

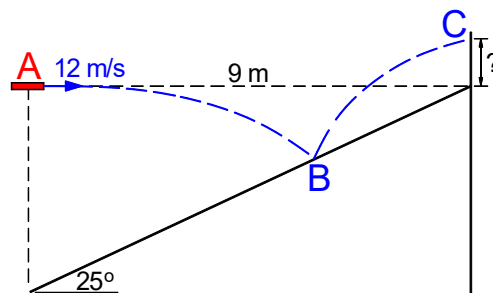
**Submission deadline: Friday 27 March 2026 (2 pm) – Teaching Week 8**

Coursework should be submitted via Blackboard in one PDF file. It may be word-processed or handwritten and scanned. **It must be your own individual work; you should not confer with others or use essay sites or AI tools.** No marks will be given if working is not shown or a scan is illegible. Marks will be deducted for multiple or non-PDF files, unnecessary padding, untidiness, units missing in final answers.

**Question 1 (25 marks)**

A ball is projected horizontally from point A at  $12 \text{ m s}^{-1}$  and bounces once on a plane sloping upward at  $25^\circ$  to the horizontal before hitting a vertical wall a horizontal distance 9 m from the point of projection. The coefficient of restitution between ball and plane is 0.75 and the geometric configuration of plane, wall and release point are as shown in the figure. Find:

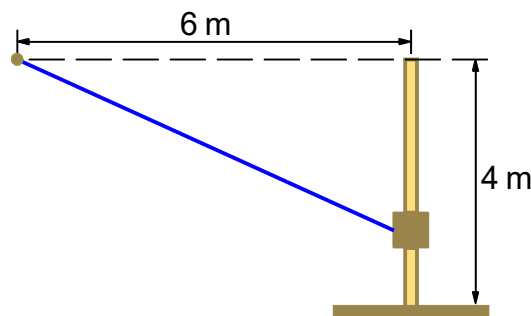
- the along-plane distance of the bounce (point B) from the wall;
- the components of velocity parallel and perpendicular to the plane just before bouncing;
- the components of velocity parallel and perpendicular to the plane just after bouncing;
- the vertical height above the end of the sloping plane when the ball hits the wall at point C.

**Question 2 (25 marks)**

A small collar of mass 3 kg, initially at rest, slides down a vertical pole of height 4 m. The motion is restrained by an elastic string of unstretched length 6 m and stiffness  $k = 90 \text{ N m}^{-1}$ , tethered a distance 6 m from the pole at the same height as the collar is released; (see figure).

Find the speed of the collar when it reaches the bottom of the pole if

- the pole is smooth;
- the coefficient of friction between pole and collar is 0.3.



Note in (b) that the friction force is *not* constant.