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6. A particle P moves in a vertical circle, with centre O and radius r, on the smooth inner surface of a fixed hollow spherical shell. The point A lies on the inner surface of the shell and the line OA is at 30° below the horizontal. Initially P is projected downwards from A with speed u in a direction perpendicular to OA. The particle first loses contact with the shell at the point B where the line OB is at 30° above the horizontal.

(a) Show that the speed of P at B is $\sqrt{\frac{rg}{2}}$

(4)

(b) Hence find u in terms of r and g.

(4)

After P has lost contact with the shell, P moves freely under gravity.

The lowest point of the inner surface of the shell is C.

(c) Find the greatest height reached by P above the level of C.

(5)

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