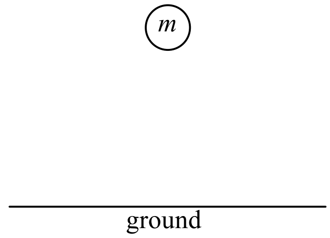
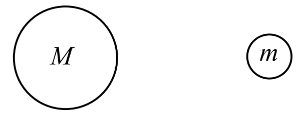
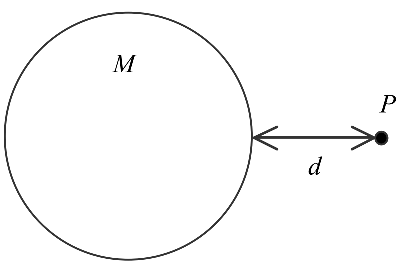
38 GRAVITY		
1. Long range forces (field forces)		
2. Gravity		
3. Gravity Field		
4. Force of Gravity		
5. Factors in fluencing the magnitude of the gravity field and the magnitude of the force of gravity.		
6. Surface gravity		
7. Agent and object and the conventions for which is which in most problems.		
8. Surface vs. Space	**Surface Gravity**	**Gravity in Space**
(A) Draw gravity field vectors for each scenario	ground	*M*
(B) Uniform or non-uniform?		
(C) How is the magnitude of the field determined in each case (equation, etc.)?		
(D) Universal gravity constant		
(E) What does the variable r represent, and how is it measured?		

9. Surface vs. Space	**Surface Gravity**	**Gravity in Space**
(A) A mass m is added to each scenario. Draw the force of gravity acting on the object in each case at the right.		
(B) What equations can be used to determine the force of gravity in each case?		
(C) What does the variable r represent, and how is it measured?		

10. Point P is located in space a distance $d = 1.0 \times 10^6$ m above the surface of a planet that has a radius of 2.0×10^6 m. The mass of this planet is $M = 3.0 \times 10^{24}$ kg.



(A) Determine the surface gravity of this planet

(B) Determine the strength of the gravity field at point P.

A space probe with a mass of 400 kg is inserted into an orbit that passes through point P. Calculate the following values at the instant that the space probe is passing through point P.

(C) Determine the force of gravity using Newton's Law of Universal Gravitation.

(D) Determine the force of gravity using $F_g = mg$.

(A)

(B)

(C)

(D)

11. Two objects $m_1 = 70$ kg and $m_2 = 60$ kg are separated by 0.60 m. Determine the force of gravity of the 70 kg object on the 60 kg object?	
12. **Inverse Square Law**	
13. The mass of a planet doubles. What is the effect on the gravity field, g, and the force of gravity, F_g, at a point in space near the planet?	
14. A star's diameter doubles. What is the effect on the gravity field, g, and the force of gravity, F_g, at a point in space near the star?	
15. A star loses half of it mass while its diameter doubles. What is the effect on the gravity field, g, and the force of gravity, F_g, at a point in space near the star?	
16. When two masses such as Earth and Moon attract each other, how does the force acting on one planet compare to the force acting on the other?	
17. The radius of Mars is half that of the Earth. Mars has one-tenth the mass of the Earth. Determine the strength of the gravity field on Mars.	
18. A star grows into a red giant. The new radius is 1000 times greater than the old radius. What will happen to the strength of the gravity field at the stars surface?	

39 ORBITS

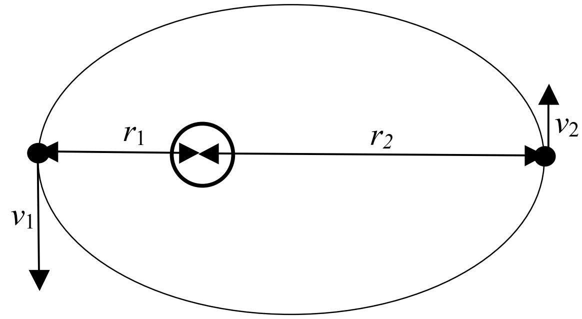
19. What is the force of gravity acting on a 1000 kg spacecraft located half way between Earth and the Moon.	
20. Orbital Speed (A) Determine the orbital speed of a spacecraft of mass m in a circular orbit of radius r about a planet of mass M in terms of the given quantities and known constants. (B) The mass of Earth is approximately 6×10^{24} kg. The radius of Earth is approximately 6×10^{6} m. Determine the orbital speed of a 1000 kg spacecraft that orbiting one Earth radii above the surface of Earth.	(A) (B)

21. Geosynchronous Orbits	(A)
(A) Define	(B)
(B) What is the period of a geosynchronous orbit?	(C)
(C) Determine the orbital radius of a spacecraft of mass m in a circular orbit of radius r about a planet of mass M in terms of the given quantities and known constants.	
(D) Determine the distance that a geosynchronous satellite must be positioned above the surface of Earth using the values for Earth mass and radius from the previous problem.	(D)

22. Kepler's First Law

23. Kepler's Second Law

24. Kepler's Third Law

25. Conservation in elliptical orbit. (A) What equation is used for the gravitational potential energy in space, and where is the zero point for this energy? (B) Conservation of energy in elliptical orbits (C) Conservation of angular momentum in elliptical orbits.	(A)	
	(B)	
	(C)	

26. Escape speed in circular orbits.

40 SIMPLE HARMONIC MOTION		
27. Oscillations (A) Are caused by... (B) What does SHM stand for? (C) Which equations, encountered previously, can be used to determine the restoring force and potential energy for an object in simple harmonic motion? (D) What objects can these equations be applied to? (E) What variable depicts displacement? (F) What is the maximum displacement of an oscillator also known as?	(A) (B) (C) (D) (E)	(F)
28. Period (A) Define (B) General formula (C) Period of a spring formula (D) What does the period of a spring depend on?	(A) (C)	(B) (D)
29. What affects the period of a spring?		
30. What affects the period of a pendulum?		
31. How does doubling the mass affect the period of an oscillating spring?		
32. What mass is needed to double the period of an oscillating spring?		
33. How does doubling the mass affect the period of an oscillating spring?		
34. An object completes 20 cycles in 5.0 seconds. Determine the period.		

35. A 500 g mass is suspended from a spring and stretches the spring 20 cm to its equilibrium position. The spring is then stretched an additional 10 cm and then released from rest. (A) Determine the spring constant. (B) Determine the maximum speed of the mass during the oscillation. (C) Determine the frequency of the spring's oscillations.	(A) (B) (C)
36. A pendulum with a length of 50 cm is displaced through an angle of 37^{o}. (A) Determine the maximum speed reached by the pendulum bob during the oscillation. (B) Determine the frequency of the oscillation	(B) (C)
37. A pendulum is brought to a distant planet. The string of the pendulum is adjusted until the frequency of the pendulums swing is 1.0 cycle per second. The length of the string is 2.5 m. Determine the magnitude of the acceleration of gravity for this planet.	

41 GRAPHING OSCILLATIONS

38. The period and frequency of an oscillating object displaced a distance x_{max} will be identical to the period and frequency of an object in circular motion with a radius $R = x_{max}$.

A Amplitude, is the maximum displacement of the oscillator: $A = x_{max} = R$

x The displacement, x, of an oscillating object is the same as the x-component of the radius line, R_x, of the corresponding circular motion: $R_x = x = A\cos\Delta\theta$

$x = A\cos\Delta\theta$

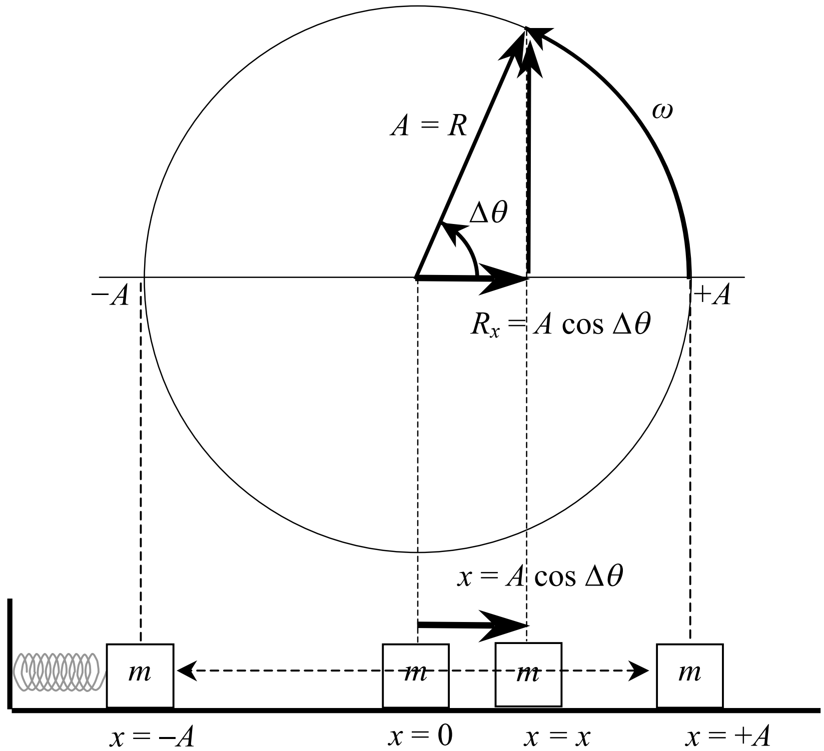
For uniform circular motion: $\Delta\theta = \omega t$

$x = A\cos(\omega t)$

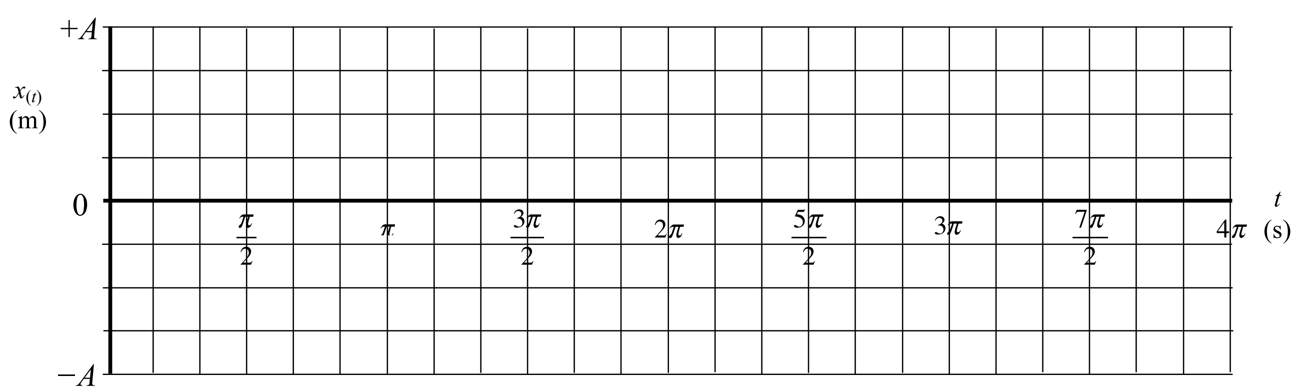
The angular velocity is related to both period and frequency $T = \dfrac{2\pi}{\omega} = \dfrac{1}{f}$

Which rearranges into $\omega = 2\pi f$

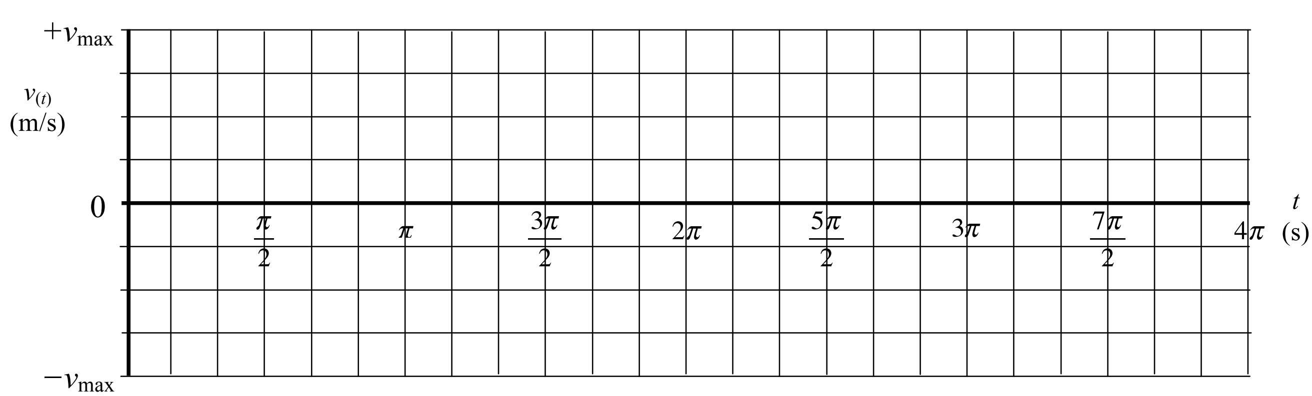
$\boxed{x = A\cos(2\pi f t)}$



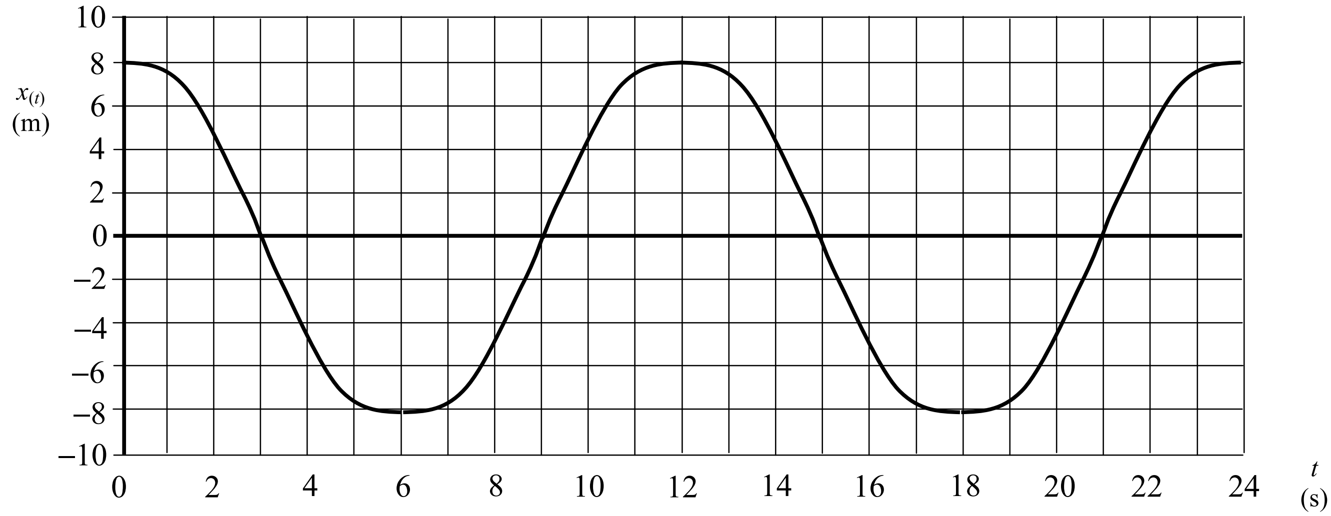
(A) The spring above is initially stretched to the right and released from rest. Complete the position-time graph for the oscillation.



(B) Sketch the corresponding velocity-time graph for this oscillation.



39. Analyze the following graph



(A) Determine the amplitude

(B) Determine the period

(C) Determine the frequency

(D) Determine angular frequency

(E) Determine the maximum speed during the oscillation.

(F) Write a displacement equation substituting the values from A to D.

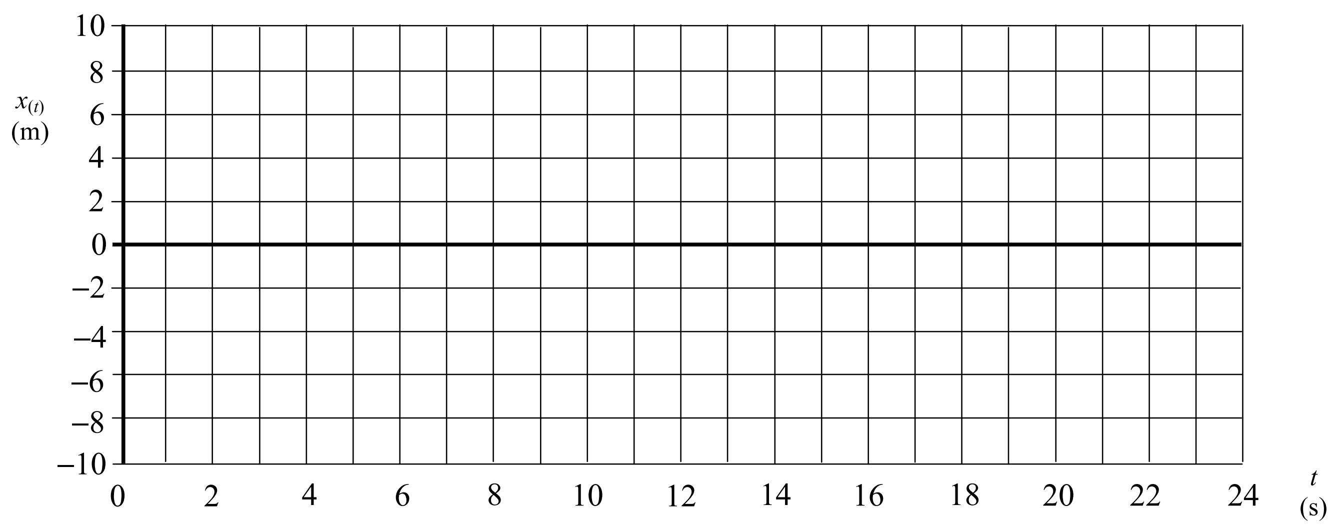
(G) Determine the displacement at $t = 8$ s.

(H) At what time(s) is the mass moving to the right at maximum speed?

(I) At what time(s) is the mass moving to the left at maximum speed?

(J) At what time(s) is the mass instantaneously at rest?

(K) On the graph below sketch a graph for an oscillation that has half the amplitude and twice the frequency.



40. Using the formula for the period of a spring explain which variables should be graphed to obtain a linear graph that can be used to determine the spring constant.

41. Using the formula for the period of a pendulum explain which variables should be graphed to obtain a linear graph that can be used to determine the gravity in space or on a planet that is different from Earth.