Mechanical Energy Worksheet (p.1)
All work needs to be done on your own paper.

Work

1. A force sets an object in motion. When the force is multiplied by the time of its application, we call the quantity ***impulse***, which changes the momentum of that object. What do we call the quantity ***force · displacement***, and what quantity does this change?

2. How much work is done in lifting a 300 Newton rock 10 meters off the ground?

3,000 J

3. A force of 200 Newtons is needed in order to push a wheelbarrow that weighs 1000 Newtons. If the wheelbarrow is pushed 30 meters, how much work is done on the wheelbarrow? What power is required if it takes 10 seconds to push the wheelbarrow?

6,000 J *600 W*

4. Work is required to lift a barbell. How many times more work is required to lift the barbell three times high?

5. Which, if either, requires more work, lifting a 10 kg load a vertical distance of 2 m or lifting a 5 kg load a vertical distance of 4 m?

6. 100 joules of work are done on an object when a force of 10 N pushes it. How far is the object pushed? What power is used if this is done in 4 seconds? *10 m* *25 W*

7. Calculate the work done when a 20 N force pushes a cart 3.5 m in 0.5 s. Calculate the power.

70 J *140 W*

KE & PE

8. What are the two main components of mechanical energy?

9. **(a)** Calculate the kinetic energy of a 3.1 kg toy cart that moves at 4.8 m/s. **(b)** Calculate the kinetic energy of the same cart at twice the speed. *36 J* *140 J*

10. Suppose an automobile has 20,000 J of kinetic energy. When it moves at twice the speed, what will be its kinetic energy? What's its kinetic energy at three times the speed? *80,000 J* *180,000 J*

11. If a mouse and an elephant both run with the same kinetic energy, can you say which is running faster? Explain in terms of the equation for KE.

12. A hammer falls off a rooftop and strikes the ground with a certain KE. If it fell from a roof that was four times higher, how would its KE of impact compare? How much faster would it be moving just before impact? (Neglect air resistance.)

13. **(a)** If you do 100 J of work to elevate a bucket of water, what is its gravitational potential energy relative to the starting position? **(b)** What would the gravitational potential energy be if the bucket were raised twice as high? **(c)** How much work would the bucket do on its surroundings as it fell back to its starting position?

14. Calculate the change in potential energy of 8,000,000 kg of water dropping 50.0 m over Niagara Falls.

4,000,000,000 J

15. A 35 kg chair is lifted 5 m off the ground. What is its potential energy?

175 J

16. How high above the ground is a 20 kg box if it has 500 joules of potential energy?

25 m

17. An astronaut in full space gear climbs a vertical ladder on the earth. Later, the astronaut makes the same climb on the moon. In which locations does the gravitational potential energy of the astronaut change more? Explain.

Mechanical Energy Worksheet (p.2)
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NRG Conservation

18. A boulder is raised above the ground so that its potential energy relative to the ground is 20,000 J. It is then dropped. What is its kinetic energy just before it hits the ground?

19. What will be the kinetic energy of an arrow having a potential energy of 50 J after it is shot from a bow?

20. What does it mean to say that in any system, the "total energy score" stays the same?

21. Calculate the work done in lifting a 500.0 N barbell 2.2m above the floor. What is the potential energy of the barbell when it is lifted to this height?

1,100 J

22. If a car traveling at 60 km/h will skid 20 m when its brakes lock-up, how far will it skid if it is traveling at 120 km/h when its brakes lock? (*Hint: Work Energy theorem*) *80 m*

23. How is energy from coal actually solar energy?

24. How does the amount of work done on an automobile by its engine relate to the energy content of the gasoline?

25. Most earth satellites follow an oval-shaped (elliptical) path rather than a circular path around the earth. The earth is not at the center of that ellipse so the satellite move closer to and farther from the earth. The PE increases when the satellite moves farther from the earth. According to the law of energy conservation, does a satellite have its greatest speed when it is closest to or farthest from the earth?

26. **(a)** Why does a small, lightweight car generally have better fuel economy than a big, heavy car? **(b)** How does a streamlined design improve fuel economy?

27. **(a)** Does using an automobile's air conditioner while driving increase fuel consumption? **(b)** What about driving with the lights on? **(c)** What about playing the car radio when parked with the engine off? Explain in terms of the conservation of energy.

28. You tell your friend that no machine can possibly put out more energy than is put into it, and your friend states that a nuclear reactor puts out more energy than is put into it. What do you say?

29. The energy we require to live comes from the chemically stored potential energy in food, which is transformed into other energy forms during the digestion process. **(a)** What happens to a person whose combined work and heat output is less than the energy consumed? **(b)** What happens when the person's work and heat output is greater than the energy consumed? **(c)** Can an undernourished person perform extra work without extra food? Defend your answers.

30. A bowling ball is traveling at 3 m/s. It starts to roll up a ramp. How high above the ground will the ball be when it stops rolling? Neglect friction and assume the ramp is plenty long enough to do this.

0.45 m

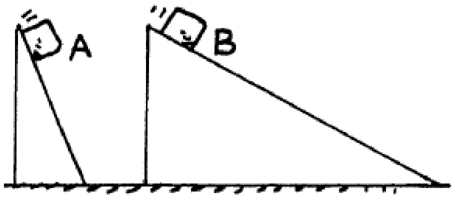
31. Another bowling ball is suspended from the ceiling on a rope. You decide to start it swinging by pulling back on it so that it is raised 0.45 meters higher than it was to start. You let it swing: how fast it it moving at the bottom of its swing? How fast is it going at the top of its swing?

3 m/s

Mechanical Energy Worksheet (p.3)

All work needs to be done on your own paper.

32. Which block gets to the bottom of the incline first? Assume no friction. (Be careful!) Explain your answer.



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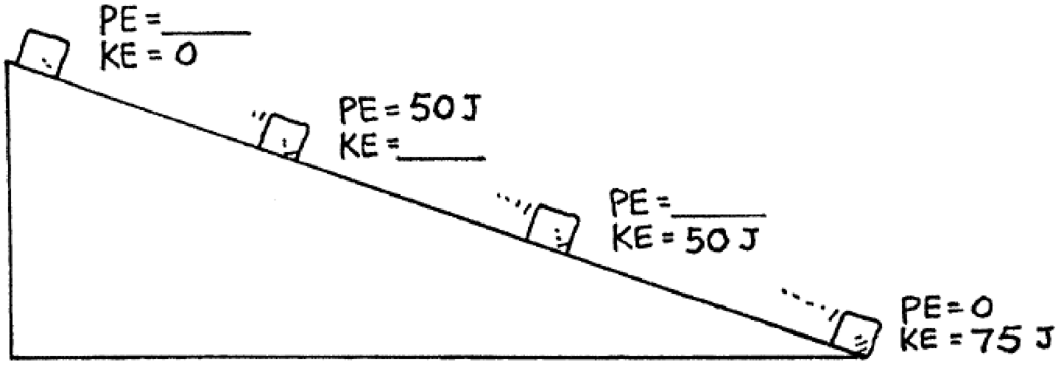
33. The KE and PE of a block freely sliding down a ramp are shown in only one place in the sketch. Fill in the missing values.



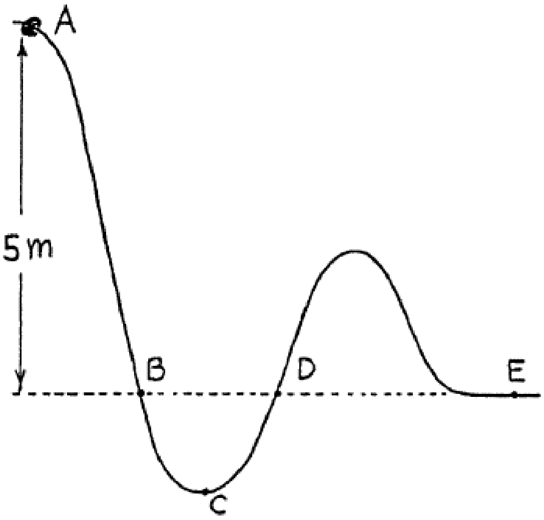
34. A big metal bead slides due to gravity along an upright friction-free wire. It starts from rest at the top of the wire as shown in the sketch. How fast is it traveling as it passes

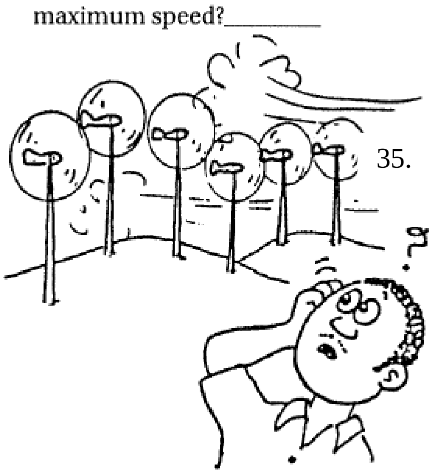
Point B?________

Point D?________

Point E?________

At what point does it have the maximum speed?________





35. Rows of wind-powered generators are used in various windy locations to generate electric power. Does the power generated affect the speed of the wind? Would locations behind the 'windmills' be windier if they weren't there? Discuss this in terms of energy conservation with your classmates.

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Conceptual PHYSICS

Mechanical Energy Worksheet (p.4)
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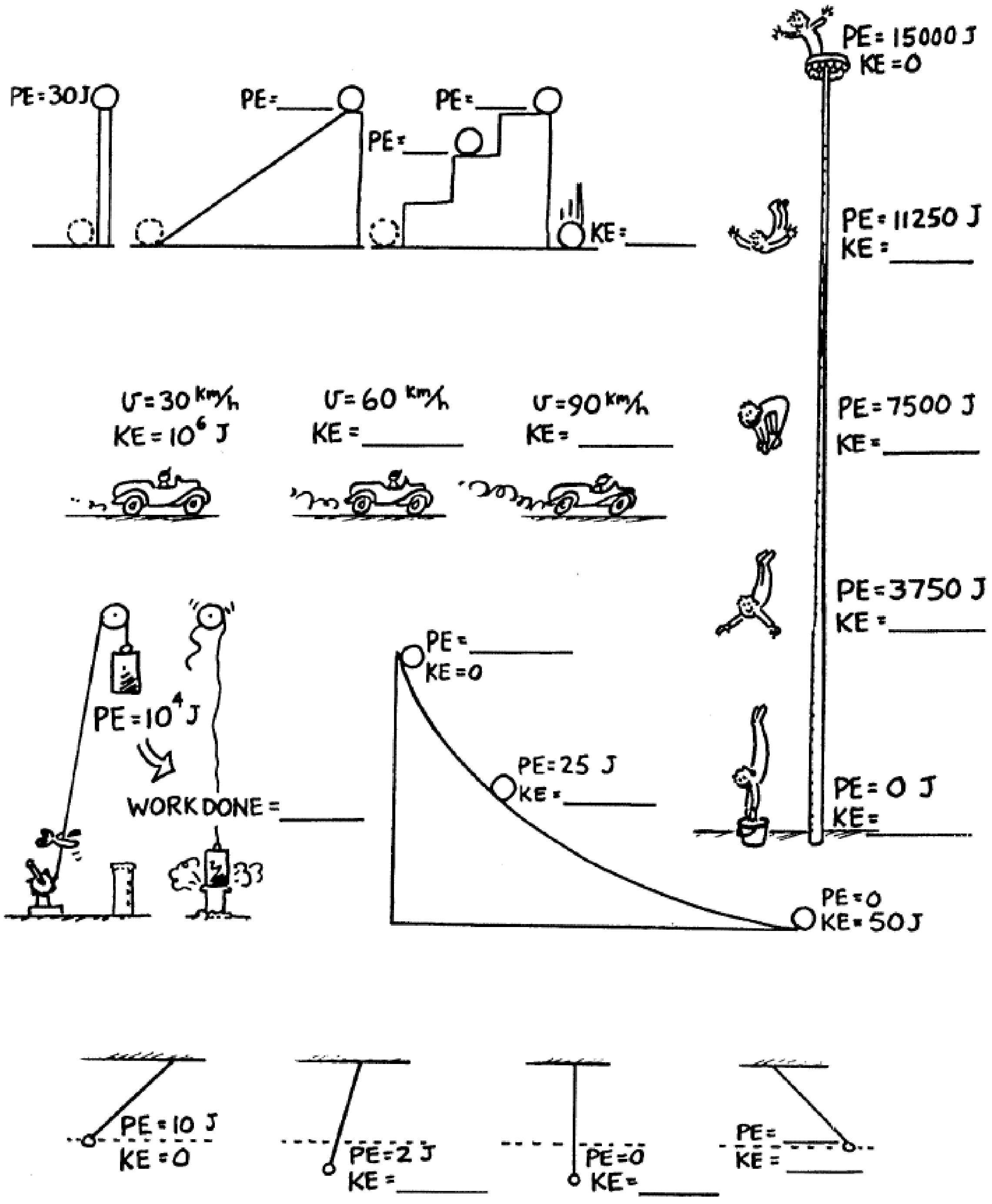
Concept-Development Practice Page 8-2

Conservation of Energy

36. Fill in the blanks for the six systems shown.



Conceptual PHYSICS