}$$

$$s = \bar{v} \cdot t$$

$$t = \frac{s}{\bar{v}} = \frac{20.25}{9} = \underline{\underline{2.25 \text{ s}}}$$

$$\bar{P} = \frac{E}{t} = \frac{14.58 \text{ kJ}}{2.25 \text{ s}} = \underline{\underline{6.48 \text{ kW}}}$$

$$c) \quad v = a \cdot t + v_0 ; a = -8 \text{ m/s}^2, v_0 = 18 \text{ m/s}$$

$$s = -8t + 18 \quad | -18$$

$$-13 = -8t$$

$$t = \frac{13}{8} \text{ s} = \underline{\underline{1.625 \text{ s}}}$$

$$s = \frac{1}{2}at^2 + v_0 t$$

$$= -4 \cdot (1.625)^2 + 18 \cdot 1.625 = \underline{\underline{9.0625 \text{ m}}}$$

$$= \underline{\underline{18.69 \text{ m}}} \quad \underline{\underline{9.063 \text{ m}}}$$

$$\text{oder: } \bar{v} = \frac{18 \text{ m/s} + 5 \text{ m/s}}{2} = 11.5 \text{ m/s}, \bar{v} \cdot t = 18.69 \text{ m}$$

$$\textcircled{5} \text{ a) } S_M = 0.3t^2 + 23t \quad S_G = 0.2t^2 + 17t + 160$$

$$V_M = 0.6t + 23 \quad V_G = 0.4t + 17$$

$$\text{b) } 0.3t^2 + 23t = 0.2t^2 + 17t + 160$$

$$0.1t^2 + 6t - 160 = 0 \quad | \cdot 10$$

$$t^2 + 60t - 1600 = 0$$

$$(t - 20)(t + 80) = 0$$

$$\underline{t_1 = 20s}, \quad t_2 = -80s$$

$$\text{c) } S_M = \frac{1}{2}at^2 + v_0t + s_0$$

$$= 0.3t^2 + 23t \quad | t = 20s$$

$$= 0.3 \cdot 20^2 + 23 \cdot 20$$

$$= 0.3 \cdot 400 + 23 \cdot 20 = 120 + 460$$

$$= \underline{\underline{580m}}$$