Y	Q	Simple Harmonic Motion
2024	5	A particle is moving with simple harmonic motion. The maximum acceleration of the particle is 20 $m\,s^{-2}$ and its maximum speed is 10 $m\,s^{-1}$. Calculate the speed of the particle when it is 1 metre from the centre of the oscillation. **4**
2023	6	A vertical spring has one end fixed and the other end attached to a particle. The particle is pulled vertically downwards a small distance and released. The ensuing motion is simple harmonic with period $\frac{\pi}{8}$ seconds. As the particle passes through the equilibrium position it has a speed of 2 $m\,s^{-1}$. (a) Calculate the amplitude of the motion. **2** (b) Calculate the maximum acceleration of the particle. **1**
2023	19	A particle of mass, m kg, is suspended in equilibrium from a point A on the ceiling of a room by a light spring of natural length l metres and modulus of elasticity $2mg$ newtons. (a) Show that the extension of the spring is $\frac{l}{2}$ metres. **2** A second identical spring is attached to the particle and secured to a point B on the floor of the room. B is vertically below A and the distance AB is $3l$ metres. (b) Given that both springs remain in tension when the particle is again in equilibrium, find an expression in terms of l for the extension of the original spring. **4**
2022	4	A particle moves with simple harmonic motion about a point O. The particle starts from its extreme position and first reaches a maximum speed of 6 $m\,s^{-1}$ after 4 seconds. (a) State the period of the motion. **1** (b) Hence, or otherwise, calculate the amplitude of the motion. **2**
2019	4	A particle is moving with simple harmonic motion. It achieves a maximum speed of 15 $m\,s^{-1}$ and a maximum acceleration of magnitude 60 $m\,s^{-2}$. Find its velocity 2 seconds after passing through the centre of the oscillation and interpret your answer. **5**
2018	7	A particle is projected from a point A at time $t = 0$ and performs simple harmonic motion with A as the centre of oscillation. The amplitude of the motion is 6 metres and period is 10 seconds. (a) Calculate the first two times when the particle will be 4 metres from A. **4** (b) Calculate the speed of the particle at the second of these times and comment on its direction. **2**

2018	14	A bungee jumper of mass 70 kg stands on a bridge 40 metres above a river. The natural length of the bungee cord is 10 metres and it has a modulus of elasticity of 1000 newtons. If the bungee jumper falls vertically from rest, calculate their height above the water when the cord is fully extended. **5** *other methods are available!
2017	12	A body of mass 750 grams is attached to a light elastic string of natural length 50 cm and modulus of elasticity 150 N. The mass hangs vertically with one end of the string attached to the ceiling. (a) Find the extension in the string when the body hangs in equilibrium. **2** The body is released from a position 2 cm below the equilibrium position. (b) (i) Show that the body moves with simple harmonic motion modelled by $\ddot{x} = -400x$ where x metres is the displacement from the equilibrium position. **3** (ii) Find the speed of the body when it is 0·5 cm above the point of release. **2** (c) On another occasion the body is pulled down 3 cm below the equilibrium position. Explain why, in this case, the subsequent motion is not simple harmonic. **1**
2016	5	The tip of a saw oscillates with simple harmonic motion. • When the tip is 5 mm from its centre of motion it has a velocity of 2 m s^{-1}. • When it is 7 mm from the centre it has a velocity of 1 m s^{-1}. Calculate the amplitude of the motion and find the number of oscillations in one second. **5**
2016 Spec	6	An object moves horizontally along the x-axis with simple harmonic motion about a point O. The period of the oscillation is 12 seconds. It is released from its extreme position A, a distance of 3 metres from O. Find the first time the particle will be a distance of 4 metres from A. **4**