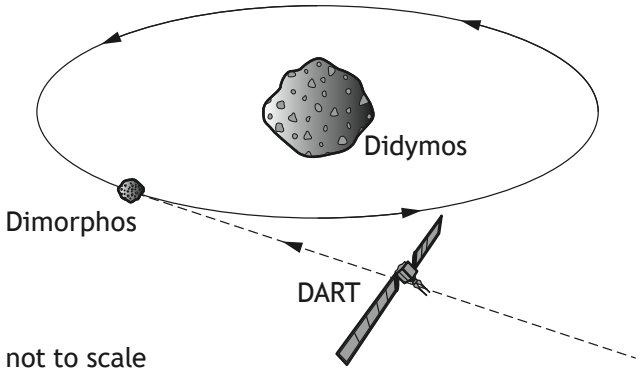
4. On 26 September 2022, Double Asteroid Redirection Test (DART) collided with Dimorphos, a small asteroid that is in orbit around the larger asteroid Didymos.

The aim of the mission was to test a defence system that could be used to redirect an asteroid that is on a collision course with Earth.

When DART collided with Dimorphos, the kinetic energy of DART was transferred to Dimorphos. This caused Dimorphos to change its path.



(a) The mass of Didymos is taken to be 5.3×10^{11} kg.

The mass of the Earth is 6.0×10^{24} kg.

(i) Compare the mass of the Earth with the mass of Didymos in terms of orders of magnitude. **2**

Space for working and answer

4. (a) (continued)

(ii) When DART collided with Dimorphos, the distance between Earth and Didymos was 1.1×10^{10} m.

Determine the gravitational force between Earth and Didymos. **3**

Space for working and answer

(b) DART had a mass of 570 kg and was travelling at 6.6 km s^{-1} when it collided head-on with Dimorphos.

(i) Calculate the maximum kinetic energy transferred from DART to Dimorphos during the collision. **3**

Space for working and answer

[Turn over

4. (b) (continued)

(ii) Complete the sketch graph of force F against time t for the force exerted on Dimorphos by DART during the collision.

Numerical values are not required on either axis. **1**

(An additional diagram, if required, can be found on *page 53*.)