Honors Physics Semester 2 Final Exam Review Answers

A truck with mass 1600 kg collides with a car with mass 800 kg at rest. They stick together and continue to move to the right.

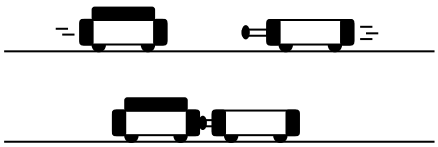
1. What is the total momentum of the system **before** the collision?
   14400 kgm/s

2. What happens to the total momentum of the system **after** the collision?
   total momentum before = total momentum after that's the law!

3. What is the velocity of the pair after the collision
   6 m/s

4. Compare the force of the truck on the car to the car on the truck during the collision.
   F truck on car = F car on truck N3LFP

A 1.0 kg low-friction non-plunger cart is moving toward a 0.50 kg low-friction plunger. The carts collide and the spring is compressed and the carts momentarily come to a stop as shown.



5. How do the accelerations of each of the carts compare?
   The acceleration of the smaller mass cart is greater

6. How do the changes in momentum Δp of the carts compare?
   The changes in momentum of each of the carts are equal and opposite

7. Why is it safer for a pole-vaulter fall onto a puffy mat than onto the ground?
   The puffy increases the stopping time thereby decreasing the stopping force

8. Is it possible for a bullet and a baseball to have the same momentum?
   Yes if the baseball is going slow and the bullet is going fast or they are both not moving ☺

9. Why do you think medieval catapults had very long flinging arms?
   Longer arms means that the force applied lasts for more time giving the projectiles a lager change in velocity

A Human Cannon Ball is a carnival trick where a person is launched from a giant cannon. Suppose that the person has a mass of 80 kg and the cannon a mass of 800 kg. When the daredevil is launched…

10. Which exerts more force, the cannon on the man or the man on the cannon?
    They exert equal forces on each other N3LFP

11. Based on mass which will have larger change in velocity the cannon or cannon ball?
    The man will move forward faster than the cannon moves backward because he has less mass

12. If the cannon applies an average force of 1000 N to the man for 0.50 seconds, at what speed does the man leave the cannon?
    6.25 m/s

To conduct a physics experiment we took some physics students and bicycles onto the high school track. The rider and bicycle have a total mass of 99 kg. On the bicycle he rode the 100 m turn in 8 seconds. The radius of the turn was 33 meters.

13. What is the average speed of the rider?
12.5 m/s

14. What is the centripetal force necessary for the runner to make the turn?
469 N

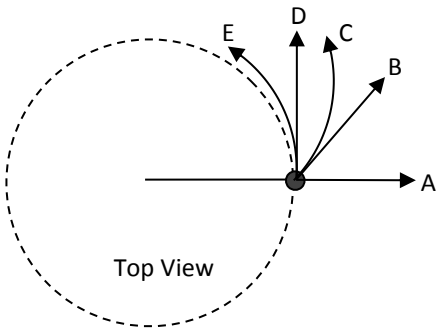
15. What provides the centripetal force necessary for the runner to make the turn?
The friction between the track and the tires

16. In what direction must the runner lean to make the turn?
When in circular motion you always lean inward toward the center – the direction of the acceleration

17. At what angle must the runner lean to make the turn?
25°

18. What is the minimum coefficient of friction necessary for the runner to take the turn without slipping?
0.47

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



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

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

21. 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

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

23. What is the nickname we give to the unbalanced force on the ball? What provides that unbalanced force? U6S0
Unbalanced force = centripetal force and is provided (in this case) by the string

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

25. If you increased the force on the ball by a factor of three what would happen to the speed of the ball?
The speed would increase by a factor of 9

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

27. 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

28. Why is it that objects float?
Objects float if the upward force by the water is equal to the downward force by the earth.

29. How is the density of an object related to its ability to float in a fluid?
If the density of the object is less than the density of the surrounding fluid the object will float.

A sample of mineral oil has a mass of 8 g and a volume of 10 ml. A piece of Styrofoam density of 0.60 g/cm^3.

30. Calculate the density of the mineral oil.
Density of mineral oil = 0.80 g/ml = 0.80 g/cm^3

31. Styrofoam will float in mineral oil. What percent of the Styrofoam remains under the oil?
75% under the surface

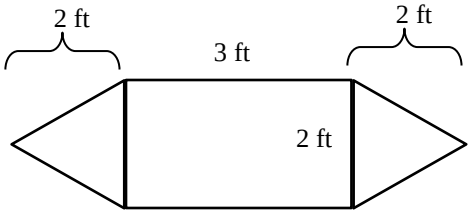
An aluminum foil boat of mass is constructed in the form of an open topped cube with individual side lengths of 4 cm. You place 5 nickels, each with a mass of 5 g, into the boat so that it sinks halfway into the water.

32. Calculate the volume of water displaced by the boat?
32 cm^3

33. What mass, in grams, can the above volume of displaced water support?
32 g

34. What is the total mass of the boat?
7 g

A cardboard boat is to be constructed so that the bottom of the boat has the dimensions shown at the right and straight sides. Rower #1 weighs 140 pounds, the boat weighs 10 pounds and the gear weighs 2 pounds. The water line is 6 inches up from the bottom of the boat.

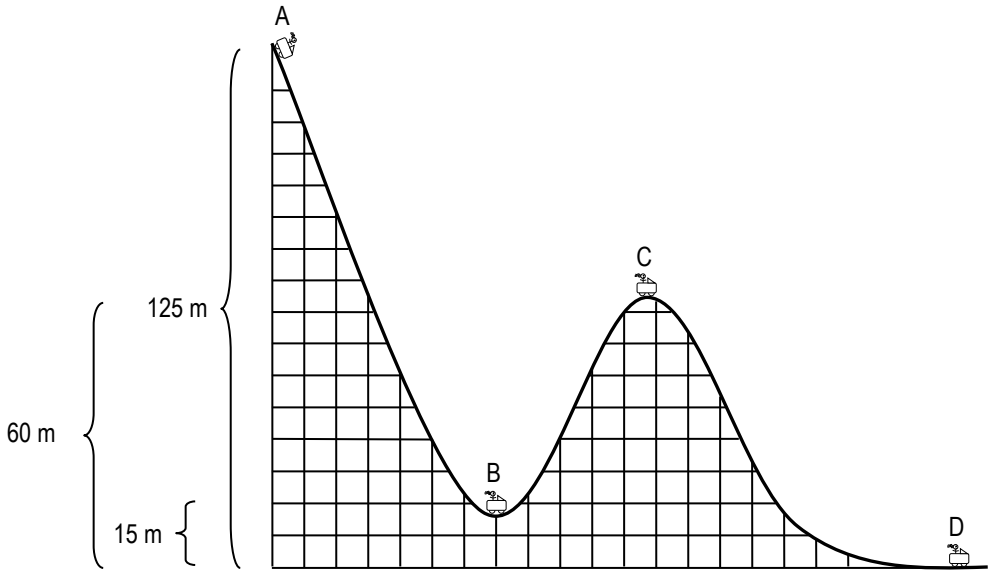


35. How much weight can one cubic foot displaced of water support?
62.4 pounds

36. Calculate the volume of water displaced by the boat.
5 ft^3

37. What is the weight of rower #2?
160 pounds

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.



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

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

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

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

42. What happens to the energy as the cart rolls from A to B?
Some of the gravitational energy is converted to kinetic energy

43. Determine the student's gravitational energy at point A.
250000 J

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

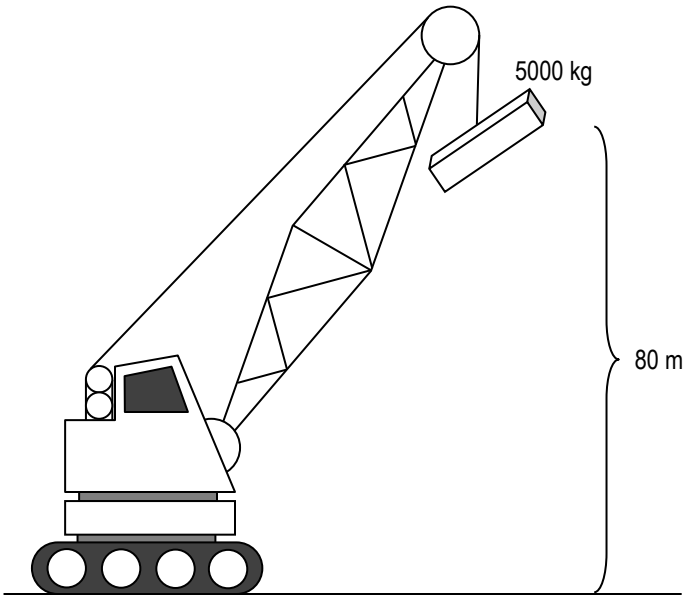
45. At point B, her height is only 15 m. Determine her gravitational energy and kinetic energies at point B.
Gravitational Energy = 30000 J Kinetic Energy = 220000 J

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

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

47. 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

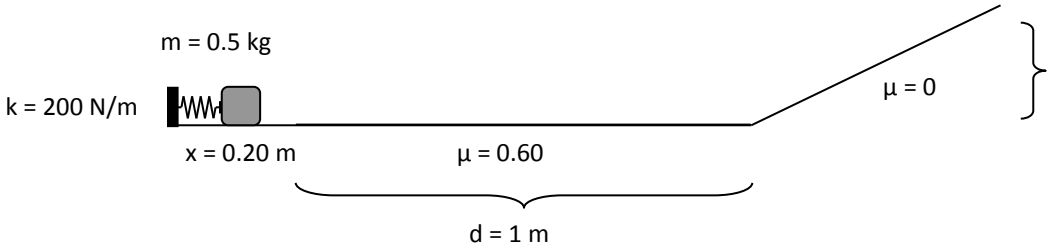
A crane lifts a steel girder of mass 5000 kg to a height of 80 meters.



48. 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

49. How much work was done by the crane's motor?
400000 J

50. If the motor pulls the girder up in one minute seconds what is the power output of the motor?
6667 Watts



A 0.50 kg block that was being pushed against a spring is released from rest. The spring pushes the block which slides along a rough surface and then up a frictionless ramp and comes to a stop near the top of the ramp.

51. What happens to the total energy of the system as the block is pushed off of the spring; slides over the rough surface and then up the hill?
The total energy of the system stays constant

52. What is the speed of the block just after it leaves the spring?
4 m/s

53. What is the speed of the block as it leaves the rough surface?
2 m/s

54. To what vertical height does the block go?
0.2 m

55. Write one sentence that describes the spring constant.
For every additional 1 meter you compress the spring you would need to apply an additional 200 N

56. What is the force that you would have to apply to hold the block against the spring?
40 N

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.

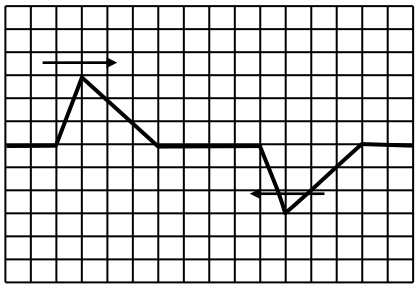
57. What is the period of the waves?
1.25 seconds/wave

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

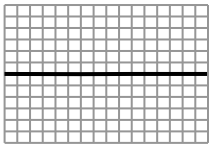
59. What is the speed of the waves in the water?
3.2 m/s

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

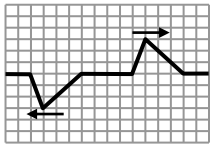
Two wave pulses approach each other from opposite ends of a spring as shown.



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



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



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.

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

64. 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.

65. 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.

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

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

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

69. 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.

70. 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

71. 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.

72. 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.

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

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

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