



Semester 1 Final Review

Unit 1

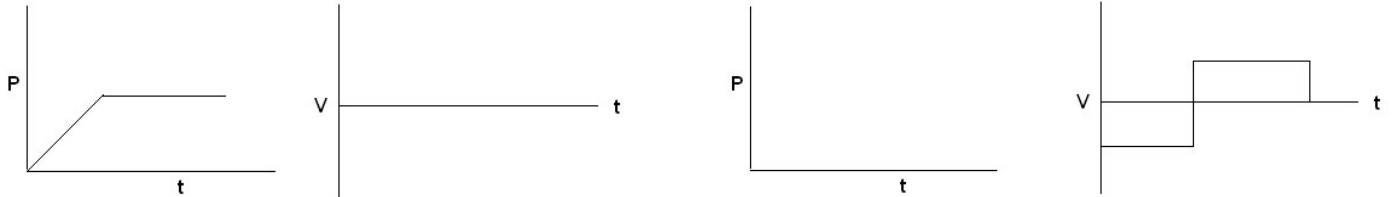
1. Be able to state what **physics** is.
2. Outline the steps of the **scientific method**.
3. Distinguish between **hypothesis, theory** and **law**.
4. Identify and use common **metric prefixes**. (centi, milli, micro, mega, kilo, giga)
5. Show you can use **significant digits** and understand their relationship to **precision**.
6. Distinguish between **dependent (DV)** and **independent (IV) variables**.
7. Be able to find and interpret the **slope** of the curve

Unit 2 Linear Motion

$$\bar{v} = \frac{\Delta d}{\Delta t} \qquad d = \bar{v}t \qquad \bar{v} = \frac{v_f + v_i}{2} \qquad \bar{a} = \frac{\Delta v}{\Delta t}$$

8. Explain the idea that motion is relative (**frame of reference**).
9. Distinguish between **distance, position** and **displacement**.
10. Explain the difference between a **scalar** quantity and a **vector** quantity.
11. Distinguish between **speed** and **velocity**.
12. Distinguish between **instantaneous velocity** and **average velocity**.

13. Interpret and plot **position-time graphs** for positive and negative positions. Be able to determine the slope of a curve on a **position-time graph** and calculate the velocity.



14. Be able to plot and interpret a **velocity-time graph**. Slope = ?

15. Define **acceleration**.

16. How can you use a **velocity-time graph** to find acceleration?

Unit 3 Acceleration

$$\bar{v} = \frac{\Delta d}{\Delta t} \quad \bar{a} = \frac{\Delta v}{\Delta t} \quad v_f = v_i + at \quad v_f^2 = v_i^2 + 2ad$$

$$d = \bar{v}t \quad \bar{v} = \frac{v_f + v_i}{2} \quad d = \frac{v_f + v_i}{2}t \quad d = v_i t + \frac{1}{2}at^2$$

17. Define **acceleration** and give examples of units for acceleration.
18. The velocity of a car increases from 2.0 m/s at time 1.0 s to 16 m/s at 4.5 s. Calculate **average acceleration**
19. Be able to calculate final velocity in the case of **uniform acceleration**. If a car with a velocity of 2.0 m/s at $t = 0$ accelerates at a rate of 4.0 m/s/s for 2.5 s, what is its velocity at time 2.5 s?
20. Be able to calculate the displacement of an object undergoing uniform acceleration when you know two out of the three quantities: acceleration, time, velocity. A car starting from rest accelerates uniformly at 6.1 m/s/s for 7.0 s. How far does the car move?

21. Describe the motion of an object in **free fall** from rest.
22. Describe the motion of an object thrown straight up until it hits the ground, given that **air resistance** is negligible.
23. Determine the speed and the distance fallen at any time after an object is dropped from rest, given that air resistance is negligible. Aunt Minnie drops a penny into a wishing well and it falls for 3.0 seconds before hitting the water. *How fast is it going when it hits? How far down is the water surface?*
24. Describe how **air resistance** affects the motion of falling objects.
25. Explain why acceleration is a **rate of a rate**.
26. Be able to solve problems of the motion of objects uniformly accelerated by **gravity**. $g = \underline{\hspace{2cm}}$

Unit 4 Newton's Laws

$$v_f = v_i + at \qquad v_f^2 = v_i^2 + 2ad \qquad d = \frac{v_f + v_i}{2} t \qquad d = v_i t + \frac{1}{2} at^2$$

$$W = mg$$

$$\text{Equilibrium: } \sum F = 0 \qquad \text{Newton's 2nd Law: } \sum F = ma \qquad F_f = \mu F_N$$

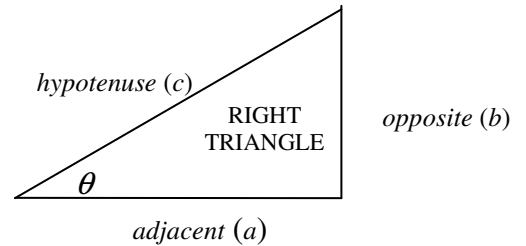
27. Define **force** .
28. State **Newton's 1st law of motion** and define **inertia**.
29. **Newton's 2nd law**: Describe the relationship between **net force** and **acceleration**. How much net-force must a 30,000 kg rocket develop to achieve an acceleration of 1.5 m/s/s?
30. State **Newton's 3rd law of motion** and be able to identify an **action-reaction pair** of forces and its role in a body's acceleration.
31. Distinguish between **weight** and **mass** and use Newton's second law to relate them.
32. Find the weight of a 2.26- kg bag of sugar?
33. Define **friction** and be able to use the **coefficient of friction** to solve problems.

34. The mass of an object is 82.0 kg. Jason pushes the object across the floor at constant velocity with a force of 320 N. What is the force of sliding friction? What is the coefficient of sliding friction?
35. State the requirements for **equilibrium**.
36. Understand the definition of **free fall** and the causes of **air resistance** and **terminal velocity**.

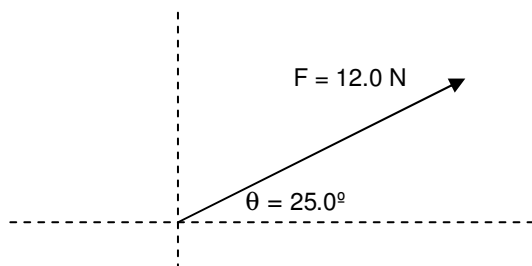
Unit 5 Vectors:

$$\sin \theta = \frac{\textit{opposite}}{\textit{hypotenuse}} \quad \cos \theta = \frac{\textit{adjacent}}{\textit{hypotenuse}} \quad \tan \theta = \frac{\textit{opposite}}{\textit{adjacent}}$$

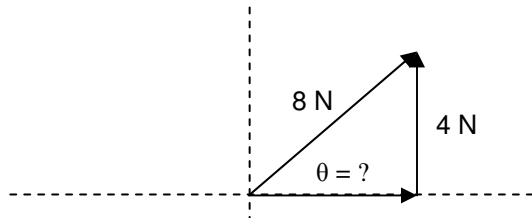
$$\sum F = 0$$



37. Show the ability to add vectors by the **graphical method**; recognize that the order of vector addition does not matter.
38. Understand the addition of forces and be able to solve force vector addition problems. **What would be the MAX and MIN resultant when adding a 10-N vector and a 5-N vector?**
39. Recognize the applications of elementary geometry and trigonometry to vector addition and be able to solve problems using these methods.
40. State the meaning of **equilibrant**, differentiating between **resultant** and **equilibrant**.
41. Specify the proper method of resolving vectors into perpendicular components; be able to choose axes and resolve vectors graphically and analytically. Draw in and calculate the x and y components to the vector below



42. Be able to solve for an angle using trig relations.



Unit 6 Projectile Motion:

$$d = \bar{v}t$$

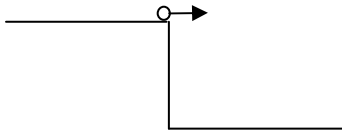
$$d = v_i t + \frac{1}{2} a t^2$$

43. Understand the independence of vertical and horizontal velocities of a **projectile** by solving problems of projectiles launched horizontally.

44. Projectiles always maintain a constant horizontal _____. Why?

Projectiles always maintain a constant vertical _____. Why?

45. A projectile is launched off a cliff that is 30.0 m high. How long will the projectile be in the air? If the horizontal speed is 4.00 m/s, what is the range of the projectile?



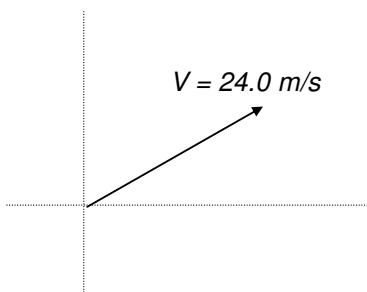
46. For a projectile, describe the changes in the **horizontal and vertical components** of its velocity when air resistance is negligible.

47. Explain why a projectile moves equal distances horizontally in equal time intervals, when air resistance is negligible.

48. Be able to sketch the **trajectory** of a projectile launched horizontally or at an angle.

49. Be able to find the maximum height, time in the air and range of a projectile launched at an angle if initial velocity and angle are given.

50. Chris Simms can throw a football with an initial velocity of **24.0 m/s**. If he throws a ball with this initial velocity at an angle of **35.0°** to the horizontal, find (a) how long will it remain in the air. (b) how far horizontally will it travel; (c) how high it will go.



Unit 7 Uniform Circular Motion, Torque, CG:

$$T = \frac{1}{f}$$

$$\Sigma \tau = 0 \quad \text{or}$$

$$\tau_{\text{ccw}} = \tau_{\text{cw}}$$

$$\tau = F_{\perp} \times d$$

$$v = \frac{2\pi r}{T}$$

$$a_c = \frac{v^2}{r}$$

$$F_c = ma_c = \frac{mv^2}{r}$$

51. Describe **center of gravity**.
52. Predict whether an object will topple, given the location of the center of gravity and the area of support of the object.
53. Distinguish among **stable equilibrium**, **unstable equilibrium**, and **neutral equilibrium**.
54. Define **torque** and describe what it depends on.
55. Describe the condition for one torque to balance another. Define **rotational equilibrium**.
56. Tell whether the forces on an object will produce rotation, given the location of the center of gravity of the object and the position and direction of the forces.
57. Distinguish between **rotate** and **revolve**. Relate **period**, **frequency** and **uniform circular motion**
58. Distinguish between **linear speed** or **tangential speed** and **rotational speed** and explain what each depends on.
59. Define **centripetal acceleration** for objects in circular motion and be able to apply Newton's Laws to such motion.

Unit 8 Universal Gravitation:

$$\left(\frac{T_a}{T_b}\right)^2 = \left(\frac{r_a}{r_b}\right)^3$$

$$F = G \frac{m_1 m_2}{d^2}$$

$$g = G \frac{M}{d^2} \quad (\text{gravitational field strength})$$

$$v = \sqrt{\frac{GM}{r}} \quad (\text{orbital velocity})$$

$$T = 2\pi \sqrt{\frac{r^3}{GM}} \quad (\text{orbital period})$$

$$G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \quad M_E = 5.98 \times 10^{24} \text{ kg}$$

$$r_E = 6.38 \times 10^6 \text{ m}$$

60. List **Kepler's laws** and be able to solve for an orbital period and an orbital radius.

61. Explain Newton's idea that the moon, like an apple, falls toward the earth.

62. Explain why the moon does not fall into the earth, or the planets into the sun.

63. State **Newton's law of universal gravitation**.

64. Understand that gravitational force is proportional to the product of both masses and the inverse square of the distance between the centers of spherical bodies.

65. Distinguish between **g (the acceleration due to gravity)** and **G (universal gravitational constant)**

66. Describe a **gravitational field**. Understand that all bodies have gravitational fields surrounding them that can be represented by a collection of vectors representing the force per unit mass at all locations.

67. Describe what is meant by **gravitational field strength**.

68. Recognize that the motion of satellites in circular orbits about Earth can be understood using equations of uniform circular motion; solve problems involving orbital velocity and period.