Exercise 13F

Q. 1. $T = 2\pi\sqrt{\frac{l}{g}}$

$= 2\pi\sqrt{\frac{0.5}{9.8}}$

$= 1.419$ s

Q. 2. $T = 2\pi\sqrt{\frac{l}{g}}$

$\Rightarrow \frac{l}{g} = \frac{T^2}{4\pi^2}$

$\Rightarrow l = \frac{gT^2}{4\pi^2}$

$= \frac{9.8\ (3)^2}{4\pi^2}$

$\Rightarrow l = 2.234$ m

Q. 3. $T = 2\pi\sqrt{\frac{l}{g}}$

$= 2\pi\sqrt{\frac{4}{9.8}}$

$\Rightarrow T = 4.014$ s

Q. 4. $T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow l = \frac{gT^2}{4\pi^2}$

$\Rightarrow l = \frac{9.8(5.5)^2}{4\pi^2} \Rightarrow l = 7.51$ m $= 751$ cm

Q. 5. $T_1 : T_2 = 2 : 1$

$\Rightarrow 2\pi\sqrt{\frac{l_1}{g}} : 2\pi\sqrt{\frac{l_2}{g}} = 2 : 1$

$\Rightarrow \sqrt{l_1} : \sqrt{l_2} = 2 : 1$

$\Rightarrow l_1 : l_2 = 4 : 1$

Q. 6. $l_1 : l_2 = 4 : 9$

$\Rightarrow \sqrt{l_1} : \sqrt{l_2} = 2 : 3$

$\Rightarrow 2\pi\sqrt{\frac{l_1}{g}} : 2\pi\sqrt{\frac{l_2}{g}} = 2 : 3$

$\Rightarrow T_1 : T_2 = 2 : 3$

Q. 7. Let g' be the acceleration due to gravity at the satellite.

$g' < g$ (by Newton's Law) $\Rightarrow \frac{l}{g'} > \frac{l}{g}$

$\Rightarrow 2\pi\sqrt{\frac{l}{g'}} > 2\pi\sqrt{\frac{l}{g}}$

$\Rightarrow$ its period of oscilliation is longer than normal

$\therefore$ it will go slow.

Q. 8. (i) Number of oscillations

$= 24 \times 60 \times 60 = 86{,}400$

(ii) The old periodic time $= 1$

$\therefore 2\pi\sqrt{\frac{l}{g}} = 1$

The new periodic time.

$T = 2\pi\sqrt{\frac{l(1.02)}{g}}$

$= \sqrt{1.02}\left(2\pi\sqrt{\frac{l}{g}}\right)$

$= \sqrt{1.02(1)}$

$= 1.01$ s

It will now perform $\frac{86{,}400}{1.01}$ oscillations in a day, i.e. 85,545 oscillations in a day

It performs $(86{,}400 - 85{,}545) = 855$ fewer.

Q. 9. Let T = the original time $= \frac{60}{30} = 2$ s

Let T' = the new time $= \frac{60}{31}$ s

$T' : T = \frac{60}{31} : 2$

$= 60 : 62$

$= 30 : 31$

$\therefore 2\pi\sqrt{\frac{l'}{g}} : 2\pi\sqrt{\frac{l}{g}} = 30 : 31$

$= l' : l = 30 : 31$

$\Rightarrow l' : l = 900 : 961$

$\Rightarrow \frac{l'}{l} = \frac{900}{961}$

$\Rightarrow l' = \frac{900}{961} l = 0.9365l$

$\therefore$ the % reduction

$= 100 - 93.65 = 6.35\%$

Q. 10. Let l', T' be the new length and periodic time respectively.

$l' : l = 2 : 1 \ \therefore T' : T = 2\pi\sqrt{\frac{l'}{g}} : 2\pi\sqrt{\frac{l}{g}}$

$= \sqrt{2} : \sqrt{1} = 1.414 : 1$

$\therefore T' = 1.414\ T$

There has been an increase of 41% in its periodic time.