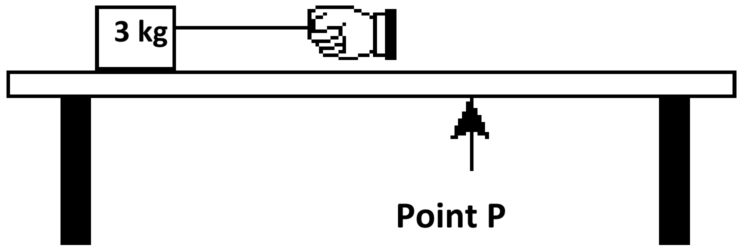
Physics Semester 2 Final Exam Review Answers

A student attaches a string to a 3 kg block resting on a frictionless surface, and then *pulls steadily* (with a constant force) on the block as shown below. Assume no effect of air resistance on the block.



1. Write a statement that describes the motion of the block along the table WHILE the student is pulling steadily.
   The block is speeding up

2. What amount of force would be required to cause the block to move from rest to a have an acceleration of 2 m/s/s?
   6 N

3. After the student pulls the block to Point P on the table, the string breaks. The motion of the block AFTER the string breaks could best be described as:
   The block moves at a constant speed

4. Which exerts more force; the table on the block or the block on the table?
   They exert the same force on each other N3LPF

5. What is the weight of the block? (assume g = 10 N/kg)
   weight = 30 N

6. Name the force(s) acting in the **horizontal direction** on the block AFTER the string breaks?
   There are no forces in the horizontal direction!

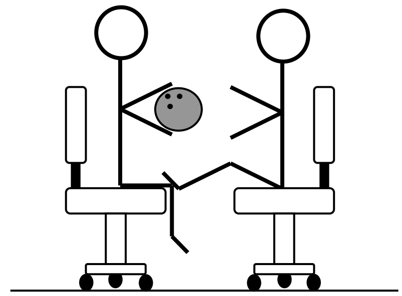
Eventually the block reaches the edge of the table.

7. How is the block speeding up after it has left the table?
   The block accelerates downward but goes at a constant speed to the right.

8. Suppose that the student sets up the 2 kg block again at rest attached to the string, but this time steadily pulls with twice as much force on the block in the same direction. What could be said of the block's motion while it was being pulled?
   It would have twice the acceleration

9. Suppose that the same student sets up a block, which is 4 kg, at rest attached to the string, and pulled with the same original force on the block in the same direction. What could be said of the block's motion while it was being pulled?
   It would have half the acceleration

To test Newton's Laws, two physics students of equal mass sit in low friction chairs (as shown at right.) One student (A) is holding a 16-pound bowling ball. The other student (B) puts her feet on A's knees and pushes off (see picture at the right).



A B

10. Write a statement that best compares the **forces** of the students.
    They exert the same force on each other N3LPF

11. Write a statement that best compares the **accelerations** of the students.
    Student A has less acceleration because he has more mass

12. Why is it more difficult to get student A to move?
    More mass means more inertia and more resistance to change in motion

13. If student A took his bowling ball to the moon how would its mass and weight change?
    The mass (the amount of matter in the ball) would remain the same – same ball but it would weigh less because the moon pull objects down less; less gravitational field strength.

A truck with mass16000 kg collides with a car with mass 800 kg at rest. They stick together and continue to move to the right.

14. What is the total momentum of the system **before** the collision?
    9600 kgm/s

15. What happens to the total momentum of the system **after** the collision?
    momentum before = momentum after *that is the law!*

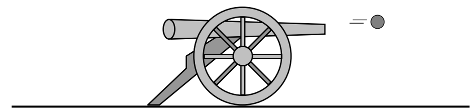
16. What is the velocity of the pair after the collision?
    4 m/s

17. Compare the force of the truck on the car to the car on the truck during the collision.
    F car on truck = F truck on car *they are Newton's 3rd Law Force Pairs*

18. Why is it safer for the driver of the car to impact the airbag than the windshield?
    The air bag increases the stopping time thereby decreasing the stopping force

19. Is it possible for a bowling ball and a golf ball to have the same momentum?
    Yes – the bowling ball has to be slow and the golf ball fast to equal out the masses

A Civil War cannon with mass 800 kg fires a cannon ball with mass 8 kg.

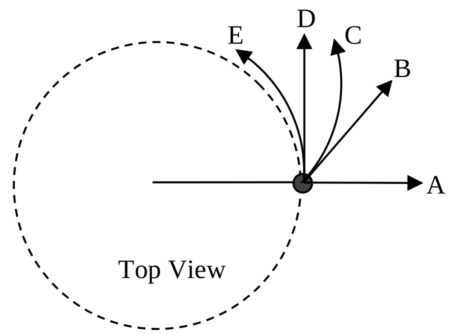


20. Which exerts more force, the cannon on the ball or the ball on the cannon?
F cannon on ball = F ball on cannon *they are Newton's 3rd Law Force Pairs*

21. Based on mass which will have larger change in velocity the cannon or cannon ball? U7S7
The ball has a bigger change in velocity because it has a smaller mass

22. If the cannon applies an average force of 10,000 N to the ball for 0.10 seconds, at what speed does the ball leave the cannon?
125 m/s

Imagine that a steel ball is swung in a horizontal circle at a constant speed.



23. In what direction does the velocity of the ball point?
The velocity always points tangent to the circular path

24. In what direction does the acceleration of the ball point?
The acceleration always points toward the center

25. Are the forces balanced or unbalanced? How do you know?
The forces are unbalanced – you know this because the velocity is changing directions so the ball is acceleration and acceleration means unbalanced forces

26. In what direction does the unbalanced force on the ball point??
The unbalanced force always points toward the center (same as the acceleration)

27. What is the nickname we give to the unbalanced force on the ball? What provides that unbalanced force?
unbalanced force = centripetal force and is provided (in this case) by the string

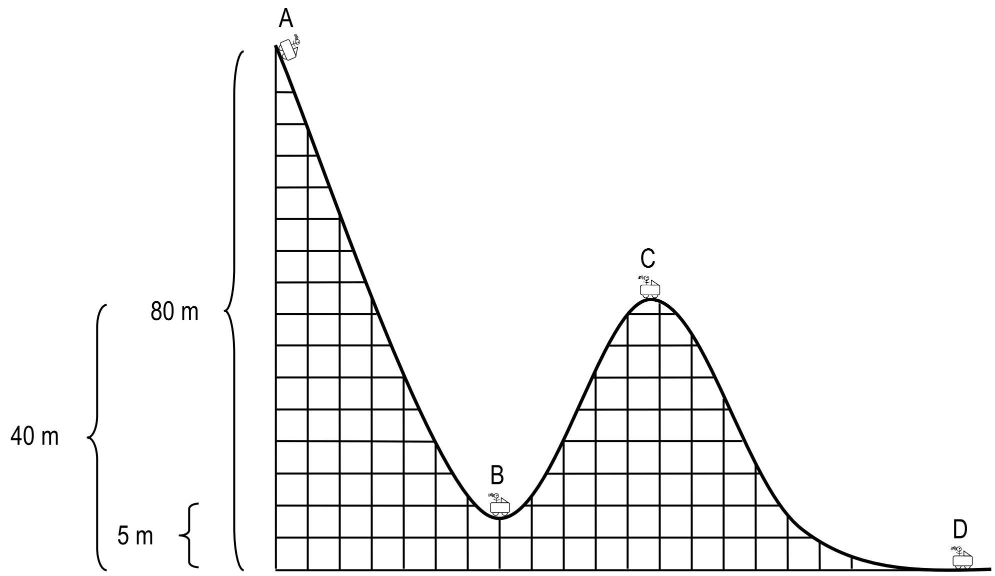
28. What provides the outward force on the ball?
It's a trick! There are no outward forces

29. If you wanted to increase the speed of the ball what would you have to do to the force on the string?
Pull harder on the string; increase the inward force

30. Look back at the original picture above. At the position shown the string breaks. Which path will the ball take?
D

31. Describe the path of the ball after the string breaks.
The ball will go in the direction of D because an object in motion will stay motion in a straight line

Pictured below is a new roller coaster. A physics student riding and the coaster car have a combined mass of 200 kg. The car is at rest at point A and there is no braking at point D. Assume no friction between the coaster car and the track.



32. Rank the total energy from least to greatest.
    The total amount of energy stays the same the whole time

33. Rank the gravitational energy from least to greatest.
    D B C A

34. Rank the kinetic energy from least to greatest.
    A C B D

35. Rank the speed of the cart from least to greatest.
    A C B D

36. What happens to the energy as the cart rolls from A to B?
    The gravitational energy is converted to kinetic energy

37. Determine the student's gravitational energy at point A.
    160000 J

38. Determine the student's kinetic energy at point A.
    0 J (it is stopped)

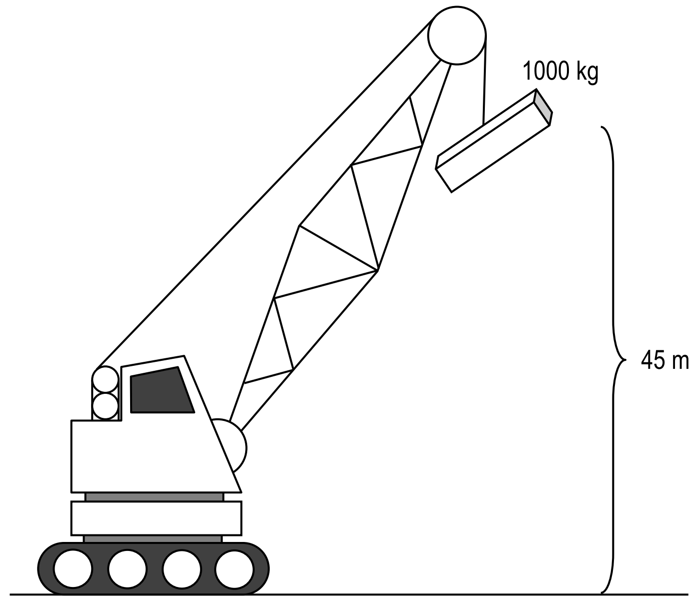
39. At point B, her height is only 5 m. Determine her gravitational energy and kinetic energies at point B.
    Gravitational Energy = 10000 J Kinetic Energy = 150000 J

40. At point D the coaster is on the ground and still moving. How fast is it going at Point D?
    40 m/s

On a real rollercoaster friction (both from the track and the air) are very present.

41. Draw pie charts for a real rollercoaster as it moves from points A to B to C to D?
    G → K + G +T → G + K +T → K + T

A crane lifts a steel girder of mass 1000 kg to a height of 45 meters.



42. Did the crane do work on the girder? How do you know?
    Yes – the crane lifts the girder giving it gravitational energy. Work is the transfer of energy and the motor transfers electrical energy to gravitational energy

43. How much work was done by the crane's motor?
    450000 J

44. If the motor pulls the girder up in 30 seconds what is the power output of the motor?
    15000 Watts

A water bug is sitting on the surface of a pond when a frog jumps in and disturbs the water. The bug makes 20 bobs up and down in 25 seconds and reaches a maximum height of 0.30 meters above still water. With his handy-dandy meter stick, he measures the length between crests of the wave to be 4 meters. After a few seconds, the height of the waves is only 0.10 meters.

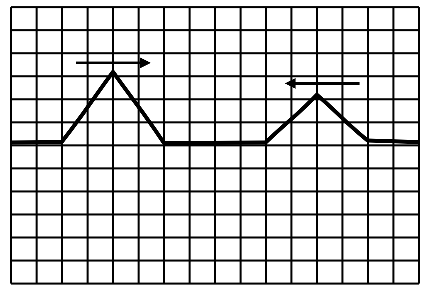
1. What is the period of the waves?
   1.25 seconds/wave

2. What is the frequency of the waves?
   0.8 waves/second

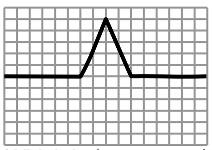
3. What is the speed of the waves in the water?
   3.2 m/s

4. What happens to the speed of the wave as the amplitude becomes smaller?
   Nothing – the speed of the waves is determined by the water.

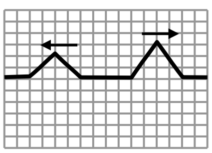
Two wave pulses approach each other from opposite ends of a spring as shown.



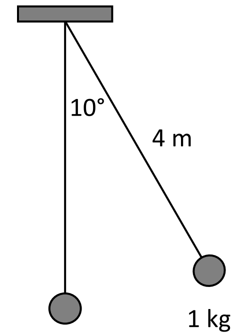
5. Which below correctly represents the waves while they are interacting?



6. Which below correctly represents the waves after they have passed through each other?



Some physics students set up a pendulum in the classroom as shown.

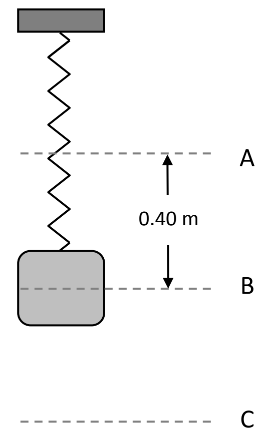


7. How much time would it take for this pendulum to complete one full swing?
   4 seconds

8. How would halving the mass of the ball AND doubling the initial displacement angle affect the period of the pendulum?
   The period would stay the same.

9. What would you have to do to the length of the pendulum to get the period to halve?
   You would have to decrease the length by a factor of 4.

10. To go along with their pendulum the physics students mentioned above built this mass and spring oscillator. Create a mass and spring konstant scenario that would have the same period as the pendulum above.
    If the mass was 2 kg and the spring konstant was 5 N/m



11. What is the amplitude of the spring and mass oscillator as shown?
    0.40 m

12. What happens to the net force on the block as it moves from A to C?
    The net force is down at A, zero at B and up at C.

13. How would the time of one oscillation change if the total displacement between A and B were doubled to 0.8 meters?
    The period would stay the same.

Riding down the street on your bicycle, you see an ambulance approaching. You pull over to the side of the road and stop, waiting for it to pass. The siren has a natural frequency of 1024 Hz.

14. How do you hear the siren as it approaches?
    Higher pitched because the waves are bunched together in front of the ambulance.

15. After it passes you the siren changes pitch. How does it sound? Why?
    The pitch drops because behind the ambulance the waves are spread out causing a smaller frequency and a lower pitch.

16. Why do trombones have a higher pitch than tubas?
    Trombones are shorter than tubas. Shorter instruments create sound waves with shorter wavelengths. Small wavelength have larger frequencies and higher pitches.

17. Middle C on the piano has a frequency of 256 Hz. The next lower C (one octave lower) has a frequency of:
    128 Hz

18. The string inside the piano that plays that lower octave is:
    Twice the length

19. Can sound waves travel through empty space?
    No – sound waves are mechanical waves and thus need a physical medium (like air) to even exist.

20. How are sound waves differernt than water waves?
    Water waves are transverse – the particles vibrate perpendicular to the direction of the wave's motion. Sound waves are compressional waves – the particles vibrate parallel to the direction of the wave's motion.

21. You're standing 340 meters from the wall of a canyon. If you yell out, how long until you'll hear the echo?
    2 seconds

22. How will the time change if you yell louder?
    It won't. The time only relies on the air, not the loudness of the sound.

23. Which travel faster through air – high frequency sound waves or low frequency sound waves?
They would travel at the same speed because if they are traveling in the same air, they have the same speed.

24. List the electromagnetic waves from highest to lowest frequency?
G – X – U – L – I – M – R

25. List the electromagnetic waves from largest to smallest wavelength?
R – M – I – L – U – X – G

26. List the electromagnetic waves from fastest to slowest?
They all travel at the same speed.