PREMIER ACADEMY OF SCIENCE & TECHNOLOGY [PAST]

Physics-Chapter1 Answers

Part one: Circel the correct answer for the following questions

1. Which of the following is not an example of periodic motion?
   a. An object orbiting the sun
   b. A pendulum swinging
   c. A mass on a spring
   d. A ball falling to the ground
2. If an object in periodic motion completes one full cycle in 0.5 seconds, what is the frequency of the motion?
   a. 0.5Hz b. 1Hz c. 2Hz d. 4Hz
3. A mass oscillates in simple harmonic motion with Amplitude **A,** if the mass is halved, but the amplitude is not changed what will happen to the mechanical energy of the system?
   a. It will increase b. It will decrease c. it will stay at the same d. None
4. A mass on a pring oscillates between point A and C as shown. Use the figure below to answer this question

   At which point is the acceleration of the mass greatest?

   (a) A
   (b) B
   (c) C
   (d) A and C

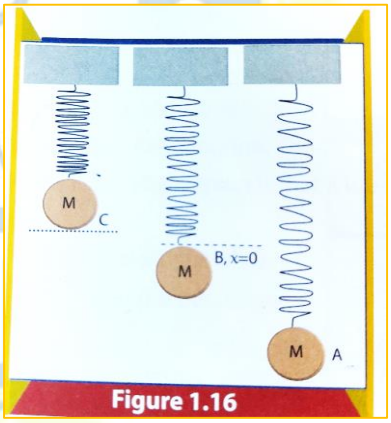


Figure 1.16

5. If the mass is 48 kg and the spring constant is 12N/m, what is the period of oscillation?
   a. 8 π s b. 4 π s c. π s d. π/2 s
6. If the mass is displaced 0.35 m from its equilibrium position the restoring force is 7N. What is the spring constant?
   a. 5×10^{2} N/m b. 2×10^{2} N/m c. 5×10^{-2} N/m d. 2×10^{1} N/m

7. Which of the following does not affect the period of the mass spring system?

   a. Mass
   c. Spring constant
   b. Amplitude of vibration
   d. All of the above

8. The total energy of the spring is 100 J. What is the kinetic energy of the mass at the equilibrium point?

   a. 25 J
   b. 75 J
   c. 50 J
   d. 100 J

9. A pendulum bob hangs from a string and moves with SHM, as shown in figure below.

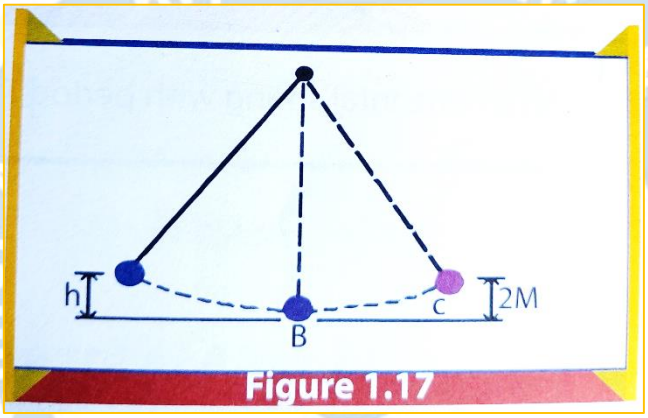
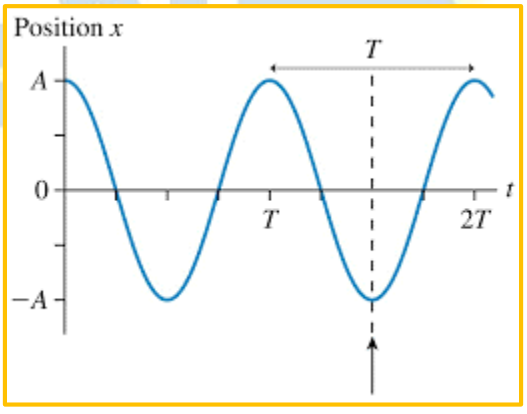


Figure 1.17

   Which of the following does not affect the period of the pendulum?

   a. The length of the string
   c. the mass of the pendulum bob
   b. The acceleration due to gravity
   d. All of the above

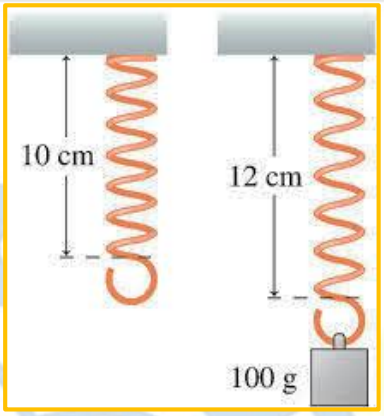
10. A mass oscillates on a horizontal spring its velocity is v_x and the spring exerts force f_x at the time indicated by the arrow



   a. *Vx* is + and fx is +
   b. *Vx* is + and fx is -
   c. *Vx* is - and fx is 0
   d. *Vx* is 0 and fx is +
   e. *Vx* is 0 and fx is –

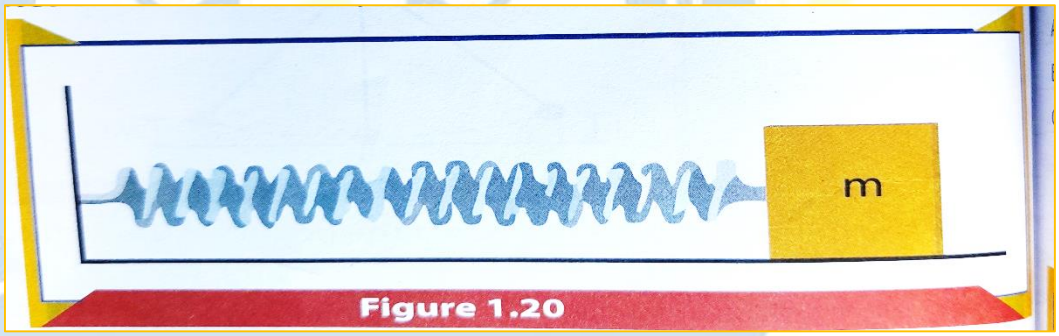
11. A hanging spring has length 10cm. A 100g mass is hung from the spring, stretching it to 12 cm what will be the length of the spring if this mass is replaced by 200g mass?

a. 14 cm
b. 16 cm
c. 20 cm
d. 24 cm



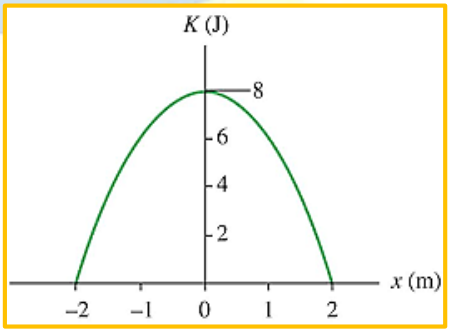
12. A mass oscillates on a horizontal spring with period T=2.0 s. What is the frequency?

a. 0.50 Hz
b. 1.0 Hz
c. 3.0 Hz
d. 4.0 Hz

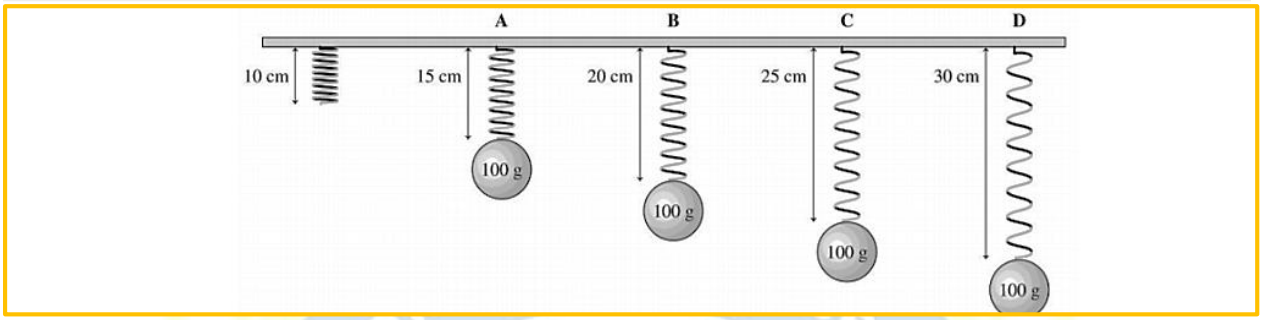


13. A block oscillates on a very long horizontal spring. The graph shows the block's kinetic energy as a function of position. What is the spring constant.

a. 1 N/m
b. 2 N/m
c. 4 N/m
d. 8 N/m



14. Four 100g masses are hung from four springs each with an unstretched length of 10 cm. The four springs stretch as noted in the following diagram.

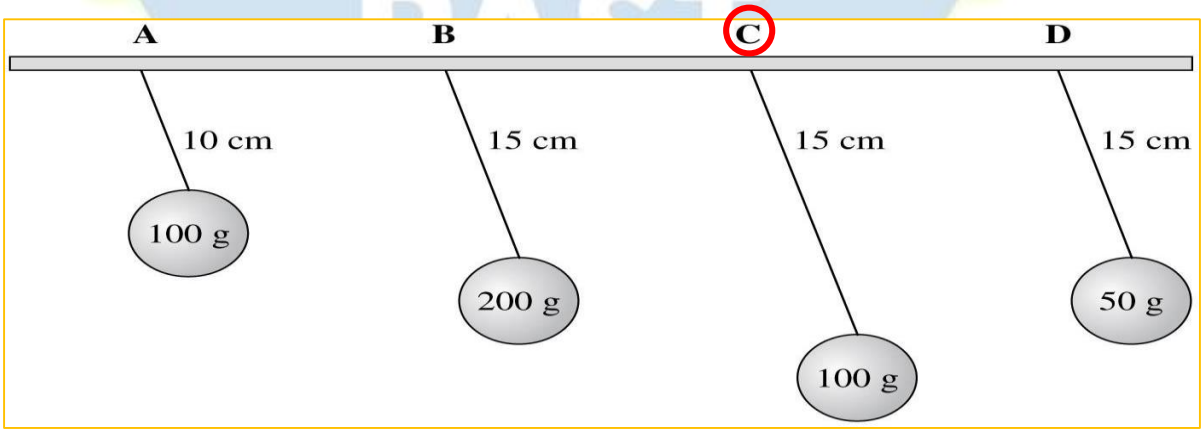


Now each of the masses is lifted a small distance, released and allowed to oscillate.

Which mass oscillates with the highest frequency.

a. Mass A
b. Mass B
c. Mass C
d. Mass D
e. All masses oscillates with the same frequency

15. A series of pendullums with different length strings and different masses is shown below. Each pendulum is pulled to the side by the same(small) angle the pendulum are released and they begin to swing from side to side.



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Physics-Chapter1 Answers

Part Two: Fill in the blank space with a suitable term

1. If the pendulum has a period of 1 s. The length of the string is **0.2484 m**
2. Motion that regularly repeats at equal interval of time is called **Periodic Motion**
3. A mass of 5kg suspended from a spring with a spring constant 400 N/m. If the amplitude is 20cm. The maximum acceleration is **$16 m/s^2$**
4. A simple pendulum is moved from earth to moon, its period **will increase.**
5. The force applied to the spring is directly proportional to the displacement, this statement is known as **Hook's Law**
6. The number of cycles per second is called **Frequency**
7. A mass on a spring undergoes SHM. The maximum displacement from the equillibrium is **Amplitude**
8. The time taken for one complete oscillation is **Period**
9. Give two examples of SHM which are not mentioned in the lesson
   1. **Bungee Jumping**
   2. **Hearing**
10. The maximum displacement from either direction is called **Amplitude**

Part Three: Subjective Questions

1. A man with a wrist in his hand fall from the top of a tower. Does the watch give correct time?
   - **Ans:** Yes, the motion in the wristwatch depends on spring action and has nothing to do with acceleration due to gravity.
2. A vibrating Simple pendulum of period is placed in a lift is accelerating downwards. What will be the effect on the time period?
   - **Ans:** Time Period **Increases** as the effective value of acceleration due to gravity decreases.

3. A girl sitting on a swing. Another girl sits by her side. What will be the effect on the periodic time of the swing?

   ❖ **Ans:** The Periodic time of the swing will not change because the periodic time is independent of mass but depends upon length of pendulum and acceleration due to gravity at a place, which are not affected by sittin another girl on a swing.

4. Can a motion be oscillatory but not SHM? If your answer yes give an example and if not explain why?

   ❖ **Ans:** Yes, When a ball is dropped from a height on a perfectly elastic plane surface, the morion of the ball is oscillatory motion but not Simple harmonic motion as restoring force F=mg =cosntant but for SHM the required condition is $F \propto -y$

5. If you double the period of a pendulum, what happens to its length?

   ❖ **Ans:** its Length will be doubled.

6. A 2kg body suspended from a spring of negligible mass is found to stretch the spring by 10cm. If the body is pulled down and then released. What is the frequency of oscillation?

   ❖ **Solution: Given**

$m = 2kg$	$\boldsymbol{k = \frac{f}{x}}$	$\boldsymbol{w = \sqrt{\frac{k}{m}} = \sqrt{\frac{196N/m}{2kg}}}$
$x = 10\ cm = 0.1m$	$\boldsymbol{f = mg}$	$\boldsymbol{w = 9.8\frac{rad}{s}}$
$g = 9.8m/s^2$	$\boldsymbol{f = (2kg)x(9.8m/s2)}$	$\boldsymbol{f = \frac{w}{2\pi} = \frac{9.8rad/s}{2\pi}}$
$f =?\ \boldsymbol{f = \frac{w}{2\pi}}$	$\boldsymbol{f = 19.6N}$	$\boldsymbol{f = 15.3\ Hz}$
$\boldsymbol{w = \sqrt{\frac{k}{m}}}$	$\boldsymbol{k = \frac{19.6\ N}{0.1\ m} = 196N/m}$	

7. A body undergoes SHM of amplitude 3cm and frequency 20Hz. What is the velocity of the body at the maximum acceleration of the object?

❖ **Ans:** The velocity of the body is **0m/s²**

8. An object of mass 0.35kg oscillates in SHM with an amplitude of 140 mm and frequency of 0.60 Hz:

Calculate or find:

i. Maximum Kinetic energy of the object

Solution: **Given**

$m = 0.35kg$	$\boldsymbol{k = mw^2}$	$\boldsymbol{k = 4.9N/m}$
$A = 140mm = 0.14m$	$\boldsymbol{w = 2\,\pi\, f}$	$\boldsymbol{K.E = \frac{1}{2}KA^2}$
$f = 0.60H?$	$\boldsymbol{w = 2\ x\ 3.14\ x\ 0.60}$	$\boldsymbol{K.E = \frac{1}{2}(4.9N/m)x(0.14m)^2}$
$\boldsymbol{K.E}$ =?	$\boldsymbol{w = 3.76\frac{rad}{s}}$	$\boldsymbol{K.E = 0.048\,J}$
$\boldsymbol{K.E = \frac{1}{2}KA^2}$	$\boldsymbol{k = mw^2}$ = (0.35)x(3.76)²	

ii. Maximum potential energy of the object

❖ **Ans:** when the object is at the maximum displacement its Potential and kinetic energy is equal E = P.E = K.E

➢ **P.E = 0.048 J**

iii. Potential and kinetic energy at midway point between the center and the extremity of the motion

$$\boldsymbol{P.E = \frac{0.048}{2} = 0.024\,J}$$

$$\boldsymbol{K.E = \frac{0.048}{2} = 0.024\,J}$$

9. Find the equation for the acceleration of SHM using differentiation

- X = A cos(wt)

$$a = \frac{dx2}{dt}$$

$$a = \frac{dv}{dt} \qquad a = -aw^2 \sin wt$$

$$a = Aw^2 coswt \quad \underline{a = Aw^2}$$

10. At a particular frequency the velocity of the cap in m/s is given by the expression

V = 0.5m cos(625t)

a) Calculate the frequency of the sound emitted

- $f = \frac{w}{2\pi} = \frac{625}{2\ x\ 3.14} = \underline{99.5\ Hz}$

b) Calculate the amplitude of the vibration

- $\underline{A = 0.5}$

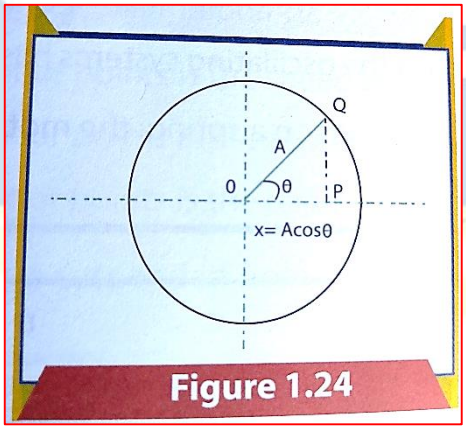
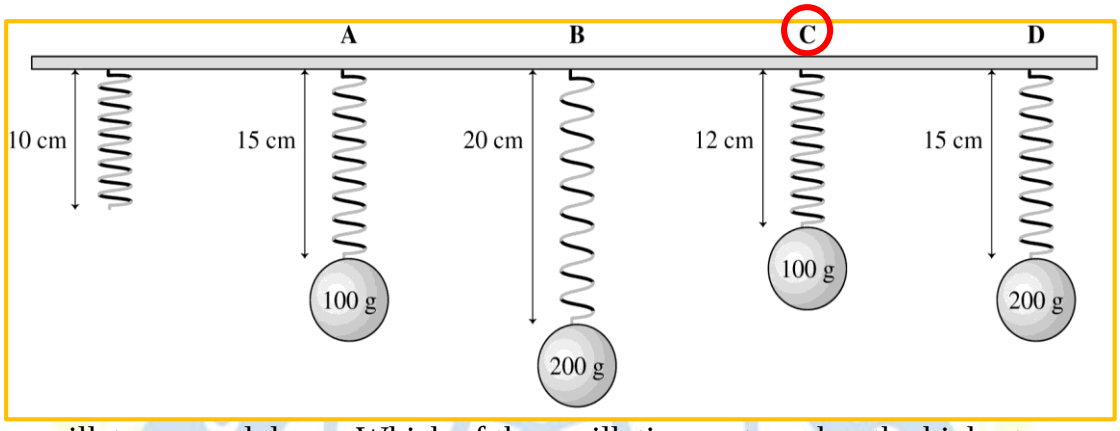


Figure 1.24

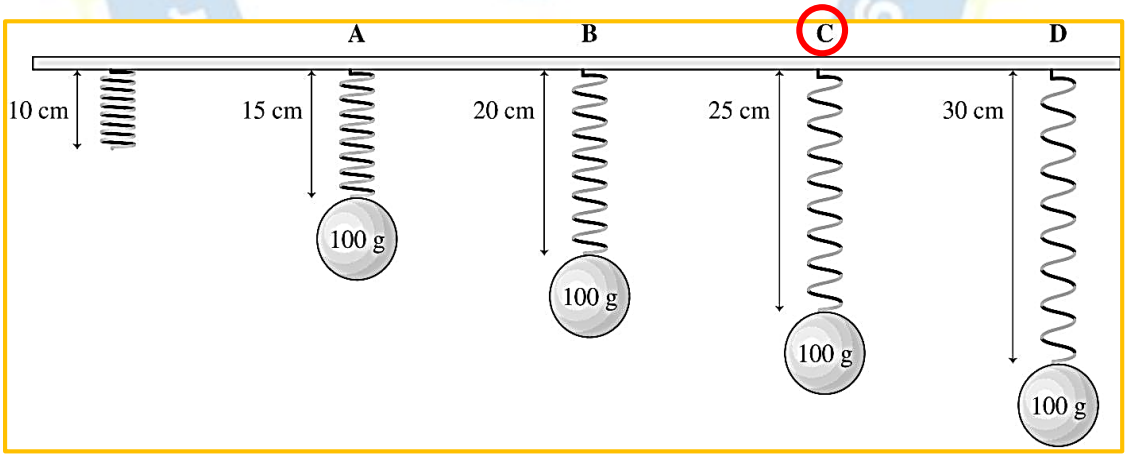
11. A set of spring all have initial length 10 cm. Each spring now has a mass suspended from its end, and the different spring stretch as shown below:



oscillates up and down. Which of the oscillating systems has the highest frequency?

- **Ans: C(12cm, 100g)**

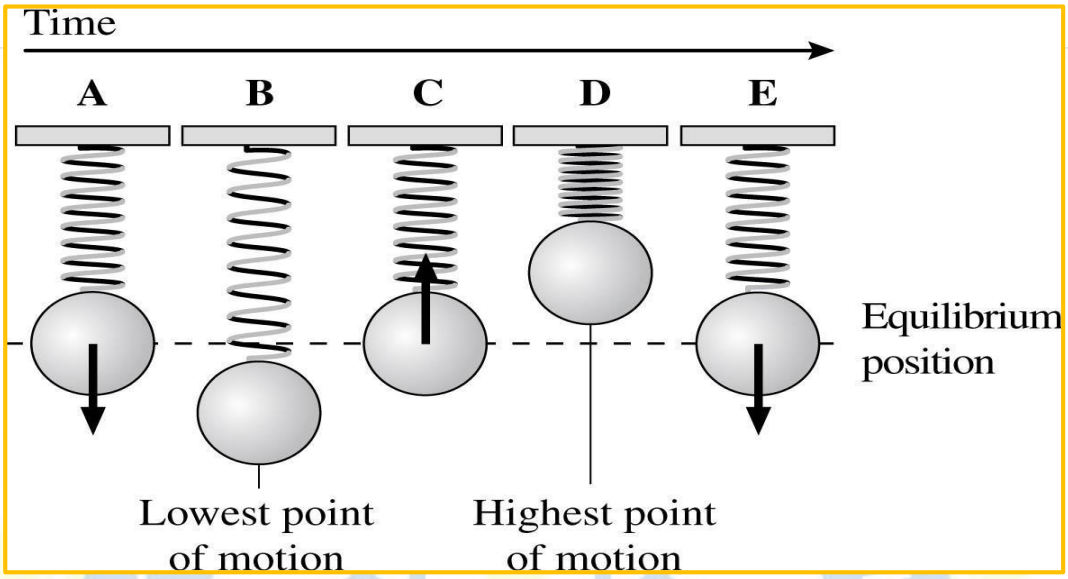
12. Four different masses are hung from four springs with an unstretched length of 10 cm, causing the springs to stretch as noted in the following diagram:



oscillates up and down. Which of the oscillating systems has the highest frequency?

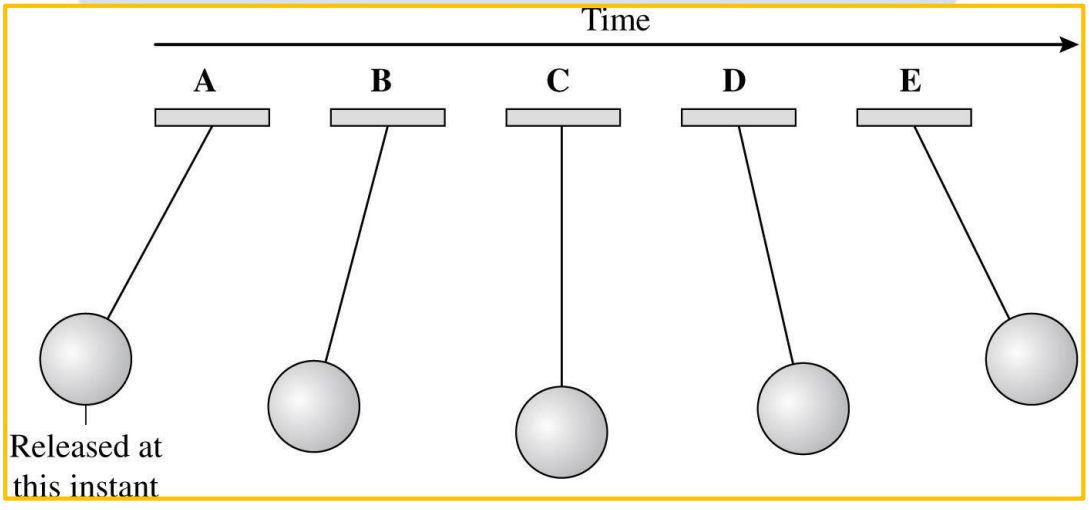
- **Ans: C(25cm, 100g)**

13. A mass oscillates up and down on a spring; the motion is illustrated at right.



1. At which time or times shown is the acceleration zero? **Ans: A, C, E**
2. At which time or times shown is the kinetic energy a maximum? **Ans: A, C, E**
3. At which time or times shown is the potential energy a maximum? **Ans: B, D**

14. A pendulum is pulled to the side and released. The mass swings to the right as shown. The diagram shows positions for half of a complete oscillation.



1. At which point or points is the speed the highest? **Ans: A, C, E**
2. At which point or points is the acceleration the greatest? **Ans: A, C, E**
3. At which point or points is the restoring force the greatest? **Ans: A, C, E**

15. A mass of 0.50kg is suspended from a spring of negligible mass, as shown in figure5(a)

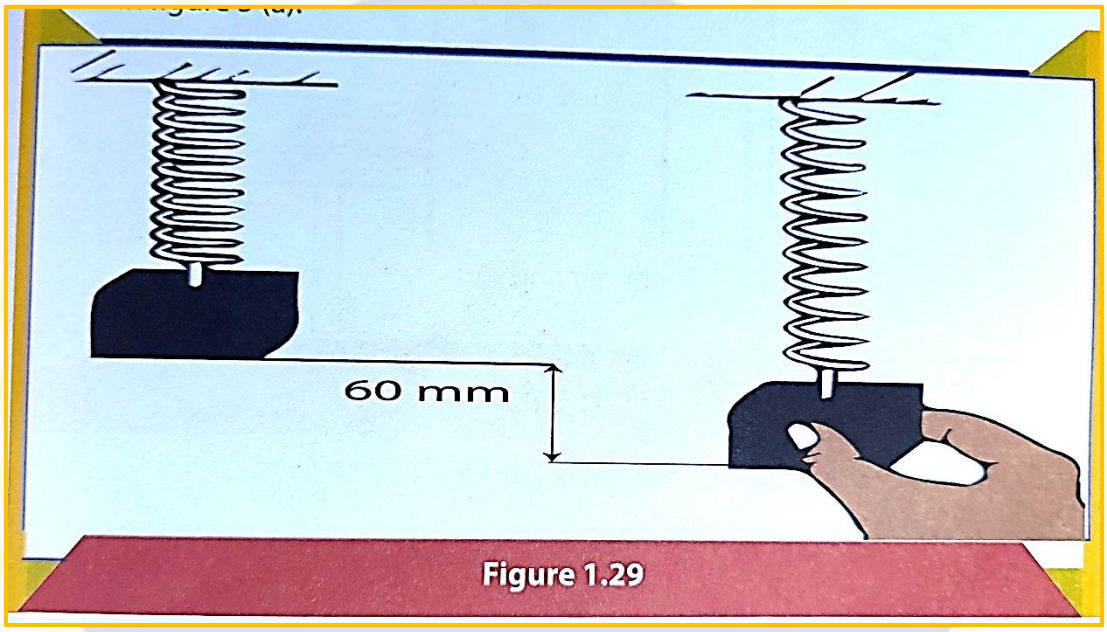


Figure 1.29

16. A student pulls the mass down a distance of 60 mm and holds it in the position shown in figure 5(b)

    The tension in the spring is now 7.0 N

    a) By considering the vertical forces acting on the mass, Calculate the force applied by the student to hold the mass in this position.

    Solution Given:

    m = 0.50kg **f = mg**

    x=60mm = 0.06m $f = (0.50kg)(9.8\ m/s^2)$ **f= 4.9 N**

b) The students releases the mass which performs simple harmonic motion

i) State the relationship between the unbalanced force acting on the mass and the displacement of the mass.

❖ **Ans:** The unbalanced force acting on the mass is proprtional to the displacement of the object and acts in the opposite direction.

ii) Calculate the acceleration of the mass immediately after its release.

❖ **Ans:** *acceleration* = **<u>9.8 m/s^2</u>**

iii) State the initial amplitude of the oscillations.

❖ **Ans:** Amplitude = **<u>0.06 m</u>**

17. The motion of a piston in a car engine closely approximates to simple harmonic motion.

In a typical engine the top of piston moves up and down between points A and B, a distance of 0.10m as shown in figure

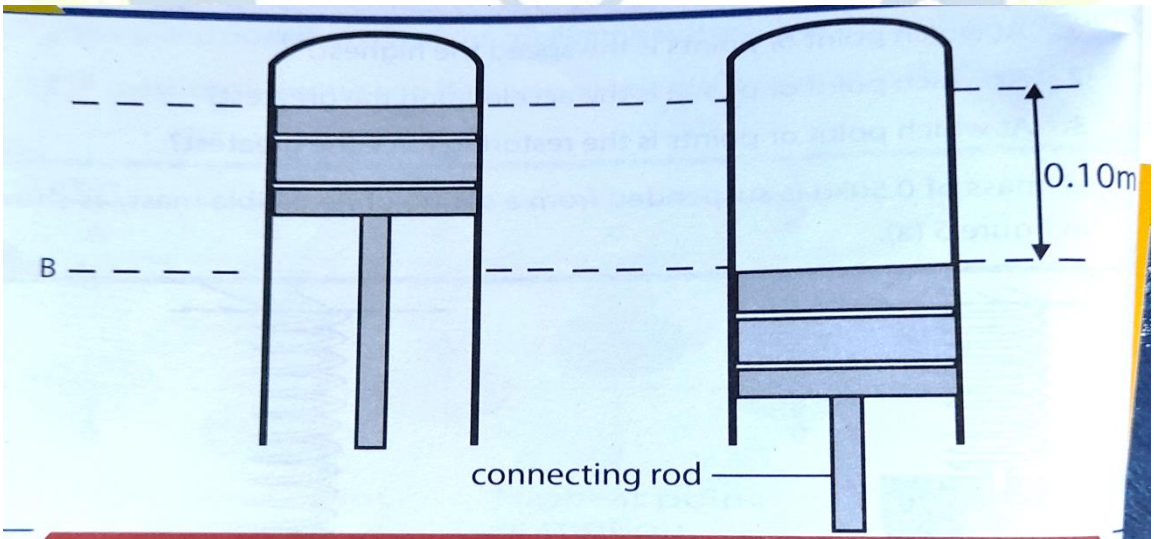


Figure 1.30

The frequency of the piston's motion is 100 Hz.

Write down an equation which describes how the displacement of the piston from its central position varies with time. Numerical values are required

❖ **Solution: Given**

X= 0.10m ***A= 0.05m.***

A=x/2 ***f = 100 Hz***

A=0.1/2 $y = A \sin(2\pi ft)$ **y = 0.05 m sin (2π x 100)t)**

Ans: **y = 0.05m sin(200 π t)**

Calculate the maximum acceleration of the piston.

Solution: **Given**

$m = 0.48kg$ $w = 2\,\pi\, f$

$A = 0.05\ m$ $w = 2\,x\,3.14\,x\,100$

$f = 100hz?$ $w = 628\frac{rad}{s}$ $a_{max} = 19719.2 m/s^2$

$a_{max} = ?$ $a_{max} = Aw^2$

$a_{max} = Aw^2$ $a_{max} = (0.05)\ x\ (628)^2$

The mass of the piston is 0.48 kg

Calculate the maximum force applied to the piston by the connecting rod.

Solution: **Given**

$m = 0.48kg$ $f = mg$ ***F = 4.7 N***

$g = 9.8m/s^2$ $f = 0.48\ kg x\ 9.8\ m/s^2$

Calculate the maximum kinetic energy of the piston.

❖ **Solution** **Given:**

w = 628rad/s $k = mw^2$

m=0.48kg $k = (0.48) \times (628)^2$

k = ? **k = 189,304N/m**

A=0.05

k.E = ½ KA^2

k.E = ½ (189,304) x $(0.05)^2$

K.E = 236.63 J

END OF CHAPTER QUESTIONS