For Examiner's Use

4 **(a)** State *Newton's Law of Gravitation*.

……..……..……..……

……..……..……..……

……..……..……..……

……..…… [2]

(b) A satellite of mass m orbits planet Mars of mass M in a circular path of radius r.

(i) Show that the kinetic energy of the satellite E_K is given by

$$E_K = \frac{GMm}{2r}.$$

[2]

(ii) Hence, show that the total energy of the satellite E_T is given by

$$E_T = -\frac{GMm}{2r}.$$

[1]

[Turn over

For Examiner's Use

(c) It was discovered that for every revolution of the satellite around Mars, Mars has rotated about its axis three times.

Data are given for the satellite and Mars in Table 4.1.

Table 4.1

duration of one day on Mars	24.6 hours
mass of Mars, M	6.39×10^{23} kg
mass of satellite, m	470 kg

(i) Determine the radius r of the circular orbit.

r = ……..…… m [3]

(ii) Determine the work done in bringing the satellite to an orbit with radius twice that of the original orbit.

work done = ……..…… MJ [2]

For Examiner's Use

(d) The satellite moves through a medium where a resistive force acts on it.

State and explain the effect on the speed of the satellite during its orbit.

……

……

……

…… [2]

[Total: 12]

[Turn over