

ESSENTIAL CONCEPTS FROM PHYS 1401 (for PHYS 1402)

Students taking PHYS 1402 (General Physics II) at CCCCD should have taken PHYS 1401 or an equivalent course. This document summarizes key concepts from PHYS 1401 that are essential for success in PHYS 1402. Practice problems are also included.

ESSENTIAL CONCEPTS

Measurement and Problem Solving

TOPICS:

Dimensional Analysis and Unit Analysis
Unit Conversions
Significant Figures

Motion in Two Dimensions

TOPICS:

Vector Components of Motion
Vector Addition and Subtraction
Relative Velocity

Work and Energy

TOPICS:

The Work-Energy Theorem: Kinetic Energy
Conservation of Energy

Kinematics: Description of Motion

TOPICS:

Distance and Speed
Displacement and Velocity
Acceleration
Kinematic Equations

Force and Motion

TOPICS:

Concepts of Force and Net Force
Newton's Laws

Vibrations and Waves

TOPICS:

Simple Harmonic Motion
Equations of Motion

PRACTICE PROBLEMS

Measurement and Problem Solving

TOPICS:

Dimensional Analysis and Unit Analysis
Unit Conversions
Significant Figures

1) The density of water is 1.00 grams/cm^3 . What is the density in kg/m^3 ?

- A) 1.00×10^{-3}
- B) 1.00×10^6
- C) 0.000100
- D) 1.00
- E) 1.00×10^3

Answer: E

2) Express the result of the following calculation, to the proper number of significant figures:

$$50.19 - 7966 \times 10^{-3}$$

Answer: 42.22

3) A 400-m tall tower casts a 600-m long shadow over level ground. At what angle θ is the sun elevated above the horizon?

- A) 33.7
- B) 65.1
- C) 48.2
- D) 41.8
- E) Can't be found; not enough information.

Answer: A

4) A ly (light year) is the distance that light travels in one year. The speed of light is 3.00×10^8 m/s. How many miles are there in a ly?

(1 mi = 1609 m and 1 yr = 365.25 days)

- A) 5.88×10^{12} mi
- B) 9.46×10^{15} mi
- C) 9.46×10^{12} mi
- D) 2.87×10^{13} mi
- E) 5.88×10^{15} mi

Answer: A

5) Express the result of the following calculation, in scientific notation, to the proper number of significant figures: $((395600.1)/(6.72)) + 19$.

Answer: 5.9×10^4

- 6) In adding the numbers 420.77, 13.821, and 2317.8
- (a) the result should be rounded to how many significant figures?
 - (b) what is the sum?

Answer: (a) 5 sig-figs (b) 2752.4

7) The formula $mg = kx$ describes a spring that is stretched by hanging an object on it. The constant k is called the spring constant. What are its units?

- A) s/m kg B) kg/s^2 C) $\text{m s}^2/\text{kg}$ D) kg s^2 E) N m

Answer: B

Kinematics: Description of Motion

TOPICS:

Distance and Speed

Displacement and Velocity

Acceleration

Kinematic Equations

1) A car decelerates uniformly and comes to a stop after 10 s. The car's average velocity during deceleration was 50 km/h. What was the car's deceleration while slowing down?

- A) 10 km/h-s
- B) 5 km/h-s
- C) 8 km/h-s
- D) 4 km/h-s
- E) 9.8 m/s^2

Answer: A

2) Eric watches a jet powered truck during an "air-show." It accelerates from rest to 300 mph in 8.0 seconds. The acceleration was equivalent to how many "g's"?

Answer: $17 \text{ m/s} = 1.7 \text{ g's}$

3) The Earth-Moon distance is about 238,000 miles. If laser measurements were to show that the Moon is moving away from the Earth at 9.5 cm per year, this would infer that the Moon was very close to the Earth how long ago (assume a constant rate of recession)?

Answer: 4.0 billion yrs (4.0×10^9 yr)

4) Consider a boat that can travel with speed V in still water. For which of the following trips will the elapsed time be least?

- A) Boat travels a distance d downstream and then returns to its starting point.
- B) Boat travels a distance d upstream and then returns to its starting point.
- C) Boat travels a distance $2d$ in still water.
- D) The time is the same in all of the above cases.

Answer: C

5) A train takes 3.0 hours to travel the 1st leg of a trip at 20 m/s. How fast must it move over the 2nd leg of 200 km to have a total average speed of 30 m/s?

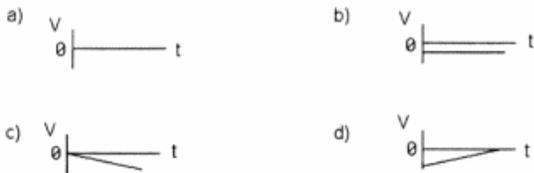
Answer: 65 m/s

6) If you run a complete loop around an outdoor track (400 m) in 100 s, your average velocity is

- A) zero.
- B) 40,000 m/s.
- C) 0.25 m/s.
- D) 4.00 km/s.
- E) 4.0 m/s.

Answer: A

7) Which graph represents a constant non-zero velocity?



- A) graph a
- B) graph b
- C) graph c
- D) graph d
- E) both graphs a and d

Answer: B

8) Consider a heavy object which is thrown straight up, reaches its highest point, and then falls back down to the ground. During what parts of the trajectory was it in "FREE FALL"? (assume here that air friction is negligible)

Answer: During its entire travel during which gravity was the only significant influence on it (it "freely fell" moving up, moving down, and at its motionless highest point).

9) A train traveling at 50 km/h approaches another train moving toward the first at 90 km/h. If they are 35 km apart (on a straight track) how long does it take before they meet?

- A) 25 min B) 45 min C) 55 min D) 30 min E) 15 min

Answer: E

Motion in Two Dimensions

TOPICS:

Vector Components of Motion

Vector Addition and Subtraction

Relative Velocity

1) Consider a velocity with components 36 m/s Westward and 22 m/s Northward. What is its magnitude and direction?

Answer: 42 m/s at 31° North of West

2) A mortar shell is launched with a velocity of 100 m/s at an angle of 30.0° above horizontal from a point on a cliff 50.0 m above a level plain below. How far from the base of the cliff does the mortar shell strike the ground?

Answer: 963 m

3) An airplane with an airspeed of 120 km/h is headed 30.0° East of North in a wind blowing due West at 30 km/h. What is the groundspeed of the plane?

Answer: 102 km/h

4) Billy swims to a point straight across a 100 m wide river that flows at 1.2 m/s. How long does it take him to swim to the other side?

Answer: 46 s

Force and Motion

TOPICS:

Concepts of Force and Net Force

Newton's Laws

1) An automobile initially moving 72 km/hr jams the brakes and skids to a stop in a distance of 24 meters on a dry pavement but stops in 81.6 m for a wet pavement (the auto weighs 2211 lbs; neglect reaction delay).

(a) What is the coefficient of friction for dry weather?

(b) What is the coefficient in wet weather conditions?

(c) Is this the STATIC or the KINETIC coefficient?

Answer: (a) 0.85 (b) 0.25 (c) kinetic coefficient

2) A decoration, of mass M , is suspended by a string from the ceiling inside an elevator. The elevator is traveling UPWARD with a constant speed. The tension in the string is

A) less than Mg .

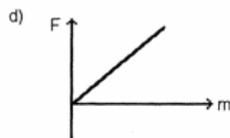
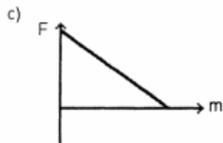
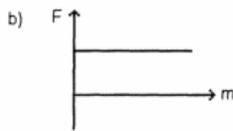
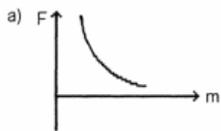
B) greater than Mg .

C) equal to Mg .

D) impossible to tell without knowing the speed.

Answer: C

3) Four students perform an experiment by pulling an object horizontally across a frictionless table. They repeat the experiment on several other objects of different masses, always applying just enough force to produce the same acceleration. They each graph the results, individually.



Which student's graph is correct?

A) graph a B) graph b C) graph c D) graph d

Answer: D

4) A skier, of mass 60 kg, pushes off the top of a hill with an initial speed of 4.0 m/s. How fast will she be moving after dropping 10 m in elevation?

A) 0.15 km/s B) 15 m/s C) 0.20 km/s D) 49 m/s E) 10 m/s

Answer: B

Work and Energy

TOPICS:

The Work-Energy Theorem: Kinetic Energy

Conservation of Energy

1) How many joules of energy are used by a 2.0 hp motor that runs for 1.0 hr?

Answer: 5.4 MJ

2) If a spring-operated gun can shoot a pellet to a height of 100. m on Earth, how high could the pellet rise if fired on the moon?

A) 16.7 m B) 3.60 km C) 600 m D) 3600 m E) 100 m

Answer: C

3) A 30. N stone is dropped from a height of 10 m, and strikes the ground with a velocity of 13 m/s. What average force of air friction acts on it as it falls?

A) 4.1 N B) 7.2 N C) 1.2 N D) 0.13 KN E) 2.9 N

Answer: A

4) My 5.0 hp mower would be equivalent to an electric mower rated at what power?

A) 0.25 KW B) 0.78 KW C) 3.7 KW D) 2.8 W E) 2.8 KW

Answer: C

Vibrations and Waves

TOPICS:

Simple Harmonic Motion

Equations of Motion

1) Waves on a lake pass under a floating bird causing the bird to bob up and down with a period of 2.5 seconds. If the distance from wave trough to wave trough is 3.0 meters, what is the speed of the wave?

A) 1.2 m/s B) 0.21 m/s C) 2.1 m/s D) 1.5 m/s E) 1.9 m/s

Answer: A

2) A 0.30 kg mass is suspended on a string. In equilibrium the mass stretches the spring 2.0 cm downward. The mass is then pulled an additional distance of 1.0 cm down and released from rest.

(a) Calculate the period of oscillation.

(b) Calculate the total energy of the system.

Answer: (a) 0.28 s (b) 0.0074 J

3) Total constructive interference occurs when two waves with similar frequency and wavelength

A) have 90 degrees phase difference.

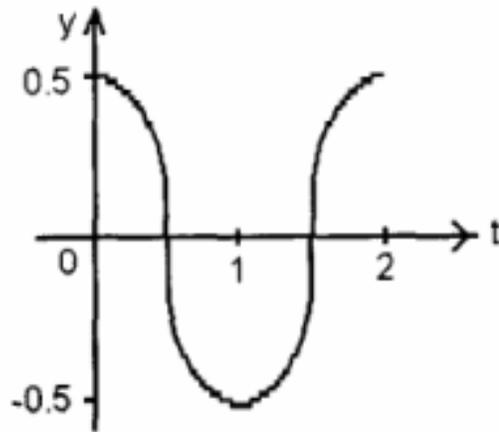
B) are completely in phase.

C) have a phase difference of -90 degrees.

D) are completely out of phase.

Answer: B

4) The equation of motion of the wave shown is



A) $y = 1.0 \cos (2\pi t)$.

B) $y = 1.0 \sin (\pi t)$.

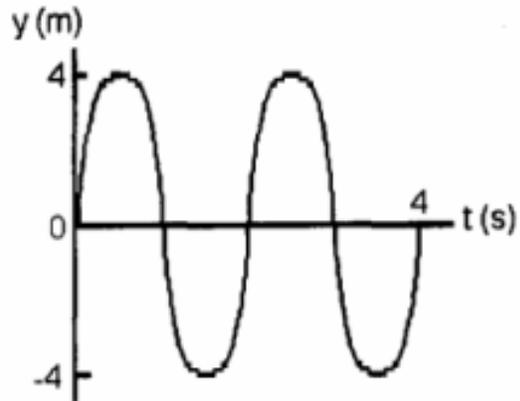
C) $y = 0.5 \cos (40t)$.

D) $y = 0.5 \sin (40t)$.

E) $y = 0.5 \cos (\pi t)$.

Answer: E

5) Consider the wave shown below.



The frequency

A) is 1 Hz.

B) is 0.5 Hz.

C) is 2 Hz.

D) is 4 Hz.

E) cannot be determined from the given information.

Answer: B