Physics 20

Self Assessment Package

PASS MARK = 65%

Effective: May 2005

Available in the Bookstore
Textbook: Physics: Giancoli 5th Edition

Available in the Learning Skills Centre, MC221
Textbook: Physics: Giancoli 5th Edition
Tutors and Worksheets

Available in the Public Library
Variety of Physics texts and materials

PHYSICS SELF ASSESSMENT GUIDE

The object of the Physics Self Assessment Guide is to assist students in determining their ability in technical physics. Physics knowledge upon entry into an engineering technology is assessed using a series of learning objectives. These objectives are listed in the following pages of the study guide. Students can review the objectives and do a self-assessment before arriving at SAIT to take the physics placement exam. A set of self-assessment questions is included in the study guide.

This booklet can help guide you in that process. By reviewing the physics outlined in the booklet and testing yourself using the sample questions, you can find your areas of weakness and brush up on those areas before you arrive at SAIT.

Here's how to use this booklet:

A. Familiarize yourself with the physics properties that you need to know by going through the list of objectives.

B. Answer the study question section. Completing these questions will take between two to four hours.

C. Check your work with the answer section of the booklet.

D. The assessment is not all inclusive. It is only a guide to the difficulty level.

Once you've gone through this process, you will be able to identify your areas of weakness. If your problems are minor, then some self study of an appropriate text or video may be all that's necessary. If you need more help, you can visit a tutor in the Learner Assessment and Skills Centre. (See information booklet for location).

Testing Content
Introduction to Physics

Learning Outcome:

Demonstrate knowledge of the science of physics and the units of measurement involved

Objectives:

1. Define physics and explain how this knowledge can help us to
2. make decisions about questions related to science and technology
3. Define model, theory, law
4. Define measurement, uncertainty, significant figures
5. Compare precision and accuracy and calculate quantities to the accepted number of significant digits
6. Define unit, standards and SI system
7. Convert units of time, mass and length in SI System, British System and between the two systems

Kinematics

Learning Outcome:

Demonstrate knowledge of velocity, acceleration, forces, and vectors

Objectives:

1. Define kinematics, mechanics, dynamics, average speed, instantaneous velocity and acceleration, average acceleration, acceleration due to gravity, uniformly accelerated motion
2. Outline how to solve applied problems
3. Define translational motion, coordinate axes, vectors
4. Calculate average speed, average velocity and distance given the appropriate variables of displacement and time
5. Calculate the instantaneous velocity given the average velocity and time interval

6. Calculate velocity and acceleration given the appropriate variables
7. Manipulate the Kinematic equations for constant acceleration
8. Calculate the speed of fall, position and time for falling object
9. Calculate the speed of rise, position and time for objects thrown upwards
10. Draw the graph of position vs. time for an object moving at a uniform velocity and calculate the slope
11. Calculate the distance an object moves given the uniform acceleration (velocity)
12. Define and compare scalar and vector quantities
13. Explain, quantitatively, two-dimensional motion, in horizontal or vertical planes, using vector components
14. Draw the resultant vector and its components given displacement
15. Use the Tail-to-Tip, Parallelogram and Trigonometric functions to add vectors

Motion and Force

Learning Outcome:

Demonstrate knowledge of changes in velocity being the result of a non-zero net force, the notions of force, inertia, and friction.

Objectives:

1. Define force, inertia, law of inertia, mass, kilogram, Newton's 1^{st}, 2^{nd}, and 3^{rd} Laws, newton, weight, contact force, normal force, net force, free body diagram, kinetic friction, and static friction
2. Explain how a force effects a change in motion
3. Apply Newton's first law of motion to explain an object's state of rest or uniform motion
4. Apply Newton's second law of motion, and use it to relate force, mass and acceleration
5. Determine, quantitatively, the net or resultant force acting on an object, using vector components, both graphically and mathematically
6. Apply Newton's law of motion to solve, algebraically, linear motion problems in horizontal, vertical and inclined planes

Circular Motion and Gravitation

Learning Outcome:

Demonstrate knowledge of motion in two dimensions and universal gravitation.

Objectives:

1. Define uniform circular motion, centripetal acceleration, law of universal gravitation, frequency and period
2. Calculate acceleration of a revolving ball
3. Calculate the force on a revolving ball
4. Calculate the force of an object going around an angle with differing levels of friction
5. Calculate centripetal acceleration and force

Mechanical Waves and Sound

Learning Outcome:

Demonstrate knowledge of waves and energy transfer and sound

Objectives:

1. Define simple harmonic motion including the terms, vibration, oscillation, and periodic
2. Outline the types of waves
3. List and calculate the measures of waves: frequency, wavelength, and velocity
4. Identify and calculate the amplitude of a wave
5. Define wave interference and give examples of interference media: boundaries between media, superposition of waves, standing waves, reflection of waves, refraction of waves, diffraction and interference of waves
6. Identify the properties of sound
7. Discuss sound waves and the Doppler shift
8. Compare and contrast pitch and loudness
9. List the sources of sound
10. Define resonance and explain how sound is detected and how the quality of sound is important
11. Calculate wavelengths, distances and time given the appropriate variables
12. Calculate the intensity level of sound

Light

Learning Outcome:

Demonstrate knowledge of light, reflection, refraction, mirrors and lenses and diffraction and interference of light

Objectives:

1. Outline the fundamentals of light including the facts surrounding light, the speed of sound and the sources of light
2. Diagram the effects of light and matter when related to colour, formation of colour in thin films and polarization of light
3. Discuss how light behaves at a boundary
4. Define the law of reflection and Snell's Law
5. Explain the refraction of light, and outline the importance of the index of refraction and the speed of light
6. Apply the ideas of total internal reflection, effects of refraction and the dispersion of light
7. Explain how images are created from objects in mirrors: plane, concave, parabolic and convex
8. Compare real versus virtual images with concave and convex mirrors
9. Explain how images are created by lenses: convex and concave
10. Discuss chromatic aberrations
11. Discuss the various optical instruments
12. Diagram and discuss when light waves interfere using the two-slit interference pattern to explain
13. Outline how to measure the wavelength of a light wave
14. Explain what a single-slit diffraction is
15. Evaluate the resolving power of lenses

Self Assessment-This assessment is only meant to give students an idea of what the questions will look like. Refer to the objectives so that you make sure to study all topic areas.

1. A truck (mass = 2500 kg) is traveling at 90 km/h on a level road. The driver applies the brakes and decelerates at -3.30 m/s/s. Find: a) the velocity of the truck at one second intervals. b) The displacement of the truck when it stops.

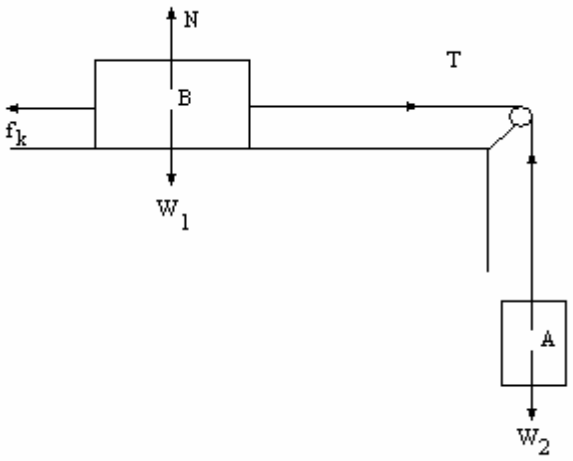
2. A stone is thrown vertically upward with an initial velocity of 20.2 m/s. Find: a) the velocity of the stone at one second intervals until it hits the ground. b) the maximum elevation of the stone.

3. Find the magnitude and standard angle of the resultant for the following three vectors A=20 N @ 24º B = 24 N @ 270º C = 12 N @ 122º

4. A student throws a ball horizontally from the top of the Senator Burns Building. If the building is 120 m high, and the ball lands 55.0 m from the building, find: a) the initial velocity of the ball. b) the velocity at t = 2.8 s.

5. You are in an elevator and you are standing on a scale that reads your weight on Newtons. If the elevator accelerates downward at 1.90 m/s^2, what is the scale reading? Your mass is 75 kg.

6. Two masses A and B are connected by a light cord. Mass B is 4 kg and rests on a horizontal table top. There is friction between mass B and the table. The kinetic coefficient is 0.33. Mass A (3 kg) hangs over the table edge by means of frictionless pully and is falling downward at 1 m/s at this instant. Find: a) the velocity when mass A has fallen 2.00 m b) the tension in the cord.



7. Calculate the centripetal acceleration of the Earth in its orbit around the Sun and net force exerted on the Earth. Assume that the Earth's orbit is a circle of radius 1.50×10^{11}.

8. A spring (k = 400 N/m) is hung vertically.
    a) If a 5 kg mass is attached to the end of the spring and gently lowered to rest position, what will be the stretch of the spring?
    b) If the 5 kg mass is attached and simply dropped, what will be the maximum velocity and the maximum stretch?
    c) What will be the period of resulting oscillation?

9. The noise level in a roller rink is 80 dB with 60 skaters present. Assuming that the noise intensity is directly proportional to the number of skaters, what would be the dB reading if only 5 skaters are in the rink?

10. On a day when the temperature is 30º C, a rifle bullet is fired across a canyon at a steel target on the other side. The bullet's average horizontal speed is 500 m/s. If the sound of the bullet striking the target is heard 11.7 s after it is fired, how far is it across the canyon?

11. You are riding on the C-Train on a warm (35º C) day in July. The windows are open and you can hear the "clang clang" of the crossing bell on 36th Street. The normal frequency of the bell is 600 Hz. The speed of the train as it passes the crossing 90 km/h. What **change** in frequency is observed as you pass by the crossing bell?

12. Find the fundamental frequency and the first three overtones for a 20 cm pipe at 20º C: a) if the pipe is open at both ends. b) If the pipe is closed at one end.

13. In a resonance experiment, the air in a closed tube of variable length is found to resonate with a tuning fork when the air column is first 6 cm and then 18 cm long. Assuming that the temperature if the air is 10ºC, find the frequency of the tuning fork.

14. A piece of light flint glass is placed in a tank of water.
    a) What is the critical angle for light passing from the glass through the water and out into the air? (Assume the light ray leaves the glass but cannot leave the water to get out into the air)
    b) If the wavelength of the light in the air is 700 nm, what is the wavelength in the glass?
    c) What is the speed of the light in the water?

15. A 35mm camera has a converging lens of focal length 50 mm.
    a) what is the size of the image in the camera of a 2.0 m tall man who is standing at a distance of 3.0 m from the lens?
    b) Is the image in the camera real or virtual?
    c) Is it upright or inverted with respect to the man?
    d) Make a scale drawing on graph paper to verify.

ANSWERS

1. a) 25.0 21.7 18.4 15.1 11.8 8.5 5.2 1.9 0 b) 94.7 m
2. a) 20.2 10.4 0.6 -9.2 -19.0 0 b) 20.8 m
3. **R** = 13.2 m @ 334º
4. a) 11.1 m/s→ b) 29.7 m/s θ = 68° down from horizontal
5. 593.25 N
6. a) 3.23 m/s b) 22.3N
7. 5.93×10^{-3} m/s^2 toward the sun (centripetal acceleration of Earth)
   3.55×10^{22} N toward the sun (net force producing acceleration)
8. a) 0.1225 m or 12.25 cm b) 1.0975 m/s c) 0.70248 s
9. 69.2 dB
10. 2.4 Km
11. ΔF = 85.22 Hz
12. a) 3430 Hz b) 3001.25 Hz
13. 1404 Hz
14. 39.265º

For more detailed answers please visit the Testing Centre in room MC221