5. A particle P of mass m is attached to one end of a light elastic **spring** of natural length a and modulus of elasticity λ
The other end of the spring is attached to a fixed point A on a ceiling.

The points B, C and D are such that

- B lies vertically below A and $AB = \frac{1}{2}a$
- C lies vertically below A and $AC = a$
- D lies vertically below A and $AD = 3a$

The particle P is pulled vertically downwards until it is at D and released from rest.

Given that P comes to instantaneous rest at B,

(a) show that $\lambda = \frac{4}{3}mg$

(4)

(b) Find, in terms of a and g, the speed of P at the instant it reaches C.

(4)

The maximum speed of P occurs when P is at the point E.

(c) Show that $AE = \frac{7}{4}a$

(3)

(d) Show that P moves with simple harmonic motion about E.

(3)

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Question 5 continued

(Total for Question 5 is 14 marks)