第六章：平面运动（2003年-2017年）.

① $F = \frac{GMm}{R^2}$ $\quad \rho = \frac{M}{V}$

$mg = \frac{GMm}{R^2}$ $\quad \rho = \frac{gR^2}{G} \div \frac{4\pi R^3}{3}$

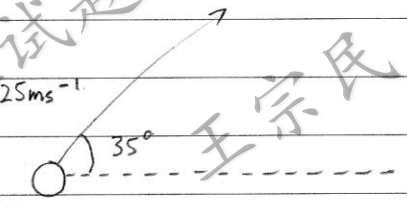
$M = \frac{gR^2}{G}$ $\quad \rho = \frac{gR^2}{G} \times \frac{3}{4\pi R^3}$

$= \frac{3g}{4\pi GR}$ #

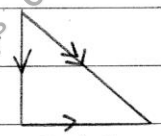
B

② C

③



竖直方向	水平方向
$u = 25\sin 35$	$u = 25\cos 35$
$a = -9.8$	$= 20.48 ms^{-1}$
$t = 2$	
$v = ?$	



$V = u + at$

$= 14.34 - 9.8(2)$

$= -5.26 ms^{-1}$

$V = \sqrt{5.26^2 + 20.48^2}$

$= 21.14 ms^{-1}$ #

B

④ $R = \frac{mv^2}{r} + mg\cos\theta$

$500 = \frac{91.84 \times 50^2}{r} + 900\cos 180$

$r = 164m$ #

C

⑤ $g = \frac{GM}{r^2}$ $\quad M_月 = \frac{g_月 r_月^2}{G}$

$M = \frac{gr^2}{G}$ $\quad M_地 = \frac{g_地 r_地^2}{G}$

$= \frac{g_月}{g_地} \times \left(\frac{r_月}{r_地}\right)^2$

$= \frac{1}{6} \times \left(\frac{5}{18}\right)^2$

$= \frac{25}{1944}$ #

D.

⑥ $F = \frac{GMm}{r^2}$

$G = \frac{Fr^2}{Mm}$

单位：Nm^2kg^{-2}.

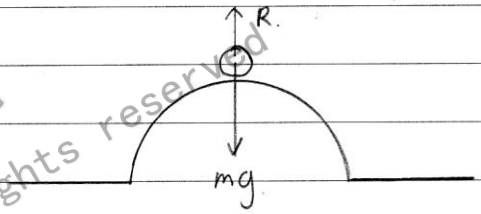
$kgms^{-2}m^2kg^{-2}$.

$m^3kg^{-1}s^{-2}$. #

C

⑦ D.

⑧



$mg - R = \frac{mv^2}{r}$

$R = mg - \frac{mv^2}{r}$ #

C

⑨

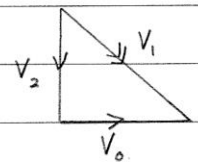
大轮	小轮
$a = \frac{v^2}{r}$	$a = \frac{v^2}{r}$
$12 = \frac{v^2}{2r}$	$= \frac{24r}{r}$
$v^2 = 24r$	$= 24 ms^{-2}$ #

（大轮和小轮转动的速度必定是相同）

C

⑩ B.

⑪ 竖直方向



$u = 0$

$a = +g$

$V = \sqrt{V_1^2 - V_0^2}$

$t = ?$

$V_1 = \sqrt{V_2^2 + V_0^2}$

$V_1^2 = V_2^2 + V_0^2$

$V_2^2 = V_1^2 - V_0^2$

$V_2 = \sqrt{V_1^2 - V_0^2}$

$v = u + at$

$\sqrt{V_1^2 - V_0^2} = 0 + gt$

$t = \frac{\sqrt{V_1^2 - V_0^2}}{g}$ #

D.

(12) $u = 0$ $\quad s = ut + \frac{1}{2}at^2$

$s = h$ $\quad h = 0 + \frac{1}{2} \times \frac{GM}{R^2} \times t^2$

$a = \frac{GM}{R^2}$ $\quad M = \frac{2hR^2}{Gt^2}$ #

$t = t$

D

作答题

(1) (a) (i) (ii) $\quad s = \frac{1}{2}(u+v)t$

$u = ?$ $\quad 45 = \frac{1}{2}(u+0)3$

$a = ?$ $\quad u = 30\,ms^{-1}$ #

$v = 0$

$t = 3$

$s = 45$ $\quad v = u + at$

$0 = 30 + a(3)$

$a = -10\,ms^{-2}$ #

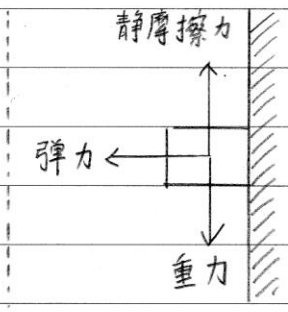
(iii) $u = 30$ $\quad v = u + at$

$v = ?$ $\quad = 30 - 10(4)$

$a = -10$ $\quad = -10\,ms^{-1}$ #

$t = 4$

(b) (i)



(ii) ① $\quad f_k = W$

$= mg$

$= 0.5 \times 10$

$= 5\,N$ #

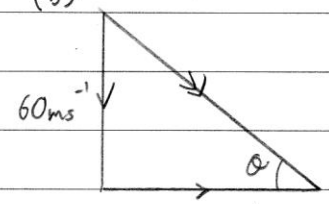
② $\quad R = mr\omega^2$

$= 0.5 \times 0.3 \times 20^2$

$= 60N$ #

(2) (a) $40\,ms^{-1}$ #

(b)



$v = \sqrt{60^2 + 40^2}$

$= 72.11\,ms^{-1}$ #

$\tan\theta = \frac{60}{40}$

$\theta = 56.31°$ #

(c) 圖 1 $\quad a_x = 0\,ms^{-2}$

圖 2 $\quad a_y = \frac{60-0}{6-0}$

$= 10\,ms^{-2}$

$a = \sqrt{a_x^2 + a_y^2}$ $\quad F = ma$

$= \sqrt{0^2 + 10^2}$ $\quad = 5 \times 10$

$= 10\,ms^{-2}$ $\quad = 50N$ #

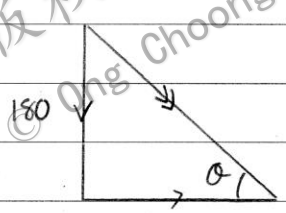
(d) 圖 1 $\quad S_x = 40 \times 6 = 240m$

圖 2 $\quad S_y = \frac{1}{2} \times 6 \times 60 = 180m$

$s = \sqrt{S_x^2 + S_y^2}$

$= \sqrt{240^2 + 180^2}$

$= 300\,m$ #



$\tan\theta = \frac{180}{240}$

$\theta = 36.87°$

(e) 图 1 $x = 40t$

$t = \frac{x}{40}$ ①

图 2 $y = \frac{1}{2} \times 10t \times t$

$y = 5t^2$ ②

① 带入 ②

$y = 5\left(\frac{x}{40}\right)^2$

$y = \frac{x^2}{320}$ #

3 (a) 任何两个物体间都有相互吸引的作用，这种引力的大小跟它们的质量的乘积成正比，跟它们的距离的平方成反比。

(b) $\frac{g_n}{g_0} = \frac{\frac{GM}{(2r)^2}}{\frac{GM}{r^2}}$

$= \frac{1}{4}$ #

(c) $a = \frac{GM}{r^2}$

$rw^2 = \frac{GM}{r^2}$

$w = \sqrt{\frac{GM}{r^3}}$

$T = \frac{2\pi}{w}$

$= 2\pi\sqrt{\frac{r^3}{GM}}$

$= 2\pi\sqrt{\frac{(6.4\times10^6)^3}{G\times6\times10^{24}}}$

$= 5084\,s$ #

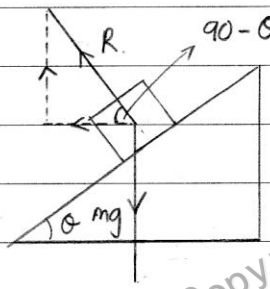
(d) $v = rw$

$= r\sqrt{\frac{GM}{r^3}}$

$= 6.4\times10^6\sqrt{\frac{G\times6\times10^{24}}{(6.4\times10^6)^3}}$

$= 7910\,ms^{-1} / 7.91\,kms^{-1}$ #

④ (a)



$F = \frac{mv^2}{r}$

$= \frac{m}{100} \times \left(\frac{90\times1000}{3600}\right)^2$

$= 6.25\,m$

$R\sin(90-\theta) = mg$

$R\sin(90-\theta) = 9.8m$ ①

$R\cos(90-\theta) = 6.25m$ ②

① ÷ ②

$\tan(90-\theta) = 1.568$

$\theta = 32.53°$ #

(b) (i) $T = \frac{2\pi}{w}$

$24\times3600 = \frac{2\pi}{w}$

$w = 7.27\times10^{-5}$

$(R+r)w^2 = \frac{GM}{(R+r)^2}$

$(R+r)^3 = \frac{GM}{w^2}$

$r = \sqrt[3]{\frac{GM}{w^2}} - R$

$= \sqrt{\frac{G\times6\times10^{24}}{(7.27\times10^{-5})^2}} - 6.38\times10^6$

$= 3.59\times10^7\,m$ #

(ii) $V = (R+r)w$

$= (6.38\times10^6 + 3.59\times10^7)\times7.27\times10$

$= 3.08\times10^3\,ms^{-1}$ #

⑤ (a) $F = \frac{GMm}{r^2}$

其中 F = 两个物体之间的引力

G = 万有引力常数

M = 物体 1 的质量

m = 物体 2 的质量

r = 两个物体之间的距离

(b) $T = \frac{2\pi}{w}$ $rw^2 = \frac{GM}{r^2}$

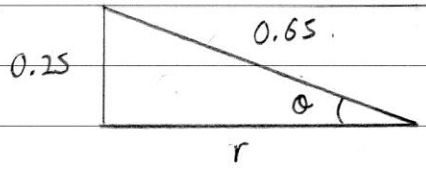
$w = \frac{2\pi}{T}$ $M = \frac{r^3w^2}{G}$

$= \frac{r^34\pi^2}{GT^2}$

$= \frac{(1.5\times10^{11})^3\times4\pi^2}{G\times(365\times24\times3600)^2}$

$= 2\times10^{30}\,kg$ #

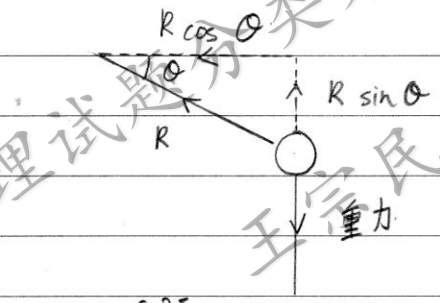
⑥ (i)



$0.65 = \sqrt{0.25^2 + r^2}$

$r = 0.6\ m$ #

(ii).



$\tan\theta = \frac{0.25}{0.6}$

$\theta = 22.62$

$R \sin\theta = mg$

$R \sin 22.62 = 4.8\ m$ ①

$R \cos\theta = mr\omega^2$

$R \cos 22.62 = 0.6 m\omega^2$ ②

① ÷ ②

$\tan 22.62 = \frac{4g}{3\omega^2}$

$\omega = 6.26\ rad\,s^{-1}$ #

⑦ (a) (i) $u = 0$ $\quad s = ut + \frac{1}{2}at^2$

$s = -1200$ $\quad -1200 = 0 + \frac{1}{2} \times -10t^2$

$t = ?$ $\quad t = 15.49\ s$ #

$a = -10$

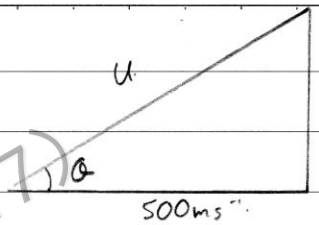
(ii). 竖直方向

$u = ?$ $\quad v^2 = u^2 + 2as$

$s = 1200$ $\quad 0^2 = u^2 + 2(-10)(1200)$

$a = -10$ $\quad u = 154.92\ ms^{-1}$

$v = 0$



$1800\ kmh^{-1} = \frac{1800 \times 1000}{60 \times 60} = 500\ ms^{-1}$

$u = \sqrt{500^2 + 154.92^2}$ $\quad \tan\theta = \frac{154.92}{500}$

$= 523.45\ ms^{-1}$ # $\quad \theta = 17.22°$ #

(b). (i) $V = \frac{s}{t}$

$s = Vt$

$= 3 \times 10^8 \times 500$

$= 1.5 \times 10^{11}\ m$ #

(ii). $T = \frac{2\pi}{\omega}$ $\quad g = \frac{GM}{r^2}$

$\omega = \frac{2\pi}{T}$ $\quad r\omega^2 = \frac{GM}{r^2}$

$M = \frac{r^3\omega^2}{G}$

$= \frac{(1.5\times10^{11})^3 \times 4\pi^2}{G \times (365\times24\times3600)^2}$

$= 2 \times 10^{30}\ kg$ #