

08 Energy, Power and climate change review questions

Power generation

- Copy and complete: "Thermal energy may be completely converted into _____ in a single process such as the _____ expansion of a gas but continuous conversion requires a _____ process and the transfer of some energy away from the _____"

(words to use: system, adiabatic, work, cyclical)

- What is degraded energy?
 - Construct a Sankey (energy flow) diagram for a nuclear power station and identify the points where energy is degraded?
- State the relative proportions of world use of the main energy sources
 - What is the prime energy source for most instances of energy use on Earth?
 - Identify two other prime energy sources that are used on Earth.
- What are the main technological barriers to using nuclear fusion as a source of electrical energy?
- The table shows energy density of potential fuels: (<http://en.wikipedia.org>)

Fuel	Used in	Specific energy obtained (MJ/kg)
Deuterium-Tritium mix	Nuclear fusion	567,000,000
Enriched Uranium (3.5% U-235)	Nuclear fission	3,456,000
Zip fuel (/wiki/Zip_fuel)	Jet engines	70
Kerosene	Jet engine	45
Coal	Power stations	30

Use the data to answer the following questions.

- Why, given the difficult technological barriers, is there still much interest and investment in nuclear fusion and
 - Why, despite the risks, are many countries developing nuclear fission reactors?
 - It takes approximately 33MJ/kg to put a satellite into orbit. Why does this make it worthwhile developing Zip fuels with higher specific energies than Kerosene?
 - How many kg of coal does a 1000 MW **coal** plant that averages 750 MW of production over the course of day use in one day?
- State the approximate efficiency of: natural gas power stations, oil fired power stations, natural gas powered stations, combined heat and power plants.
 - Neutrons are most easily absorbed by U-235 when they have an energy of about 1eV. What is 1 eV and use this knowledge to explain what needs to happen to neutrons for a chain reaction to occur.
 - What environmental problems are caused by the recovery (extraction) of (a) Coal, (b) Oil.
 - What environmental problems are caused by the burning of fossil fuels?
 - Draw a labeled diagram of a PWR nuclear power station and explain the purpose of each part.
 - U-238 will also capture neutrons in the nuclear reactor but will not fission.
 - What does the Uranium-238 decay into after it absorbs a neutron?
 - What can the element produced then be used for?
 - How can thermal meltdown of a nuclear reactor arise?
 - Why do responsible governments need to keep careful control over what happens to nuclear fuel?
 - Draw a labeled diagram of a photo-voltaic cell.

15. Draw a labeled diagram of a solar heating panel.
16. Explain why solar power on its own is not a cost effective source of heating for a temperate country.
17. Draw diagrams to show the differences between the following hydro-electric power schemes.
(a) water storage in lakes (b) tidal water storage (c) pumped water storage and give an advantage and disadvantage for each one.
18. Draw a labeled diagram of a wind generator
19. Draw a labeled diagram of an oscillating water column ocean wave energy converter.
- 20.

Climate

The sun has a luminosity of 3.8×10^{26} W. The Earth is 150 million km from the Sun.

1. (a) Calculate the intensity of sunlight incident on the Earth
(b) Calculate the intensity incident at a surface 45 degree to the incident sunlight.
(c) Calculate the average total solar power reaching the Earth.
(d) Calculate the average intensity received over the whole of the surface of the Earth
(e) Explain the difference between your answers to (a) and (d).
2. Define albedo and state what geographical features increase the albedo of the Earth.
3. Explain, in terms of variation of absorbencies with wavelength of radiation, why “greenhouse” gases act to insulate the Earth.
4. The level of carbon di-oxide in the atmosphere is increasing. (a) What activities of humans have been directly increasing the amount in the atmosphere? (b) Explain how deforestation also increases the amount of carbon dioxide in the atmosphere.
5. Global temperature is semi-stable.
(a) What are the stabilising factors that keep global temperatures steady (variables that do not tend to change and that regulate the temperature)?
(b) Explain why the amount of snow and ice near the poles of the Earth is a variable that causes instability in the climate by positive feedback.
(c) Give another example of a variable which causes instability by a positive feedback.
6. (a) The coefficient of volume expansion of water is 0.000180 K^{-1} . If the oceans of the Earth have a cross-sectional area of $3.6 \times 10^8 \text{ km}^2$ and an average depth of 4km how much sea level rise would result in one degree of warming assuming that the land did not expand. (b) what other consequence of global warming might make the sea levels rise? (c) Why are accurate predictions of sea level changes difficult to make?
7. Given the data in 6(a), the specific heat capacity of sea water of $4000 \text{ J kg}^{-1} \text{ K}^{-1}$ and density of 1000 kg m^{-3} estimate how much energy the oceans would absorb for a temperature rise of one degree.
8. The greenhouse effect is useful. Explain this statement.
9. Outline seven steps that humankind would need to take to reduce the enhanced greenhouse effect.
10. What international agreements have been made to attempt to reduce the enhanced greenhouse effect?