P42 57 - 60 all, 63, 67, 69, 71, 77, 79, 83

(57) (a) falling

$u = 0$
$v = ?$
$a = -9.81\ ms^{-2}$
$s = -15.0\ m$

$v^2 = u^2 + 2as$
$v = \sqrt{2as}$
$= \sqrt{2(-9.81\ ms^{-2})(-15\ m)}$
$v = -17.16\ ms^{-1}$

caught in net

$u = -17.16\ ms^{-1}$
$v = 0$
$a = ?$
$s = -1.0\ m$

$v^2 = u^2 + 2as$
$a = \frac{-u^2}{2s}$
$= \frac{-(-17.16\ ms^{-1})^2}{2(-1.0\ m)}$
$a = -150\ ms^{-2}$

(b) loosen

(58) $v^2 = u^2 + 2as$
$v = 0$ for maximum height

Earth
$a = -g$

$s_E = \frac{-u^2}{2(-g)} = \frac{u^2}{2g}$

Moon
$a = \frac{-g}{6}$

$s_m = \frac{-u^2}{2\left(\frac{-g}{6}\right)} = \frac{6u^2}{2g}$

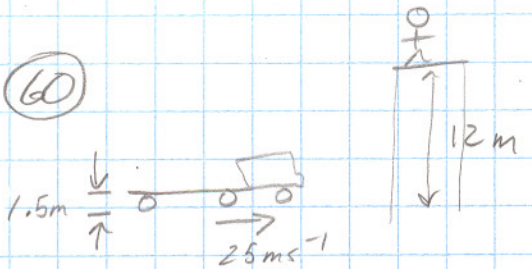
So... $s_m = 6s_E$

∴ The object will go 6 times higher.

(59) $u = 100\ kmh^{-1} = 27.78\ ms^{-1}$
$v = 0$
$a = -30g = -30(9.81\ ms^{-2}) = -294.3\ ms^{-2}$
$s = ?$

$v^2 = u^2 + 2as$
$s = \frac{-u^2}{2a} = \frac{-(27.78\ ms^{-1})^2}{2(-294.3\ ms^{-2})} = 1.31 = 1\ m$

(60)




time for Bond to drop

$u = 0$

$s = -(12 - 1.5) = -10.5\ m$

$a = -9.81\ ms^{-2}$

$t = ?$

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

$t = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2(-10.5m)}{-9.81\ ms^{-2}}}$

$t = 1.46\ s$

distance truck can travel

$v = 25\ ms^{-1}$ (constant)

$t = 1.46\ s$

$v = \frac{s}{t}$

$s = vt = (25\ ms^{-1})(1.46s)$

$= 36.5\ m$

in telephone poles

$\frac{36.5m}{25m} = 1.5$ poles

(probably a little less because you want to hit the truck bed)

(63)

$u = 0$

$v = 25\ ms^{-1}$

$s = 180\ m$

$a = ?$

$v^2 = u^2 + 2as$

$a = \frac{v^2}{2s} = \frac{(25\ ms^{-1})^2}{2(180\ m)} = 1.736\ ms^{-2}$

$u = 25\ ms^{-1}$

$v = ?$

$a = 1.736\ ms^{-2}$

$s = 95\ m$

$v^2 = u^2 + 2as$

$v = \sqrt{u^2 + 2as}$

$= \sqrt{(25\ ms^{-1})^2 + 2(1.736\ ms^{-2})(95m)}$

$v = 31\ ms^{-1}$

(67) Uphill 7.0m from cup

$u = ?$
$a = -3.0\,ms^{-2}$
$s = 6.0m$
$v = 0$

$v^2 = u^2 + 2as$
$u = \sqrt{-2as}$
$= \sqrt{-2(-3.0\,ms^{-2})6.0m}$
$u = 6.0\,ms^{-1}$

$s = 8.0m$

$u = \sqrt{-2as}$
$= \sqrt{-2(-3.0\,ms^{-2})8.0m}$
$u = 6.9\,ms^{-1}$

uphill range: $6.0 - 6.9\,ms^{-1}$
downhill range: $4.9 - 5.7\,ms^{-1}$

$\Delta v = 0.9\,ms^{-1}$
$\Delta v = 0.8\,ms^{-1}$

downhill 7.0m from cup

$u = ?$
$a = -2.0\,ms^{-2}$
$s = 6.0m$
$v = 0$

$u = \sqrt{-2as}$
$= \sqrt{-2(-2.0\,ms^{-2})(6.0m)}$
$u = 4.9\,ms^{-1}$

$s = 8.0m$

$u = \sqrt{-2as}$
$= \sqrt{-2(-2.0\,ms^{-2})(8.0m)}$
$u = 5.7\,ms^{-1}$

(69) 2nd stone

$u = 0$
$v = -12.0\,ms^{-1}$
$a = -9.81\,ms^{-2}$
$s = ?$
$t = ?$

$v^2 = u^2 + 2as$
$s = \frac{v^2}{2a}$
$= \frac{(-12\,ms^{-1})^2}{2(-9.81\,ms^{-2})}$
$s = -7.33m$

$v = u + at$
$t = \frac{v}{a} = \frac{-12\,ms^{-1}}{-9.81\,ms^{-2}}$
$t = 1.22s$

1st stone

$t = 1.22s + 1.50s = 2.72s$
$u = 0$
$a = -9.81\,ms^{-2}$
$s = ?$

$s = ut + \frac{1}{2}at^2$
$= \frac{1}{2}(-9.81\,ms^{-2})(2.72s)^2$
$s = -36.29m$

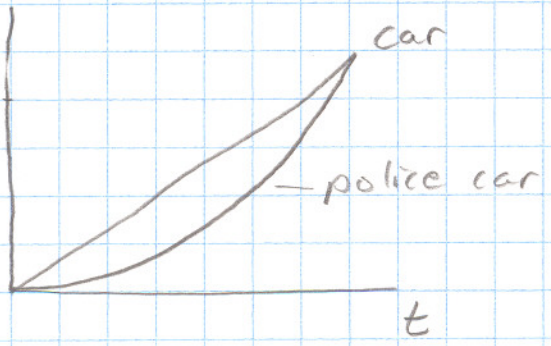
distance between rocks
$-7.33m - -36.29m = 28.96$

**29.0 m**

(71) $u = 18\ km\,h^{-1} = 5\ ms^{-1}$
$v = 75\ km\,h^{-1} = 20.8\ ms^{-1}$
$s = 4.0\ km = 4000\ m$

$$v^2 = u^2 + 2as$$
$$a = \frac{v^2 - u^2}{2s} = \frac{(20.8\ ms^{-1})^2 - (5\ ms^{-1})^2}{2(4000\ m)} = \underline{0.051\ ms^{-2}}$$

(77) (a)




(b) police car
$u = 0$
$s = 750\ m$
$t = ?$
The time must be the same for both cars
so $\underline{t = 23\ s}$

car
$v = 120\ km\,h^{-1} = 33.3\ ms^{-1}$
$s = 750\ m$
$t = ?$
$v = \frac{s}{t}$
$t = \frac{s}{v} = \frac{750\ m}{33.3\ ms^{-1}} = 22.5\ s$

(c) $s = \cancel{ut} + \frac{1}{2}at^2$

$$a = \frac{2s}{t^2} = \frac{2(750\ m)}{(22.5\ s)^2} = 2.96\ ms^{-2} = \underline{3.0\ ms^{-2}}$$

(d) $v^2 = u^2 + 2as$
$v = \sqrt{2as}$
$= \sqrt{2(2.96\ ms^{-2})(750\ m)}$
$v = \underline{67\ ms^{-1}}$

(79) height of each floor = $h$

Stone 1

$u = 11.0\ ms^{-1}$
$a = -9.81\ ms^{-2}$
$s = -12h$
$t = 4.5s$

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

$$-12h = (11.0ms^{-1})(4.5s) + \frac{1}{2}(-9.81ms^{-2})(4.5s)^2$$

$$h = 4.15m$$

Stone 2

$u = ?$
$a = -9.81\ ms^{-2}$
$s = -4h = -4(4.15m) = -16.6m$
$t = 4.5s$

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

$$-16.6m = u(4.5s) + \frac{1}{2}(-9.81ms^{-2})(4.5s)^2$$

$$u = 18\ ms^{-1}$$

(93)

drop
$u = 0$
$a = -9.81\ ms^{-2}$
$t = 1.2s$
$s = ?$

$$s = \cancel{ut} + \frac{1}{2}at^2$$
$$= \frac{1}{2}(-9.81ms^{-2})(1.2s)^2$$
$$s = -7.06m$$

throw
$u = ?$
$a = -9.81\ ms^{-2}$
$s = 7.06m$ (height of cliff)
$v = 0$ (comes to rest in your hand)

$$v^2 = u^2 + 2as$$
$$u = \sqrt{-2as}$$
$$= \sqrt{-2(-9.81ms^{-2})(7.06m)}$$
$$u = 12\ ms^{-1}$$