Conceptual Physics Final Exam Review

Linear Motion

$$v = \frac{\Delta x}{\Delta t}$$

$$a = \frac{\Delta v}{\Delta t}$$

Linear Dynamics

$$a = \frac{\Sigma F}{m}$$

$$F_{EarthonObject} = mg$$

g = 10 m/s^2

Momentum

$$I = F\Delta t$$

$$p = mv$$

Work and Energy

$$W = F\Delta x$$

$$U_g = mgh$$

$$P = \frac{W}{t}$$

Properties of Matter

$$d = \frac{m}{V}$$

DC Circuits

$$I = \frac{V}{R}$$

$$P = VI$$

Waves and Sound

$$v = f\lambda$$

Conceptual Physics Final Exam Review

**Note: these problems are a general overview of what we have learned. Going through your notes, textbooks, old quizzes, old tests, and possibly even some labs will aide in your studying for the final exam.*

Linear Motion

Make sure you know how to:

a) draw a motion diagram for a moving object.
b) determine the direction of acceleration using a motion diagram.
c) interpret a position vs clock reading graph.
d) solve problems using the equations for motion (and know the correct units).

Hewitt Chapter 4

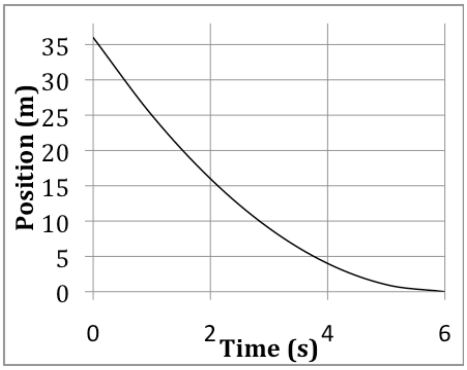
1. Are you moving while sitting on a train that is leaving the station?

2. Give an example in which an object with negative acceleration and is speeding up. Give an example in which an object with positive acceleration is slowing down.

3. Meg created a dot diagram for a bug she found on the ground.

a. Use the dot diagram to describe the motion of the bug. You may add information to the dot diagram if you need to.
b. What must be true about an observer so that the observer draws a dot diagram for the bug that looks the same as that created by Meg?

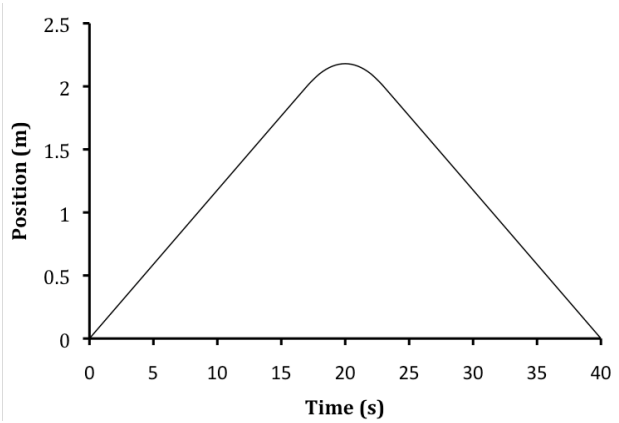
4. Write a story that would represent the same motion as in the position versus time graph.



Conceptual Physics Final Exam Review

5. Wilbur starts at a position of 0 m and walks towards his house at a speed of 2 m/s.
    a. Draw a picture of the situation.
    b. Draw a dot diagram for Wilbur.
    c. Sketch a position vs time graph.
    d. How much time will it take him to walk to his house 8 m away?

6. The position of an object for 40 seconds is represented in the graph above.



a. Write a short story about the object's motion represented in the graph.

b. Draw a motion diagram that could represent the same motion that is represented in the position versus time graph above.

c. What is the object's position at 10 seconds?

d. What is the object's path length from 0 – 40 seconds?

e. What is the object's displacement from 0 – 40 seconds?

Linear Dynamics

Make sure you know how to:
a) identify a system.
b) construct a force diagram.
c) use a force diagram to solve problems using Newton's second law.

Hewitt Chapters 2, 3, 6, 7

7. You slide toward the right at decreasing speed on a horizontal wooden floor. Choose yourself as the system and list external objects that interact with and exert forces on you.

Conceptual Physics Final Exam Review

8. Why do you need to keep pushing a grocery cart in a store in order to keep it moving?

9. An elevator in a tall office building moves downward at constant speed. How does the strength of the upward force exerted by the cable on the elevator compare to the strength of the downward force exerted by Earth on the elevator? Explain your reasoning.

10. Identify third law force pairs for the following interactions: A rollerblader and the floor, a volleyball player and the volleyball, and a speeding up car's tires and the road.

11. The following integer (number) statement represents a situation involving forces exerted on **the same** object.

$$(-7\text{ N}) + (+7\text{ N}) = 0$$

    a. Choose the object of interest and say what other objects interact with this object.
    b. Draw a picture of a situation that the statement can represent.
    c. Then draw a force diagram describing the same situation.

12. You are pushing a refrigerator horizontally on a smooth floor exerting a 75 N force on it. The Earth pulls on the refrigerator exerting a 700 N force on it.
    a. Draw a force diagram for the refrigerator.
    b. What is the force that the floor exerts on the refrigerator? Explain how you know.
    c. What is the unbalanced force exerted on the refrigerator? Explain how you know.

13. Draw a motion diagram and a force diagram of each of the following objects (the object of interest is in bold) once the object is in motion. Make sure that you check for consistency.
    a. A **ball** is dropped.
    b. A **ball** is thrown upward but has not yet been released.
    c. A **football** lands on a cushion (while the cushion is being compressed)
    d. A **rabbit** sits in its cage.

14. You are pushing on a box on a smooth floor exerting a 7.0 N force on it. The mass of the box is 3.5 kg.
    a. Draw a force diagram for the box assuming that other forces exerted on the box are balanced.
    b. Draw a motion diagram.
    c. Are they consistent? What is the acceleration of the box?
    d. You push for 1.5 seconds. What is the speed of the box after 1.5 seconds?

15. Imagine that after 1.5 seconds you stop pushing the box in question 14.
    a. What will happen to the box? Explain.
    b. Draw a motion diagram and a force diagram to support your answer.

16. A 2 kg book sits on the tabletop.
    a. What is the *Newton's Third Law pair* for the *force that the Earth exerts on the book*?
    b. If the Earth exerts a 5 N force on the book, what is the force that the book exerts on the Earth?
    c. What is the acceleration of the book if Earth is the only object that exerts a force on it?
17. Reason
    a. You hit a stationary puck with a hockey stick. The stick exerts a 100-N horizontal force on the puck. What is the force exerted by the puck on the stick. How do you know?
    b. A truck rear ends a small sports car that is moving in the same direction as the truck. The collision makes the truck slow down and the sports car is propelled forward. What object exerts a larger force on the other object: the truck on the car or the car on the truck. Explain how your answer reconciles with Newton's third law and with the fact that the sports car is damaged more than the truck.
    c. The Earth pulls on apple exerting a 1.0 N force on it. What is the force that the apple exerts on the Earth? Why does the apply fall towards the Earth but the Earth does not move towards the apple?
    d. The tree branch exerts a 1.0 N force holding the apple. What is the force that the apple exerts on the tree branch?

Static Equilibrium

Make sure you know how to:

a) define center of mass.
b) define equilibrium.
c) balance a mobile (i.e. where should heavier objects be hung? Lighter objects?).

Hewitt Chapter 11

Conceptual Physics Final Exam Review

Momentum

Make sure you know how to:

a) differentiate between elastic and inelastic collisions.
b) understand the difference between constant and conserved for various systems.
c) solve problems using the formulas for impulse and momentum.

Hewitt Chapter 8

18. At the National Transportation Safety test facility, they record the collision of two identical cars initially moving at 80 km/h (45 mph) toward each other. Immediately after the collision, the cars are at rest stuck to each other. The velocities before the collision were the same magnitude but in opposite directions. Explain. Include a bar chart and remember to identify your system in your sketch.As a bullet enters a block, the block exerts a force on the bullet, causing the bullet's speed to decrease to almost zero. How can we use conservation of momentum to analyze this situation?

19. A 10 kg object has a speed of 5 m/s what is its momentum?

20. Two people one with a mass of 70 kg and the other with a mass of 100 kg are both running at 2 m/s who has more momentum? Why?

21. A 2000 kg car moves at 20 m/s has how much momentum?

22. When would a ball hitting a wall have a greater change in momentum: when it hits the wall and bounces back at the same speed or when it hits and sticks to the wall? Explain your answer. Include sketches and bar charts in your explanation.

23. A 1000-kg car traveling east at 24 m/s collides with a 2000-kg car traveling west at 21 m/s. The cars stick together. Their velocity immediately after the collision is _____.

24. A baseball bat contacts a 0.145-kg baseball for 0.0013 s. The force exerted by the bat on the ball is 8900 N. What is the impulse exerted on the ball?

Conceptual Physics Final Exam Review

Work and Energy

Make sure you know how to:

a) choose a system and the initial and final states of a physical process.
b) differentiate between positive work, negative work, zero work, and solve problems using the equation for work.
c) interpret work and energy bar charts.

Hewitt Chapter 9

25. Describe two processes where an external force is exerted on a system object and there is no work done on the system.

26. When we use energy conservation ideas, how do we incorporate the force that Earth exerts on an object?

27. Thomas and Nikola are running towards each other at high speeds. They collide and stop. Where did their kinetic energy go? What happened to their momentum?

28. Why is it important to choose the system of interest before attempting to analyze a process?

29. Describe a real-life situation in which an external force does the following:
    a. Positive work on a system
    b. Positive work on a system but with a value that is less than that in part (a)
    c. Negative work on a system
    d. Zero work, even though an object in the system moves.

30. Kathleen does 1000 J of work to push a lawnmower 10 m across the yard. How much force does she exert on the lawn mower?

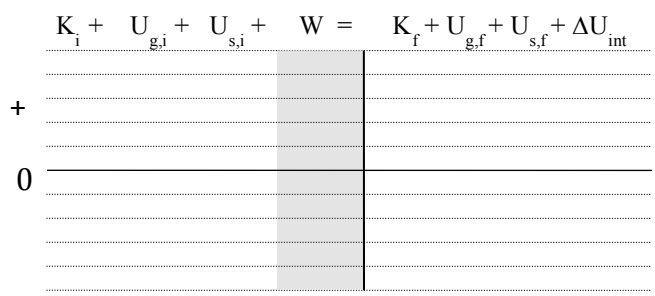
31. Samir very, very slowly moves a box from the table down to the floor. Draw a picture showing the direction of the force that he exerts on the box and the direction of the box's displacement.

32. Think of a real-life situation that is consistent with the work-energy processes described below. Do not mention previous examples.
    a. No external work is done on the system, but due to some processes in the system, kinetic energy of the system transforms into gravitational potential energy.
    b. Positive work is done on the system, both kinetic energy and gravitational potential energy of the system increase.

33. You are on a swing. Your friend pulls the swing up to 1 m above ground. You start swinging. **Choose and identify your system** and represent the following processes on the bar chart.
    a. Initial state: you are at the bottom of the swing, not moving; final state: the friend pulls the swing up.
    b. Initial state: you are at the top of the swing (1 m above ground), final state: you are at the bottom of the swing's path, still moving.

Need Some Help?

Work-energy bar charts provide a concrete way to represent work-energy processes. In a work-energy bar chart, a bar represents each type of energy initially in the system, as well as the final energies of the system. If external objects do work on the system (positive or negative), then there is a bar to represent work.



Across the top of the chart, you see several symbols for different energies…

K – Kinetic energy
U_g – Gravitational potential energy
U_s – Elastic or spring potential energy
W – Work
ΔU_{int} – Change in internal energy
- (Difference between final and initial)

2. The ***i*** and the ***f*** represent initial and final states

We don't know the exact amount of energy or work usually but we can still make estimates based on the situation. The column for the work bar is shaded to indicate that it is not a type of energy but is instead a process involving an interaction between a system object and an object outside the system.

Properties of Matter

Make sure you know how to:

a) differentiate between objects of different densities.
b) solve problems using the density equation.

Hewitt Section 18.2

34. What is the difference between Mass and Volume? What is one example of an instrument we can use to measure each of these physical quantities?

35. Calculate the density of a metal cylinder whose mass is 8.1 g and volume is 3 cm^3.

Conceptual Physics Final Exam Review

36. Find the volume of a solid whose density is 4.5 g/cm^3 and mass is 31.5 g.

37. Find the mass of a cube whose volume is 6 cm^3 and density is 8.9 g/cm^3.

Electrostatics and Electric Fields

Make sure you know how to:

a) describe the force that one charged object exerts on another charged object.
b) apply the concept of electric field to understand electric interactions.
c) distinguish between protons, neutrons, and electrons.
d) distinguish between positive and negative charges.
e) know how to draw electric field lines for positive and negative charges.

Hewitt Chapters 32 and 33

38. Use the ideas of shielding and electric fields to explain why you are safe in your car if there is lightning nearby.

39. What is the difference between a conductor and an insulator? Provide an example of each.

40. Draw electric field lines for the electric field created by the particles described below:
    a. Two positive charged particles objects.
    b. A small positively charged particle and a small negatively charged particle with three times as much charge.

41. How does a Van de Graff generator work?

42. Your clothing tends to cling together after going through the dryer. How might this occur in the dryer? Is your answer consistent with what you observed in class? Explain and represent your answer with a picture.

43. Two conducting spheres have an excess of negative charged particles and are placed very far apart from one another.
    a. Draw a picture of the spheres when they are very far apart.
    b. Draw a picture of the spheres when they are close together, but not touching.
    c. Draw a picture of the spheres when they are moved far apart again.
    d. Repeat for one positive and one negative charged sphere.

Conceptual Physics Final Exam Review

44. You have a plastic comb with a zero net electric charge. You rub the comb with a piece of felt that makes it negatively charged. Imagine that the total negative charge is equal to -17 units of charge.
    a. Draw sketches that show the net charge on the comb and felt before and after rubbing them together.
    b. Write a math statement that describes the charge-transferring process for the felt.
    c. Write a math statement that describes the charge-transferring process for the comb.
    d. Explain why the felt and the comb are attracted to each other after having been rubbed together even though they don't interact at all before they are rubbed together.

DC Circuits

Make sure you know how to:

a) distinguish between series and parallel circuits.
b) find the total resistance of a series circuit.
c) solve simple circuit problems using Ohm's law and the power equation.
d) know the proper symbols for circuit diagrams.

Hewitt Chapters 34 and 35

45. Draw schematic diagrams for the following circuits:
    a. 4 resistors and a battery all in parallel.
    b. A battery with 1 resistor in series with 2 light bulbs in parallel and a switch on one of the branches.

46. Your friend has built a circuit and forgot if it is done in series or parallel. Describe a method for how you can test if it is a series circuit or a parallel circuit.

47. You have 0.12 A of current flowing through a 75- Ω resistor. What is the voltage across the resistor?

48. You put a light bulb in a circuit with a 9-V battery. The ammeter shows that the current though it is 0.07A. What is the resistance of the bulb?

49. A person accidentally touches a 120-V electric line with one hand while touching a ground wire with the other hand, completing the circuit. Determine the current through the body when the hands are dry (100,000-Ω resistance) and when wet (5000- Ω resistance). Are either or both currents dangerous? (For reference: 0.001 A = faint tingle, 0.005 A = slight shock, 0.006-0.030 A = painful shock, 0.05 – 0.150 A = Extreme pain, cannot let go. over 1 A = death is likely) Explain how you know.

Conceptual Physics Final Exam Review

50. A 60 W lightbulb is connected to a 90 V power source. What is the current through the lightbulb? What is the resistance of the lightbulb?
51. A microwave draws a 12 A current from a 120 V power source. How much power is delivered to the microwave?

52. A battery with a voltage of 12 V is connected to a lamp. The current flowing in the circuit is 0.40 A. The resistance of the lamp is:

53. If a 320 Ω resistor is connected to a 16 V battery, the current in the circuit will be___.

Magnetism

Make sure you know how to:

a) distinguish between electric interactions and magnetic interactions.

Hewitt Chapter 36

54. Are electrostatic interactions the same as magnetic interactions? What is similar? What is different?

Waves and Sound

Make sure you know how to:

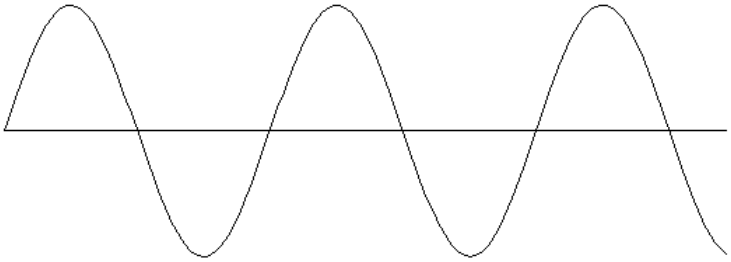
a) distinguish between transverse and longitudinal waves.
b) label the parts of a transverse wave.

Hewitt Chapters 25 and 26

55. Draw a picture of the following types of waves:
    a. Longitudinal
    b. Transverse
    c. How does one point on a **transverse** wave move? (draw a picture or describe with words)

Conceptual Physics Final Exam Review

56. Label the following parts of a wave: Amplitude, Crest, Trough, Wavelength



Optics

Make sure you know how to:

a) describe the conditions necessary to see light.
b) distinguish between image formation for different types of mirrors.
c) predict how light will refract when passing through different substances.
d) describe the conditions necessary to separate white light.

Hewitt Chapters 27, 29, 30

57. Compare and contrast concave mirrors, convex mirrors, and plane mirrors in terms of image formation.

58. What is reflection? What is refraction?

59. How do rainbows form?

60. Describe the conditions necessary for us to see light.

61. Your friend thinks that an image formed on a plane mirror is on the surface of mirror itself (like a painting). Do you agree or disagree? Describe an experiment you can do to test your friend's idea. Include a ray diagram in your explanation.

62. Draw the refracted beams for a glass prism in air.