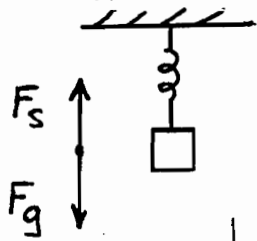


SIMPLE HARMONIC MOTION

1. VALERIE HANGS A SPRING FROM THE CEILING. ITS UNSTRETCHED LENGTH IS .2 M. SHE NOW ATTACHES A .4 KG MASS TO THE LOWER END OF THE SPRING. THE TOTAL LENGTH OF THE SPRING IS NOW .25 M.



$$ma = F_s - F_g$$

$$D = kx - mg$$

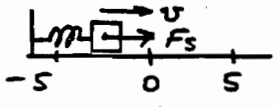
FIND THE SPRING CONSTANT
(80 N/m)

2. $k = 90 \text{ N/m}$ $m = 145.9025 \text{ kg}$

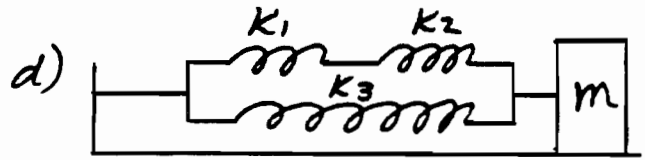
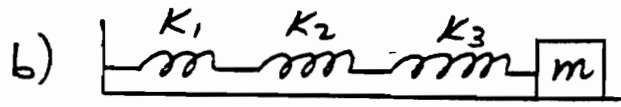
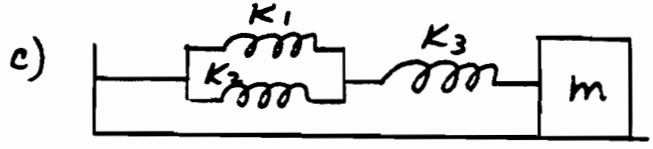
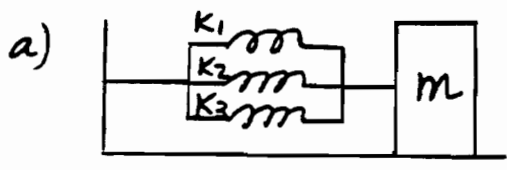
- FIND THE ANGULAR FREQUENCY, THE FREQUENCY AND THE PERIOD OF OSCILLATION FOR THIS SYSTEM.
- FIND THE TIME TO MOVE FROM: A TO THE ORIGIN, A TO -A, A TO -A AND BACK TO ORIGIN, AND A TO A.
- FIND THE TIME TO MAKE 5 CYCLES.
- FIND THE NUMBER OF CYCLES MADE IN 136 SECONDS.
(.7854 sec⁻¹, .125 Hz, 8 sec, 2, 4, 6, 8, 40, 17)

3. $k = 90 \text{ N/m}$ $m = .625 \text{ kg}$
 $v_0 = 0$

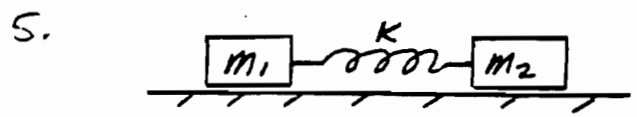
- FIND THE ANGULAR FREQUENCY. (12 sec⁻¹)
- EUGENE RELEASES THE MASS FROM REST AT (5, 0). WRITE EQUATIONS FOR THE LOCATION, THE VELOCITY AND THE ACCELERATION OF THE MASS AS A FUNCTION OF TIME.
- CALCULATE THE LOCATION, VELOCITY AND ACCELERATION OF THE MASS AT $t = .32$ SECONDS AND SKETCH A CARTOON.
- CALCULATE THE VALUES OF THE INITIAL FORCE ON THE MASS, THE INITIAL PE OF THE SPRING AND THE INITIAL KE OF THE MASS.
- FIND THE SPEED OF THE MASS AT $x = 3$ AS WELL AS THE F_s AND THE ACCELERATION AT THAT LOCATION.

ANSWERS : $x = 5 \cos 12t$, $v = -60 \sin 12t$,
 $a = -720 \cos 12t$; -3.82 m , 38.58 m/s , 551.4 m/s^2 ,
; -450 N , 1125 J ; 0 J ; 48 m/s , -270 N , -432 m/s^2

4. FIND THE TOTAL SPRING CONSTANT FOR THE FOLLOWING COMBINATIONS, WHERE $K_1 = 840$ $K_2 = 4200$ $K_3 = 2800 \text{ N/m}$




(7840 N/m, 560, 1800, 3500)



$m_1 = 15 \text{ kg}$ $m_2 = 60 \text{ kg}$
 $K = 300 \text{ N/m}$

FIND THE ANGULAR FREQUENCY OF OSCILLATION. (5 sec^{-1})

6. A BRICK WHOSE MASS IS 24 kg IS CONNECTED BY A SPRING OF CONSTANT 9522 N/m TO ANOTHER BRICK. THEY OSCILLATE WITH A FREQUENCY OF $\omega = 23 \text{ sec}^{-1}$. FIND THE MASS OF THE SECOND BRICK. (72 kg)

7. A HYDROGEN CHLORIDE IS  PICTURED TO THE RIGHT.

A) FROM THE PERIODIC TABLE, HYDROGEN HAS A MASS OF 1 ATOMIC MASS UNIT, CHLORINE HAS 35.5 A.M.U. FIND THE REDUCED MASS OF THIS DIATOMIC MOLECULE.

B) THE COVALENT BOND OF HCl VIBRATES WITH A FREQUENCY OF $f = 8.7 \times 10^{13} \text{ Hz}$. AN ATOMIC MASS UNIT EQUALS $1.67 \times 10^{-27} \text{ kg}$. FIND THE EFFECTIVE SPRING CONSTANT FOR THE BOND. ($.9726 \text{ A.M.U.}$, 485.3 N/m)

7. CAROLYN, WHO LIVES ON A NEW PLANET C^2 HAS A 6 m PENDULUM, WHOSE PERIOD IS $\frac{1}{8}$ SEC.

- a) FIND THE PERIOD FOR A PENDULUM WHOSE LENGTH IS 24 m. (16 SEC)
 b) FIND g ON THIS PLANET. (3.7 m/s^2)

8. A SIMPLE PENDULUM HAS LENGTH 16.211 m.

JOHN DISPLACES IT .4 RADIANS AND RELEASES IT FROM REST. FIND :

- A) ITS ANGULAR FREQUENCY
 B) ITS FREQUENCY C) ITS PERIOD D) TIME TO GO BACK AND FORTH FIFTY TIMES E) NUMBER OF TIMES THAT IT CAN GO BACK AND FORTH IN 120 SEC.
 F) EQUATIONS FOR ITS ANGULAR LOCATION, ANGULAR SPEED AND ANGULAR ACCELERATION.
 G) FOR $t = 3$ SEC, CALCULATE $\theta, \Omega, \alpha, v$.
 H) THE BOB HAS A MASS OF 25 KG. FIND ITS K.E.

AT $t = 3$ SEC.

(.7854 sec^{-1} , .125 Hz, 8 SEC, 400 SEC, 15 TIMES,

$$\theta = .4 \cos(.7854t), \Omega = -.31446 \sin(.7854t)$$

$$\alpha = -.24674 \cos(.7854t), \text{ } -.2828 \text{ RADIAN/S}, \text{ } -.2221 \text{ SEC}^{-1}, \text{ } .17447 \text{ SEC}^{-2}, \text{ } -3.6 \text{ m/s}, \text{ } 162 \text{ J}$$