Standard Grade Physics

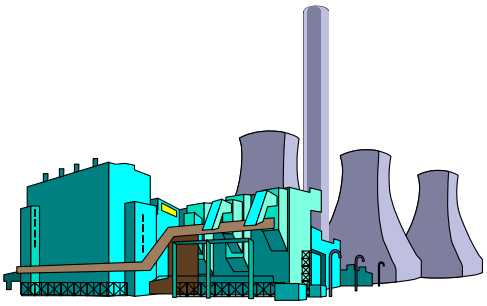
North Berwick High School

Physics Department

UNIT 9

Power Stations

PUPIL PACK



Homework Sheets

Power Stations
Working at Home

TO THE PUPIL

Each day you have physics at school, you should set aside time for work at home. By this stage you should be accepting more responsibility for your own learning and should undertake the following tasks on a regular basis:

- Tackle the supplied homework sheets as each section of work is completed in class.
- Check your own progress in the homework sheets by referring to the homework answer files available in class. Discuss any difficulties that arise with your class teacher.
- Complete any formal homework tasks that your teacher may issue from time to time and hand them in on the due date for marking.
- Revise the work you have covered in class activities by referring to your classwork jotters.

TO THE PARENT

Your co-operation would be appreciated in ensuring that pupils are encouraged to complete homework. It would be helpful if you could talk over the work given for homework and sign the homework record sheet on this page after they have completed each exercise.

The physics department hopes that this record of your child's achievement will be of interest to you, and we would welcome any comments on this or other areas related to the work of the department.

Please sign here to confirm that you have seen the homework record sheet: _____

HOMEWORK RECORD SHEET

HOMEWORK	SECTION OF WORK	MARK	CHECK	PARENTAL SIGNATURE
9.1	Supply and Demand 1			
9.2	Supply and Demand 2			
9.3	Generation of Electricity 1			
9.4	Generation of Electricity 2			

Some questions in the pack are marked with symbols to give you specific information. Here is the key:

Credit Level question. This relates directly to the Credit Level learning outcomes.

Problem Solving question. This puts the knowledge you have gained into new contexts.

Power Stations
Homework Exercises

Homework 9.1 – Supply and Demand I

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:

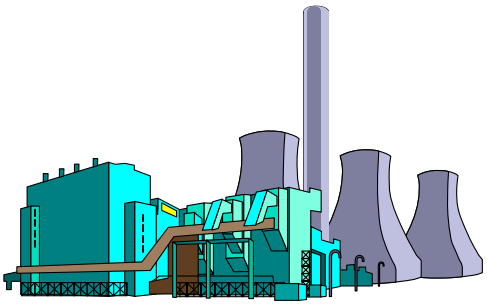
   (a) Giant fans are fitted to the ceiling of some factories. (1)
   (b) Some power stations are designed to pump hot water from their heat transfer system to local factories and homes. (1)
   (c) Commuters are encouraged to use trains and buses rather than their own cars. (1)
   (d) Dripping hot water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

PS

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)

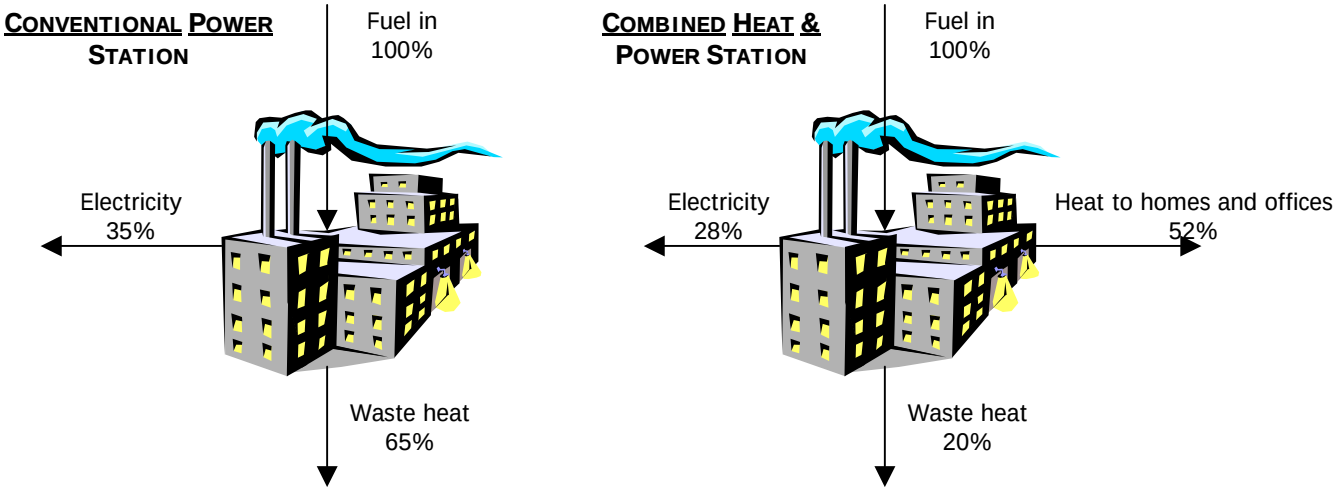


Total 10 marks

Power Stations
Homework Exercises

Homework 9.2 - Supply and Demand II

PS 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)

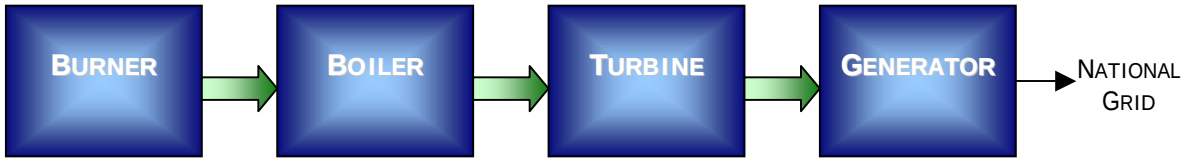
CR 3. Copy and complete this table. Remember to leave enough room in each row to explain the advantages and disadvantages fully! (5)

ENERGY SOURCE	ADVANTAGE	DISADVANTAGE
Solar		
Wave		
Hydroelectricity		
Geothermal		
Wind		

Total 10 marks

Power Stations
Homework Exercises

Homework 9.3 – Generation of Electricity I

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 four stages. (2)

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)
   (b) Which fuels are commonly used in thermal power stations? (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)

CR

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

Power Stations
Homework Exercises

Homework 9.4 - Generation of Electricity II

PS

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)

CR

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