National 4/5 Physics

Name:

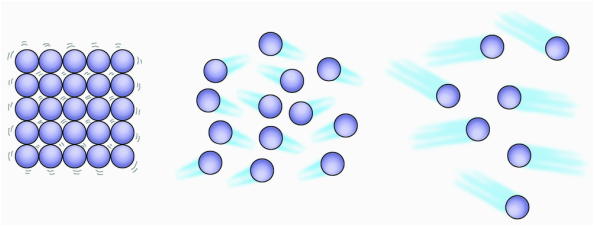
Barrhead High School

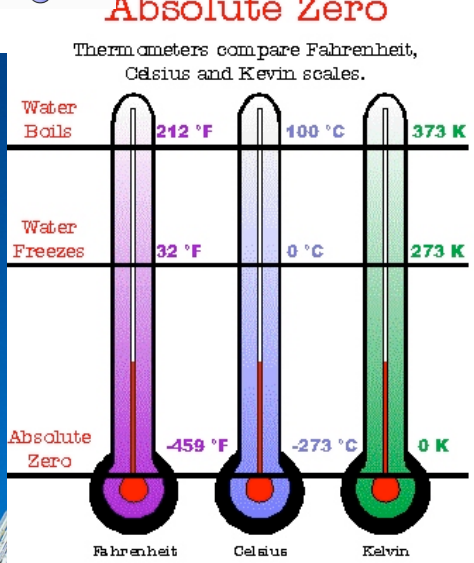
Physics Department

UNIT

Energy & Gas Laws

Quick Homework





www.physics.co.nf

Date	Homework	Mark/grade	Parent signature

The table above must be completed after each homework has been marked.

Homework tips

- Start homework as soon as possible. Do not leave it until the night before the due date.
- Refer to summary notes, jotter notes and example problems when completing homework.
- If after doing above there are any issues ask your teacher for help. This must be done at least 1 full day before due date. This will then give you the opportunity to complete the homework by due date.

Sign below to state that you have read this.

Pupil _____

Parent _____

Homework Exercises

Homework 1 (Pupil Pack page 1)

1. (a) Name the three main fossil fuels. (1)
   (b) These fuels are known as non-renewable sources. What does this mean? (1)

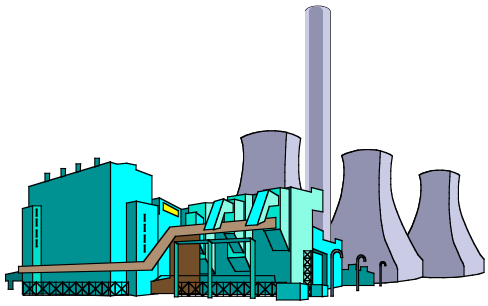
2. Explain how the following reduce energy consumption in home, industry and transport:

   (a) Giant fans are fitted to the ceiling of some factories. (1)
   (b) Some power stations are designed to pump hot water from their heat transfer system to local factories and homes. (1)
   (c) Commuters are encouraged to use trains and buses rather than their own cars. (1)
   (d) Dripping hot water taps should be turned off properly. (1)

3. A power station uses 1.5 million tonnes of coal in a year (1 tonne = 1000 kg). On average, each kilogram of coal supplies 2.8×10^7 J of heat energy.

   (a) What is the power station's total energy consumption in 1 year? (2)
   (b) The power station is only 40% efficient. This means that its energy output in one year is only 1.68×10^{16} J.

   Calculate the power output of the station. Take one year to be roughly 31.5×10^6 s. (2)

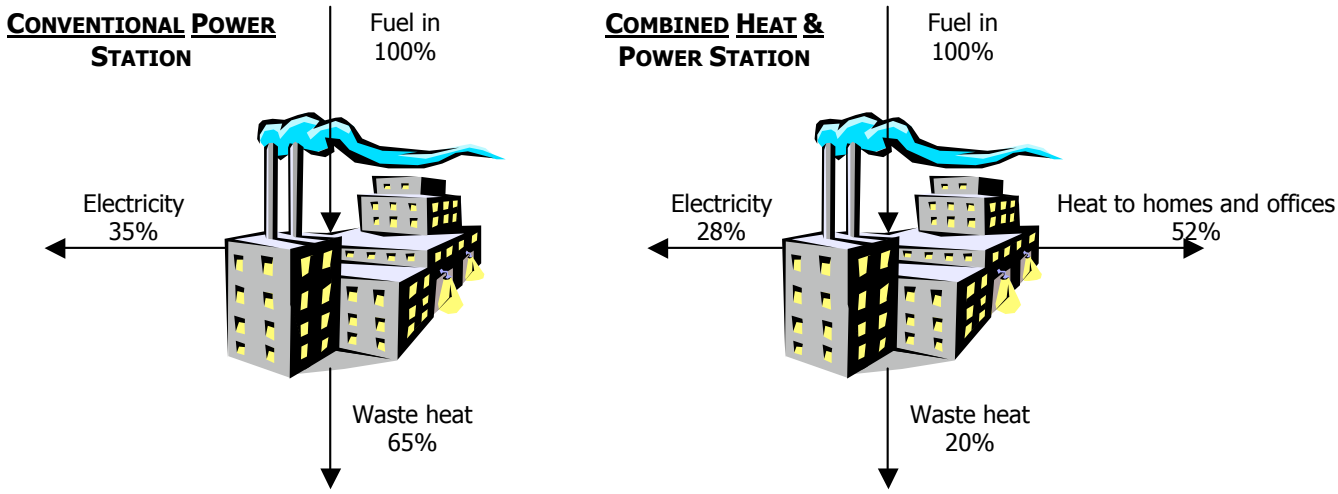


Total 10 marks

Homework Exercises

Homework 2 - Pupil Pack Page 1

1. The diagrams below show how a combined heat and power (CHP) station uses its energy compared with a conventional power station. The fuel input in each case is 200,000 GJ.



(a) What is the percentage drop in production in electrical energy when switching to a CHP station? (1)
(b) How much of the waste heat is saved by a CHP station (in Joules)? (2)

2. Make a table with two columns called *renewable energy sources* and *non-renewable energy sources*. Put each of these sources into the correct column.

solar; wind; coal; waves; uranium; natural gas; geothermal; oil. (2)

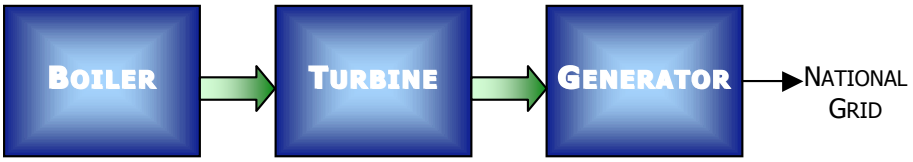
3. Copy and complete this table. Remember to leave enough room in each row to explain the advantages and disadvantages fully! (5)

ENERGY SOURCE	ADVANTAGE	DISADVANTAGE
Solar		
Wave		
Hydroelectricity		
Geothermal		
Wind		

Total 10 marks

Homework 3 – Pupil Pack Page 2

1.



The sketch shows a block diagram of a coal-fired (thermal) power station.
State the main energy change that occurs at each of the three stages. (3)

2. Thermal power stations and nuclear power stations both use heat energy to boil water, but their methods are different.

   (a) Which fuel is used in a nuclear power station? State the energy change that takes place as this fuel is used. (1)

3. Nuclear power stations can produce electricity as cheaply as coal fired power stations and they do not give out carbon dioxide or acid gases. Why are so many people opposed to them? (1)

4. (a) In a hydroelectric power station, there is no boiler. Where does the energy come from to drive the turbine? (1)
   (b) In a pumped storage system, water is pumped back up into the reservoir during the night. Why is this done? (1)

5. (a) A kilogram of uranium-235 can release 8.19×10^{13} J of energy. How many tonnes of coal equivalent is this if one t.c.e. = 2.8×10^{10} J? (2)
   (b) A large coal-fired power station will burn about 4 million tonnes of coal per year.
   How much uranium-235 would a nuclear power station use to produce the same amount of energy? (1)

Total 10 marks

Homework Exercises

Homework 4 - Pupil Pack Pages 5-7

1. A loch on the mountains can hold 20 million tonnes of water and is 300m above a suitable site for a power station.

   (a) If water flows out of the loch at the rate of 1500 kg per second, calculate the potential energy transferred each second. (1)
   (b) What is the power station's maximum power output? (2)

2. In a pumped storage hydroelectric scheme, the upper loch is 500m above the lower loch. When it is full, it stores 500,000 kg of water.

   (a) If the pumps are taken to be 100% efficient, how much energy must be supplied to completely fill the upper loch with water? (2)
   (b) If all the water is allowed to run down the pipeline in 4 hours and the generators are 80% efficient, how much power would be available from this plant? (2)

3. A crane, driven by a petrol engine, lifts several 750 kg cars to the top of a 13m high stack of scrap vehicles. One litre of petrol can supply 33.3 MJ of energy.

   (a) Assuming that no energy is lost, how many cars could be lifted to the top of the stack on 1 litre of petrol? (2)
   (b) The actual number would be far less than this due to the engine being inefficient. State one way in which energy is wasted in the engine. (1)

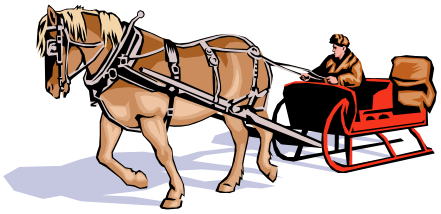
Total 10 marks

Homework 5 – Pupil Pack Page 6

1. In each of the cases below, state the **main** energy change involved for the vehicle.

   (a) A rollercoaster carriage rolling up a slope to a high point. (1)
   (b) A skier skiing down a slope. (1)
   (c) A bus driving along a level road at a constant speed. (1)

2. (a) What is work done? Your answer should **not** be an equation! (1)
   (b) Calculate the work done by a horse when it uses a force of 800 N to pull a sled a distance of 150 m. (2)



3. Copy and complete the table below. You must show full calculations for each problem. (4)

POWER(W)	WORK DONE(J)	TIME(s)
	400	4
	1000	0.5
30		10
100		60

Total 10 marks

Energy
Homework Exercises

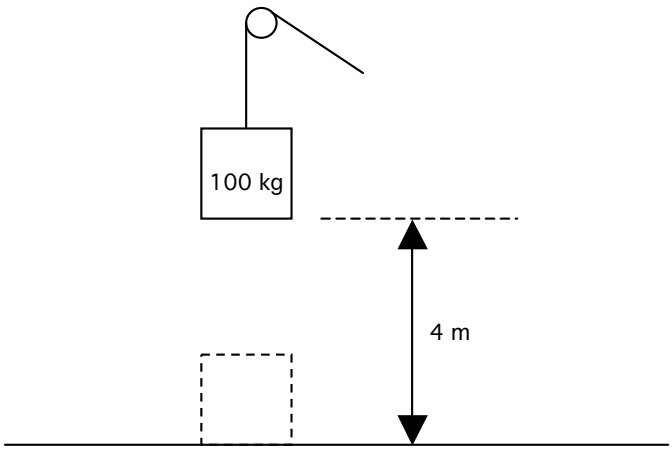
Homework 6- Pupil Pack Pages 5-7

1. A roller coaster carriage has a mass of 300 kg when it is carrying a full load.

(a) Calculate the potential energy of the carriage when it is at the top of a drop, 30 m above the ground. (2)
(b) At the bottom of the drop it is at a height of 2 m above the ground. Calculate its potential energy now. (1)
(c) Calculate how much kinetic energy the carriage will have at this point. (1)

2. Name two quantities that affect a vehicle's kinetic energy. (1)

3. A winch pulls a crate up to a height of 4 m in a time of 20 s. If the crate has a mass of 100 kg, find the power of the motor. (3)



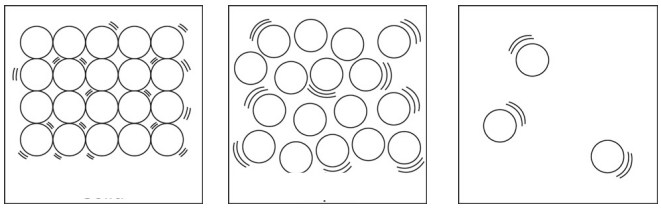
4. Find the kinetic energy of a car of mass 800 kg travelling at 30 m/s. (2)

Total 10 marks

Homework 7

1. What state of matter is represented by the following diagrams:

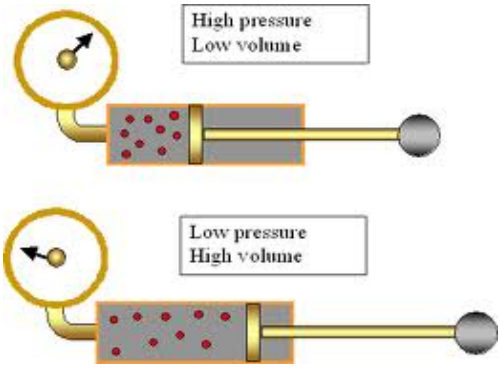
(a) (b) (c)



(3)

2. Copy and Complete:

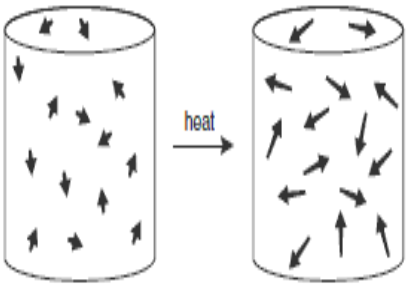
As the volume of gas increases the pressure decreases. This is because the particles are further apart and collide ____ frequently with the walls of the container.



(1)

3. Copy and Complete:

As the temperature of the gas increases the particles gain _____ energy (longer arrows in diagram below) and move _____. They hit the walls of the container _____ often and with _____ force thereby causing the pressure to increase.



(3)

4. Copy and Complete:

As the temperature of the gas increases, the particles gain _____ energy and move _____. The particles hit the walls of the container more often and with _____ force. The volume must _____ to give a greater surface area to keep the pressure constant.

(3)

Homework 8

1. A syringe has a piston with a cross-sectional area of 0.000 2 m^2. The piston is pushed with a force of 12N. Calculate the pressure.

(2)

2. Explain why the use of large tyres helps to prevent a tractor from sinking into soft ground.

(2)

3. If you want to rescue someone who has fallen through ice on a pond, would it be easier to walk or crawl across the ice towards him? Explain why.

(1)

4. An elephant exerts a force of 5000N by pressing his foot on the ground. If the area of his foot is 0.02m^2, calculate the pressure exerted by his foot.

(2)

5. A tank contains 10 kN of water. If the base of the tank has an area of 20m^2, calculate the pressure exerted by the water on the base.

(3)

Homework 9

1. A fixed mass of gas is kept at constant temperature but the pressure is increased from 1.01×10^5 Pa to 3.00×10^5 Pa. If the original volume was $0.2 m^3$, determine the final volume.

(2)

2. The pressure of a fixed mass of gas is 200kPa at 40°C and the volume is $1.5 m^3$. The temperature is increased to 100°C but the volume remains the same. What is the new pressure?

(3)

3. The pressure of air in a car tyre is 2.5×10^5 Pa at a temperature of 27°C. After a motorway journey the pressure has risen to 3.0×10^5 Pa. Assuming the volume of air in the tyre has not changed,
    a. Calculate the resulting temperature of air in the tyre (3
    b. Explain the change in pressure in terms of the motion of air particles in the tyre. (2E

Homework 10

1. Change the following Celsius temperatures into Kelvin temperatures
   c. -273°C b. -150°C c. 500°C (3)

2. Change the following Kelvin temperatures into Celsius temperatures
   d. 0K b. 272K c. 500K (3)

3. A weather balloon contains $100m^3$ of helium when atmospheric pressure is 90 kPa. at 0°C. If the atmospheric pressure changes to 100 kPa and the temperature to 20°C, calculate the new volume of helium. (4)

Homework 11

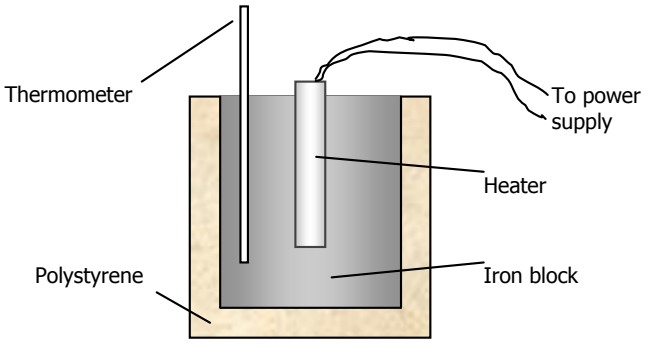
1. (a) Give a definition of temperature. (1)
   (b) What unit is temperature measured in? (1/2)

2. (a) Describe one way of reducing convection heat losses in a house. (1/2
   (b) Describe one way of reducing radiation heat losses in a house. (1/2)
   (c) Describe one way of reducing conduction heat losses in a house. (1/2)

3. Assuming the specific heat capacity of water to be 4 200 J/kg°C, how much heat energy is required to:

   (a) Heat 1 kg of water in a kettle from 20°C to 100°C? (2)
   (b) Heat 400 litres of water in a tank from 20°C to 60°C? (1 litre of water has a mass of 1 kg) (2)

4. In an experiment to determine the specific heat capacity of iron, the following experiment is set up:



   The block of iron has a mass of 2 kg. The heater is left on for 5 minutes and it supplies 6000 J of heat energy to the block in this time. The temperature rises from 20°C to 26.25°C.

   (a) What value do these figures give for the specific heat capacity of iron? (2)
   (b) Why was the block encased in polystyrene? (1)

Total 10 marks

Homework 12

1. When a liquid changes to a gas, it takes heat energy in from its surroundings.

   (a) What must happen to the temperature of the surroundings? (1)
   (b) What happens to the temperature of the liquid as it changes to a gas? (1)
   (c) Give an example of an everyday use for this principle. (1)

2. Use your knowledge of latent heat to explain the following situations:

   (a) In desert countries, water is stored in skin bags that are slightly porous to keep it cool. Some water leaks out of the pores. (1)
   (b) A climber is more likely to suffer from hypothermia in mild, wet and windy weather than on a calm, frosty day. (1)

3. A 2 kW kettle contains 1.5 kg of water. Its automatic cut-off is broken, meaning it will not switch off when it starts to boil. The specific latent heat of vaporisation for water is 2.26×10^6 J/kg.

   (a) Calculate how much heat energy would be required to turn all of the water into water vapour. (2)
   (b) How long would the kettle take to evaporate all the water? (1)

4. The specific latent heat of fusion for ice is 3.3×10^5 J/kg. What mass of water could be turned into ice if a freezer removed 165 000 J of heat energy? (2)

Total 10 marks