Q. If the mass of the sun were ten times smaller and gravitational constant G were ten times larger in magnitude. Then,

(a) walking on ground would become more difficult

(b) the acceleration due to gravity on the earth will not change

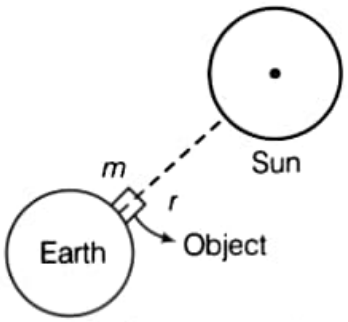
(c) raindrops will fall much faster

(d) airplanes will have to travel much faster

Ans. ***(a, c, d)***

Given, $G' = 10G$

Consider the adjacent diagram.



Force on the object due to the earth $= \frac{G'M_e m}{R^2} = \frac{10GM_e m}{R^2}$ [$\because G' = 10G$ given]

$= 10\left(\frac{GM_e m}{R^2}\right)$

$= (10g)\, m = 10\, mg$ $\left[\because g = \frac{GM_e}{R^2}\right]$ ...(i)

Force on the object due to the sun $F = \frac{GM_s' m}{r^2}$

$= \frac{G(M_s)m}{10r^2}$ $\left[\because M_s' = \frac{M_s}{10} \text{ (given)}\right]$

As $r >> R$ (radius of the earth) $\Rightarrow$ F will be very small.

So, the effect of the sun will be neglected.

Now, as $g' = 10\, g$

Hence, weight of person $= mg' = 10\, mg$ [from Eq (i)]

i.e., gravity pull on the person will increase Due to it, walking on ground would become more difficult

Critical velocity, v_c is proportional to g *i.e.*,

$v_c \propto g$

As, $g' > g$

$\Rightarrow$ $v_c' > v_c$

Hence, rain drops will fall much faster

To overcome the increased gravitational force of the earth, the aeroplanes will have to travel much faster.