Test 7

Corrected

Spaceman Speff orbits spherical asteroid *X* with his spaceship. To remain in a circular orbit at **443** km from the asteroid's center, he should maintain a speed of **36** m/s. What is the mass of asteroid *X*? ($G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$)

Item 1

- [x] 0.86×10^{19} kg
- [ ] 0.86×10^{18} kg
- [ ] 2.4×10^{17} kg
- [ ] 2.4×10^{14} kg

given this,

$$m v^2 / r = GM.m/r^2$$

$$M = v^2 r / G = 36^2 * 443 x 10^3 / 6.67 x 10^{-11}$$

$$\boxed{M = 0.861 \times 10^{19}\ kg}$$

Planet Z-34 has a mass equal to 1/3 that of Earth, a radius equal to 1/3 that of Earth, and an axial spin rate 1/2 that of Earth. With *g* representing, as usual, the acceleration due to gravity on the surface of Earth, the acceleration due to gravity on the surface of Z-34 is

Item 2

- 3*g*.
- 6*g*.
- *g*/9.
- *g*/3.
- 9*g*.

Given:	Find:
$M = (1/3)M_e$ $R = (1/3)R_e$	a

on earth $g = 9.8\ m/s^2 = GM/R^2 = a$

on Z-34:

$$a = G(1/3)M_e / [(1/3)R_e]^2 = 3 * GM_e / [\ R_e\ ]^2 = 3g$$

A certain planet has an escape speed V. If another planet of the same size has twice the mass as the first planet, its escape speed will be

Item 3

- ◉ $\sqrt{2}V$.
- ○ V.
- ○ $V/2$.
- ○ $V/\sqrt{2}$.
- ○ $2V$.

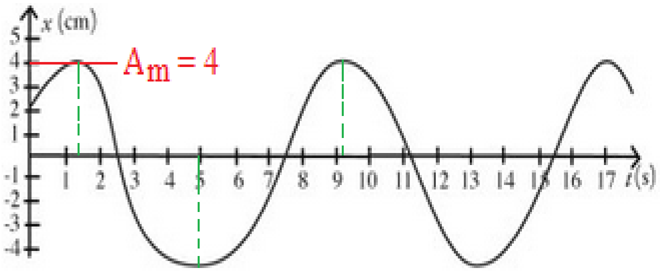
Given:	Find:	Formulae:
$R_1 = R_2 = R$ $M_2 > M_1 = 2M_1 = 2M$	V	$V = \sqrt{\dfrac{2GM}{R}}$

V = Sqrt((2(G)(2M)) / R)

= Sqrt(2) * Sqrt((2(G)(M)) / R)

= Sqrt(2) * V

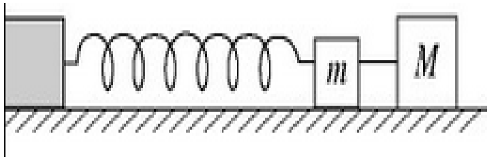
The simple harmonic motion of an object is described by the graph shown in the figure. What is the equation for the position $x(t)$ of the object as a function of time t?



- $x(t) = (4.0\text{ m})\cos[(2\pi/8.0\text{ s})t + \pi/3.0]$
- $x(t) = (4.0\text{ m})\cos[(2\pi/8.0\text{ s})t - \pi/3.0]$
- $x(t) = (4.0\text{ m})\sin[(2\pi/8.0\text{ s})t + \pi/3.0]$
- $x(t) = (8.0\text{ m})\cos[(2\pi/8.0\text{ s})t + \pi/3.0]$
- $x(t) = (4.0\text{ m})\cos[(2\pi/8.0\text{ s})t + 2\pi/3.0]$

Item 4

In the figure, two masses, M = 11 kg and m = 5.5 kg, are connected to a very light rigid bar and are attached to an ideal massless spring of spring constant 100 N/m. The system is set into oscillation with an amplitude of 22 cm. At the instant when the acceleration is at its maximum, the 11-kg mass separates from the 5.5-kg mass, which then remains attached to the spring and continues to oscillate. What will be the amplitude of oscillation of the 5.5-kg mass?



Item 5

- 22 cm
- 11 cm
- 66 cm
- 44 cm
- 7.3 cm

The amplitude of oscillation is still 22 cm even M was removed.

Two planets having equal masses are in circular orbit around a star. Planet A has a smaller orbital radius than planet B. Which statement is true?

- Planet A has more kinetic energy, more potential energy, and more mechanical energy (potential plus kinetic) than planet B.
- Planet A has more kinetic energy, less potential energy, and less mechanical energy (potential plus kinetic) than planet B.
- Planet A and planet B have the same amount of mechanical energy (potential plus kinetic).
- Planet A has more kinetic energy, less potential energy, and more mechanical energy (potential plus kinetic) than planet B.

Item 6

these statements are valid for circular orbital motion

- Negative kinetic energy equals half the potential energy ($-K = ½U$).
- Potential energy equals twice the total energy ($U = 2E$).
- Total energy equals negative kinetic energy ($E = -K$).
- Twice the kinetic energy plus the potential energy equals zero ($2K + U = 0$).

A mass M is attached to an ideal massless spring. When this system is set in motion, it has a period T. What is the period if the mass is doubled to $2M$?

Item 7

- $4T$
- $2T$
- $\boxed{\sqrt{2}T}$
- $T/2$
- T

Given:

M

k = Spring constant

Find:

T when M = 2M

Formulae:

$T = (2\pi) * \text{Sqrt}(M / k)$

when M = 2M

$T = (2\pi) * \text{Sqrt}(2M / k)$

$= \text{Sqrt}(2) * [(2\pi) * \text{Sqrt}(M / k)]$

$\boxed{T = \sqrt{2}T}$

A simple harmonic oscillator has an amplitude of 3.50 cm and a maximum speed of 30 cm/s. What is its speed when the displacement is 1.75 cm?

- 28.5 cm/s
- 26.0 cm/s
- 15.0 cm/s
- 21.2 cm/s

Item 8

The total energy of the system = 1/2*k*A^2 or $(1/2)\ m * v_{max}^2$

When x = 1/2A then the potential energy =1/2*k*(A/2)^2 = 1/4of E max

So the kinetic energy at this time is 3/4 of K max

so 1/2*m*(v)^2 = 3/4 * $(1/2)\ m * v_{max}^2$

so v = vmax*sqrt(3/4) = 30.0cm/s*sqrt(0.75) = 26.0 cm/s

A 0.12-kg block on a horizontal frictionless surface is attached to an ideal massless spring whose spring constant is 210 N/m. The block is pulled from its equilibrium position at $x = 0.00$ m to a displacement $x = +0.080$ m and is released from rest. The block then executes simple harmonic motion along the horizontal x-axis. When the displacement is $x = 1.4\times10^{-2}$ m, what is the kinetic energy of the block?

- 0.73 J
- 0.65 J
- 0.77 J
- 0.61 J
- 0.69 J

Item 9

$$F = k \cdot x$$

$$= 210\ N/\cancel{m} \cdot 0.08\cancel{m} = 16.8N$$

$$(1/2) \cdot k \cdot x^2 = (1/2) . 210 . 0.08^2 = 0.672\ J$$

$$E(0.08m) = E(0.014m)$$

$$0.672 = KE + (1/2) . 210 . (0.014)^2$$

$$KE = 0.672 - (1/2) . 210 . (0.014)^2$$

$$\boxed{KE = 0.65\ J}$$

A satellite in a circular orbit of radius R around planet X has an orbital period T. If Planet X had one-fourth as much mass, the orbital period of this satellite in an orbit of the same radius would be

- $T/2$.
- $T\sqrt{2}$
- $\boxed{2T.}$
- $T/4$.
- $4T$.

Item 10

from kepler's third law,
time period T =(2π/√GM)R^3/2

time period T' =(2π/√GM/4)R^3/2 = $\boxed{2T}$

option A is correct.

$$T^2 = \frac{4\pi^2}{G(M_1 + M_2)} a^3$$

Given:	Find:	Formulae:
M = (1/4)M	T	$T = (2\pi \ / \ Sqrt(G\,M)\,)R^{(3/2)}$