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Solutions by JJG

Ch 4: Q 9, 23; Ex 7, 11 // Ch 5: Q: 3, 9, 13; Ex 3, 11, 19.

4: Q9 (a) Speeding up & moving in a straight line, because $\vec{a}$ is $\parallel$ to $\vec{v}$

(b) Speeding up & turning left, because component of $\vec{a} \perp \vec{v}$ is directed upward, and generates $\vec{v}$ component to the left of forward.

4: Q23 The same time, since the vertical and horizontal motions are separate and independent, although simultaneous.
[But if the rock were thrown so fast horizontally that the curvature of the moon's surface became important, see pages 79–81]

4: Ex 7. $a_c = v^2/r = \frac{(20)^2}{50} = 8\ m/sec^2$; $F = ma = (120)(8) = 960N$.

4: Ex 11. Neglecting Air resistance, $v_{HORIZ} = 22 m/sec$ at $t = 1$ sec

& $v_{VERT} = v_0 - gt = 14 - 10 \cdot 1 = 4 m/sec$ at $t = 1$ sec. downward.
because the acceleration is vertically downward.

5 Q3: The force that Earth exerts on moon is SAME (in magnitude) as force " MOON " " EARTH, by (NIII).

5: Q9: $F_G = \frac{GMm}{r^2}$ on Earth $F_G = 800N = \frac{GM_E m_{SP}}{R_E^2}$

on planet MSU3, $F_G = \frac{GM_E \cdot m_{SP}}{\ }= \frac{800}{4} = 200N = F_G^{MSU3}$

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5: Q 13 $\quad a = F_G/m_{App} = \dfrac{G M_E m_{App}}{m_{App} \cdot (R_E)^2} = g = \dfrac{10\ m}{sec^2}$ ON EARTH

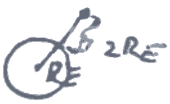
in our universe, where $G = 6.67 \times 10^{-11} \dfrac{N m^2}{(kg)^2}$.

In the parallel universe with M_E and m_{App} and R_E the same, the acceleration $a_p = g_p = 20\ m/sec^2 = \dfrac{G_p \cdot M_E m_{App}}{m_{App} \cdot (R_E)^2}$

Then $\dfrac{g_p}{g} = \dfrac{\dfrac{G_p\ M_E m_{App}}{m_{App}\ (R_E)^2}}{\dfrac{G\ M_E m_{App}}{m_{App}\ (R_E)^2}} = \dfrac{G_p}{G} = \dfrac{20}{10} = 2$

Thus, in the parallel universe, the Gravitational Constant has a value twice that of G in our universe: $G_p = \boxed{2 \times} G$
$= 13.34 \times 10^{-11} \dfrac{N m^2}{(kg)^2}$

5 EX 3 : $\quad \dfrac{F_G}{m} =$ acceln due to gravity $= \dfrac{G M_E m}{m (3R_E)^2} = \dfrac{1}{9} \dfrac{G M_E}{(R_E)^2} = \dfrac{g}{9}$



since distance = $3R_E$ to earth's center.

$\boxed{= 1.1 \dfrac{m}{sec^2}}$

By ____
On __/__/__

5: Ex 11 $F = \frac{G M_E m}{r^2} = 800N$ when $m = 320$ kg.

where $\frac{G M_E}{(R_E)^2} = g = 10 \, m/sec^2 = 10 \frac{N}{kg}$ & $R_E = 6.4 \times 10^6$ m.

$$F = 800N = \frac{G M_E m}{(R_E)^2 (r/R_E)^2} = \frac{(g)\, 320N}{(r/R_E)^2}$$

$(r/R_E)^2 = \frac{10 \cdot 320}{800} = 4.0 \Rightarrow r = \sqrt{4}\, R_E$ = distance = $2R_E$ = 12.8×10^6 m

and ALTITUDE $= r - R_E = 1.0\, R_E = 6.4 \times 10^6$ m.

[Using $R_E = 6.4 \times 10^6$ m. For the Radius of EARTH from inside back cover.]

5: Ex 19 If Orbit has $r = 6.6 R_E$ & $T = 24$ hours, then

satellite travels $2\pi r = 2\pi (6.6) \times 6.4 \times 10^6$ m $= \boxed{2.65 \times 10^8 \, m/day}$

& its orbital velocity is $= \frac{2.65 \times 10^8 m}{day} \times \frac{1 day}{24 hrs} \times \frac{1 hr}{60 min} \times \frac{1 min}{60 sec}$

$$\boxed{= 3.07 \times 10^3 \, m/sec}$$

....end of HW #3 solutions