3 **(a)** Two identical cars are moving around a horizontal track. One car follows path X and the other follows path Y, as shown in Fig. 3.1.

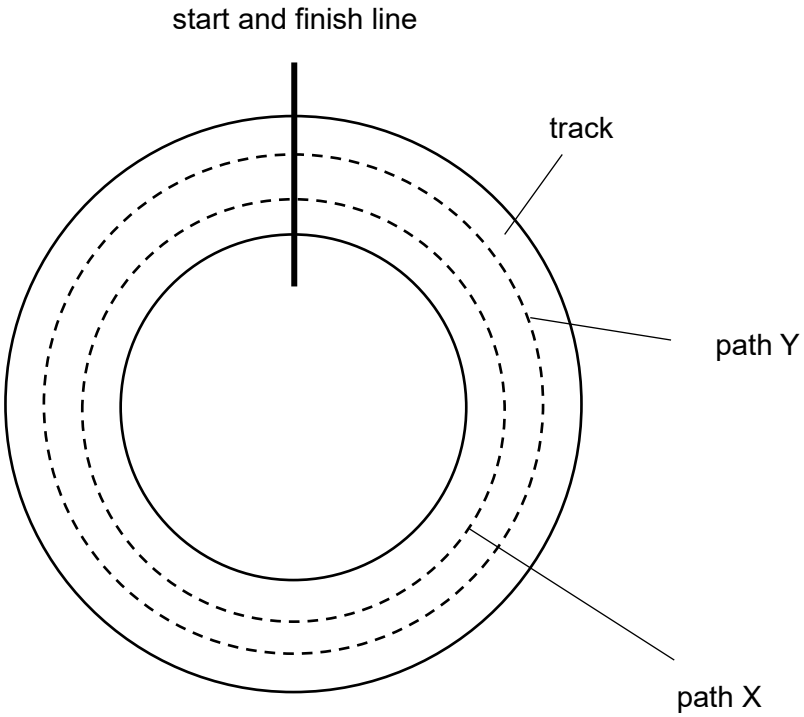

Fig. 3.1

The maximum lateral friction force that the cars can experience without sliding is the same for both cars. Each car is travelling at its maximum speed at which it can move without sliding.

State and explain whether the magnitude of the acceleration and maximum speed of the car on path Y is less than, greater than or same as the car on path X.

acceleration

……

……

……

maximum speed

……

……

……[4]

(b) Jupiter has close to eighty moons, of which eight of them are in approximately circular orbits. Jupiter has a mass M_J, radius R_J and a Jupiter-day is approximately 0.417 Earth-days.

The orbital radii and periods of two of the moons of Jupiter are tabulated in Table 3.1. The orbital radii and the orbital periods of these moons are expressed in units of R_J and Earth-days respectively.

Table 3.1

name of Moon	orbital radius / R_J	orbital period / Earth-days
Amalthea	2.62	.....
Thebe	3.18	0.676

(i) Show that the period T of a circular orbit around Jupiter, expressed in terms of the radius of the orbit R is given by

$$T = \sqrt{\frac{4\pi^2 R^3}{GM_J}} .$$

[2]

(ii) Using the data provided in Table 3.1, determine the orbital period for Amalthea.

orbital period = ……..Earth-days [2]

(iii) A *stationary orbit* refers to a circular orbit around a planet in which a moon would appear stationary to an observer on the planet's surface.

Using the data provided in Table 3.1, explain whether it is possible for the moon Thebe to be in a stationary orbit around Jupiter.

…….....

…….....

…….[2]

[Total: 10]