**Chapter 7 Summary of terms**

**Work**

* It is the effort exerted on something that will change its energy
* Work done depends on
  + application of force
  + the movement of something by that force
* When
  + force is constant and
  + the motion is in a straight line in the direction of the force
  + Work = force x distance
  + W = fd
* A weightlifter who holds a barbell weighing 1000 N overhead does no work
* When the weightlifter raises the barbell from the floor, he does work on it
* Work – 2 categories
  + Work done against another force e.g., gravitational force in push-ups
  + Work done to change the speed of an object, e.g., car speeding up
  + In both categories work involves a transfer of energy
* Unit of Work is newton meter (N.m) or joule (J)

**Check Point page 103**

1. How much work is needed to lift a bag of groceries that weighs 200 N to a height of 3m?
2. How much work is needed to lift it twice as high?

**Power**

* It measures how fast the work is done
* It is equal to the amount of work done per time it takes to do it
* Power = work done **/** time interval
* Unit of Power is J**/**s or watt (W)
* Twice the power means
  + the engine can do twice the work in the same time
  + or do the same amount or work in half the time
  + A more powerful engine can get a car up to a given speed

in less time than a less powerful engine

**Check Point page 104**

If a forklift is replaced with a new forklift that has twice the power,

* how much more dirt can it lift in the same amount of time?
* If it lifts the same amount of dirt, how much faster can it operate?

**Mechanical Energy**

* When work is done by an archer in drawing a bowstring, the bent bow

acquires the ability to do work on the arrow.

* What enables an object to do work is energy
* Unit of Energy is joules (J)
* Two most common forms of mechanical energy
  + The energy due to position of something (potential energy or P.E)
  + Or the energy due to movement of something (kinetic energy or K.E)
* Mechanical energy can be in the form of P.E, K.E, or the sum of two

**POTENTIAL ENERGY (P.E)** –

* An object may store energy by virtue of its position
* The energy that is stored and held in readiness is called P.E,
  + because in the stored state it has the potential for doing work
  + e.g., when a bow is drawn, energy is stored & it can do work on arrow

**GRAVITATIONAL POTENTIAL ENERGY (G.P.E)**

* Work is required to elevate objects against Earth’s gravity
* The P.E due to elevated positions is called G.P.E
* The amount of G.P.E possessed by an elevated object

= work done against gravity in lifting it

* Work done = Fd

= (force required to move it upwards) x (vertical distance it moved)

* Where, the upward force required while moving at constant velocity

= the weight of the object

= mg

* And d = h, is the vertical height through which lifting takes place
* So, the work done in lifting it through a height h, is = mgh
* Therefore, G.P.E = mgh
* Height, h is the distance above some chosen ref. level e.g. ground
* G.P.E of an elevated ball does not depend on the path taken

**P.E or G.P.E has significance only**

* when it changes
* when it does work
* or transforms to energy of some other form e.g., K.E

**Check Point page 105**

1. How much work is done in lifting the 100-N of ice a vertical distance of 2-m?

2. How much work is done in pushing the same block of ice up the 4-m long ramp?

(The force needed is only 50-N, which is the reason ramps are used)

3. What is the increase in the block’s G.P.E in each case?

**Kinetic Energy (K.E)**

* If you push an object, you can set it in motion
* If an object is moving, then it is capable of doing work.
* It has an energy of motion; it has K.E
* **Kinetic Energy = ½ x mass x (speed x speed)**
* K.E = ½(m)(vxv)
* The K.E of a moving object

= work required to bring it from rest to that speed, or

= work the object can do while being brought to rest

**(Net force) x (distance) = K.E**

* In K.E, the speed is squared
* So, if the speed of an object is doubled,
* Its K.E quadrupled
* Therefore, it takes 4 x (the work done) to double the speed

**Whenever work is done, energy changes**

**Work-Energy Theorem**

Net Work Done = Change in Energy

* Work is not a form of energy,
  + but a way of transferring energy from one place to another,
  + or one form to another

**Check Point Page 108**

1. When you are driving at 90 km**/**h,

how much more distance do you need to stop

compared with driving at 30 km**/**h?

**Conservation of Energy**

Energy cannot be created or destroyed;

It may be transformed from one form into another;

But the total amount of energy never changes

**Example:**

1.By virtue of its elevated position,

The water behind the dam has energy;

that may be used to power a generating plant below,

Where it will be transformed to electric energy

2.The energy travels through wires to homes,

Where it is used for lighting, heating, cooking

Ironing, air conditioning and operating electrical gadgets

**Fig. 7.14 page 109 of circus diver**

At top of the pole, P.E =10,000 J and K.E = 0 J

At one – fourth below top, P.E =7,500 J and K.E = 2,500 J

At on-half below top, P.E = 5,000 J and K.E = 5,000 J

At three-fourth below top, P.E = 2,500 J and K.E = 7,500 J

At the bottom of the pole, P.E = 0 J and K.E = 10,000 J

As he dives from top of the pole, his P.E 🡪 K.E, but the total energy is constant

**Exercises page 119**

3,If your friend pushes a lawnmower 4 times as far as you do, while exerting only half the force, which one of you does more work? How much more?

5. Which requires more work: stretching a strong spring a certain distance or stretching a weak spring the same distance? Defend your answer.

9. When a rifle with a long barrel is fired, the force of expanding forces acts on the bullets for a longer distance. What effect does this have on the velocity for the emerging bullet?

19 A moving hammer hits a nail and drives it into the wall. If the hammer hits the nail with twice the speed, how much deeper will the nail be driven? What if it hits with 3 times the speed?

25 Someone wanting to sell you a superball claims that it will bounce to a height greater than the height from which it is dropped? Can this be?

27 Consider a ball thrown straight up in the air. At what position is its K.E, at a maximum? Where is its G.P.E, at a maximum?

45 Does the K.E of a car change more when it goes from 10 to 20 km**/**h or when it goes from 20 to 30 km**/**h?

47 When the mass of a moving object is doubled with no change in speed, by what factor is its momentum changed? By what factor is its K.E changed?

49 Which, if either, has greater momentum, a 1-kg ball moving at 2-m**/**s or a 2 kg ball moving at 1 m**/**s? Which has greater K.E?

51 If an objects K.E is zero, what is its momentum?

53 If two objects have equal K.Es, do they necessarily have the same momentum? Defend your answer.