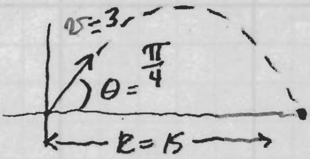
Chapter 4 - 14, 20, 25, 28, 32, 39, 49, 52, 62

14) $\theta_{max} = 45° = \pi/4$



① $(v\cos\theta)t = R$

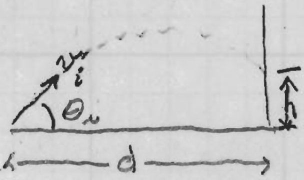
② $(v\sin\theta)t - \frac{1}{2}gt^2 = 0$

} Solve for g

② $v\sin\theta = \frac{1}{2}gt \Rightarrow \frac{2v\sin\theta}{t} = g \Rightarrow \frac{2v^2\sin\theta\cos\theta}{R}$

$$\frac{2(9)\frac{\sqrt{2}}{2}\frac{\sqrt{2}}{2}}{15} = \frac{9}{15} = \boxed{.6 \ m/s^2}$$

20)



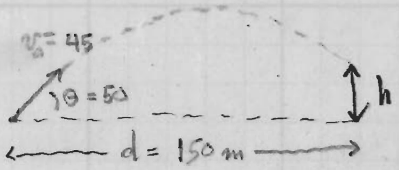
$h = (v_i\sin\theta_i)t - \frac{1}{2}gt^2$

$d = (v_i\cos\theta_i)t$

} Solve for h

$$h = (v_i\sin\theta_i)\frac{d}{v_i\cos\theta_i} - \frac{g}{2}\frac{d^2}{v_i^2\cos^2\theta_i} = \boxed{(\tan\theta_i)d - \frac{gd^2}{2v_i^2\cos^2\theta_i}}$$

25)



time to go d $\Rightarrow$ $\boxed{t = \frac{d}{v_0\cos\theta}}$

h at that time $= (v_0\sin\theta)t - \frac{1}{2}gt^2$

$$= \frac{v_0\sin\theta\, d}{v_0\cos\theta} - \frac{g}{2}\frac{d^2}{v_0^2\cos^2\theta}$$

$$\boxed{h = (\tan\theta)d - \frac{gd^2}{2v_0^2\cos^2\theta}} = \boxed{47.0 \ m}$$

Apple: $\cancel{v^2} = v_{Apple}^2 - 2gh$

$$v_{Apple} = \sqrt{2gh} = \sqrt{2(9.8)(47)} = \boxed{30.4 \ m/s}$$

$$\frac{h}{\bar{v}} = t = \frac{47}{30.4/2} = \boxed{3.1 \ s}$$

28)

$$a = \frac{v^2}{R} = \frac{\left(\frac{2\pi R}{T}\right)^2}{R} = \frac{4\pi^2 R}{T^2}$$

radius of Earth = 6.4×10^6

period of Earth's rotation = 24 hrs

$$= \boxed{.034 \ m/s^2}$$

32) $r = 6400 + 600 = 7000\ km = 7.0\times10^6\ m$

$\frac{v^2}{r} = 8.21 \Rightarrow v = ((8.21)r)^{1/2} =$ $\boxed{7.58\times10^3\ m/s}$

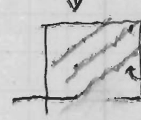
$T = \frac{2\pi r}{v} = \frac{2\pi\ 7\times10^6}{7.58\times10^3} =$ $\boxed{5.8\times10^3 s}$ $= 1.61\ hr$ (1 hour + 36 min)

39) ↓ rain, 50 km/o → car

note the "bad" units

$v_{CAR,EARTH} \equiv \vec{v}_{CE} = \{50, 0\}$

$v_{RAIN,EARTH} = \vec{v}_{RE} = \{0, v_{RE}\}$

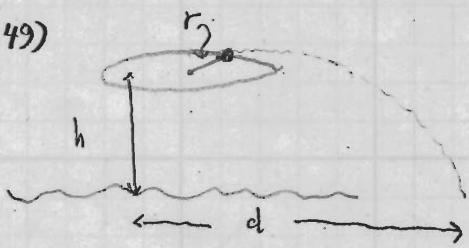


I want $\vec{v}_{RC} = \vec{v}_{RE} + \vec{v}_{EC} = \vec{v}_{RE} - \vec{v}_{CE} = (-50, v_{RE})$

$\tan 60 = \frac{50}{v_{RE}} = v_{RE} = \frac{50}{\tan 60} =$ $\boxed{28.9\ km/hr}$

$v_{RC} = [50^2 + (28.9)^2]^{1/2} =$ $\boxed{57.8\ km/hr \text{ at } 60^\circ \text{ from vertical}}$

49)

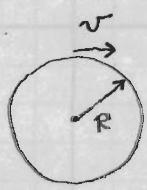


$h = \frac{1}{2}gt^2 \Rightarrow t = \left(\frac{2h}{g}\right)^{1/2}$

$v = \frac{d}{t} = d\left(\frac{g}{2h}\right)^{1/2}$

$a = \frac{v^2}{r} =$ $\boxed{\frac{d^2 g}{2hr}}$ $= \frac{4(9.8)}{2(1.2)(.3)} =$ $\boxed{54.4\ m/s}$

52.)

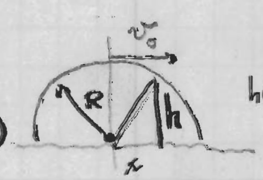


$\frac{v^2}{r} = g/6 \Rightarrow v = \left(\frac{gr}{6}\right)^{1/2} = \left(\frac{9.8\ \ 1.74\times10^6}{6}\right)^{1/2} =$ $\boxed{1.69\times10^3\ m/s}$

$T = \frac{2\pi r}{v} = \frac{2\pi r}{(gr/6)^{1/2}} = \left(\frac{4\pi^2 r^2 6}{gr}\right)^{1/2} = 2\pi\left(\frac{6r}{g}\right)^{1/2}$

$=$ $\boxed{6.5\times10^3 s}$ ⇒ 1 hr 48 min

62)



$h(x) = (R^2 - x^2)^{1/2}$

$x(t) = v_0 t$

$\Rightarrow h(t) = (R^2 - v_0^2 t^2)^{1/2}$ ← height of rock as function of time

$y(t) = R - \frac{1}{2}gt^2$ ← height of ball as a function of time

We insist $y(t) \geq h(t)$ for all $t \Rightarrow$ $\boxed{v_0 \geq (Rg)^{1/2}}$

$R^2 - v_0^2 t^2 \leq R^2 - Rgt^2 + \frac{1}{4}g^2 t^4$

$-v_0^2 \leq -Rg + \frac{1}{4}g^2 t^2$

$\Rightarrow v_0^2 \geq Rg - \frac{1}{4}g^2 t^2$

$\Rightarrow v_0 \geq (Rg)^{1/2}$

$t_{in\ flight}$ comes from $R = \frac{1}{2}gt^2$

$\Rightarrow t = (2R/g)^{1/2}$

So $R + x = v_0 t = (Rg\ 2R/g)^{1/2} = R\sqrt{2}$

$x = R\sqrt{2} - R =$ $\boxed{R(\sqrt{2} - 1)}$