

3 (a) State what is meant by a gravitational field.

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..... [2]

(b) A communications satellite of mass 5000 kg is placed into an equatorial orbit of radius r . The satellite has an angular velocity equal to the angular velocity of the Earth's rotation about its axis. As a result, the satellite remains above the same point on the Earth's surface throughout its orbit.

(i) Determine the angular velocity ω_E of the Earth's rotation about its axis.

$$\omega_E = \dots\dots\dots \text{rad s}^{-1} \quad [2]$$

(ii) Assume that the mass of Earth is 6.0×10^{24} kg and the radius of Earth is 6400 km. Calculate the radius r of the satellite's orbit.

$$r = \dots\dots\dots \text{m} \quad [3]$$

[Turn over]

(iii) When the satellite was moved from a position on the surface of the Earth's equator to the required orbit, calculate

1 the change in potential energy ΔE_P of the satellite

$\Delta E_P = \dots\dots\dots$ J [2]

2 the change in kinetic energy ΔE_K of the satellite.

$\Delta E_K = \dots\dots\dots$ J [2]