SAINT JOSEPH'S PREPARATORY SCHOOL
PHYSICS TEST QUESTIONS.....T P FITZPATRICK
Simple Harmonic Motion

1. A 4.00 kg mass is hung from a spring whose constant is 145 N/m. When the system undergoes simple harmonic motion, what is the period of vibration? If the mass is replaced by one whose mass is 1.00 kg, what will the period become?
2. A 1.25 kg mass is hung from a spring and is observed to undergo 25.0 vibrations in exactly 21.0 s. What is the spring constant?
3. A 1250 kg car has a suspension whose overall spring constant is 3160 N/m. Without shock absorbers, what would be the period of oscillation whenever the car hits a bump?

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4. If a particle undergoes SHM with amplitude 0.18 m, what is the total distance it travels in one period?
5. An elastic cord is 65 cm long when a weight of 75 N hangs from it but is 85 cm long when a weight of 180 N hangs from it. What is the "spring" constant, *k* of this elastic cord?
6. The springs of a 1500-kg car compress 5.0 mm when its 68-kg driver gets into the driver's seat. If the car goes over a bump, what will be the frequency of vibrations?
7. A fisherman's scale stretches 3.6 cm when a 2.7-kg fish hangs from it. (*a*) What is the spring stiffness constant and (*b*) what will be the amplitude and frequency of vibration if the fish is pulled down 2.5 cm more and released so that it vibrates up and down?
8. An elastic cord vibrates with a frequency of 3.0 Hz when a mass of 0.60 kg is hung from it. What is its frequency if only 0.38 kg hangs from it?
9. Construct a Table indicating the position *x* of the mass in Fig. 11–2 at times $t = 0, \frac{1}{4}T, \frac{1}{2}T, \frac{3}{4}T, T,$ and $\frac{5}{4}T,$ where *T* is the period of oscillation. On a graph of *x* vs. *t*, plot these six points. Now connect these points with a smooth curve. Based on these simple considerations, does your curve resemble that of a cosine or sine wave (Fig. 11–8a or 11–9)?
10. A small fly of mass 0.25 g is caught in a spider's web. The web vibrates predominately with a frequency of 4.0 Hz. (*a*) What is the value of the effective spring stiffness constant *k* for the web? (*b*) At what frequency would you expect the web to vibrate if an insect of mass 0.50 g were trapped?
11. A mass *m* at the end of a spring vibrates with a frequency of 0.88 Hz. When an additional 680-g mass is added to *m*, the frequency is 0.60 Hz. What is the value of *m*?
12. A 0.60-kg mass at the end of a spring vibrates 3.0 times per second with an amplitude of 0.13 m. Determine (*a*) the velocity when it passes the equilibrium point, (*b*) the velocity when it is 0.10 m from equilibrium, (*c*) the total energy of the system, and (*d*) the equation describing the motion of the mass, assuming that *x* was a maximum at $t = 0.$
13. At what displacement from equilibrium is the speed of a SHO half the maximum value?
14. A mass attached to the end of a spring is stretched a distance x_0 from equilibrium and released. At what distance from equilibrium will it have acceleration equal to half its maximum acceleration?
15. A mass of 2.62 kg stretches a vertical spring 0.315 m. If the spring is stretched an additional 0.130 m and released, how long does it take to reach the (new) equilibrium position again?

16. An object with mass 3.0 kg is attached to a spring with spring stiffness constant $k = 280\ \text{N/m}$ and is executing simple harmonic motion. When the object is 0.020 m from its equilibrium position, it is moving with a speed of $0.55\ \text{m/s}$. (*a*) Calculate the amplitude of the motion. (*b*) Calculate the maximum velocity attained by the object. [*Hint*: Use conservation of energy.]

17. It takes a force of 80.0 N to compress the spring of a toy popgun 0.200 m to "load" a 0.180-kg ball. With what speed will the ball leave the gun?

18. A mass sitting on a horizontal, frictionless surface is attached to one end of a spring; the other end is fixed to a wall. 3.0 J of work is required to compress the spring by 0.12 m. If the mass is released from rest with the spring compressed, the mass experiences a maximum acceleration of $15\ \text{m/s}^2$. Find the value of (*a*) the spring stiffness constant and (*b*) the mass.