## Section A

Answer **all** the questions in the spaces provided.

**1** A satellite of mass $m_S$ is in a circular orbit of radius $x$ about the Earth.

The Earth may be considered to be an isolated uniform sphere with its mass $M$ concentrated at its centre.

**(a) (i)** Show that the kinetic energy $E_K$ of the satellite is given by the expression

$$E_K = \frac{GMm_S}{2x}$$

where $G$ is the gravitational constant. Explain your working.

[3]

**(ii)** State an expression, in terms of $G$, $M$, $m_S$ and $x$, for the potential energy $E_P$ of the satellite.

.....[1]

**(iii)** Using answers from **(i)** and **(ii)**, derive an expression for the total energy $E_T$ of the satellite.

$E_T$ = .....[2]

**(b)** Small resistive forces acting on the satellite cause the radius of its circular orbit to change.

Use your answers in **(a)** to state, for the satellite, whether each of the following quantities increases, decreases or remains constant.

**(i)** total energy

.....[1]

**(ii)** radius of orbit

.....[1]

**(iii)** potential energy

.....[1]

**(iv)** kinetic energy

.....[1]