CP3, CP7 and CP8 Answers

A. Energy changes and energy stores part 1 – Energy systems and energy changes

1. Describe the energy store changes when a rocket firework is lit, goes up in the air and then falls back to the ground. (4)

Chemical → thermal → kinetic → gravitational → kinetic → thermal
(1 mark for each correct energy store change, maximum 4 marks)

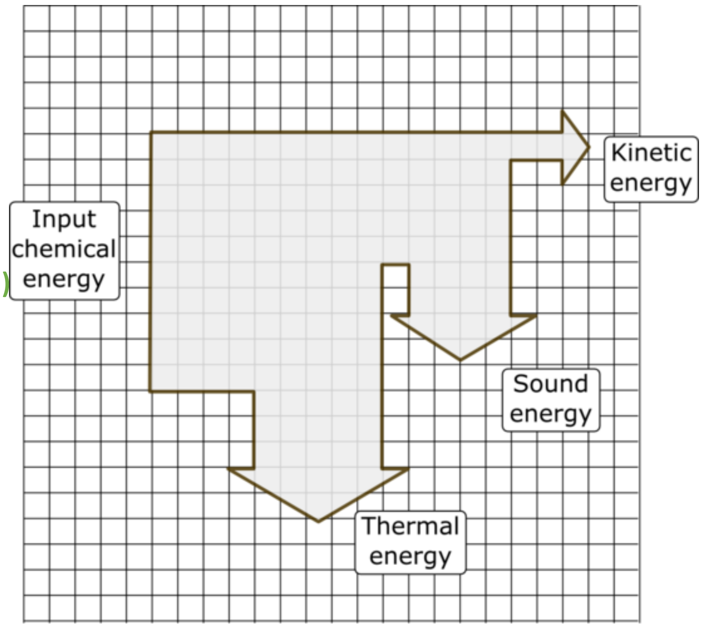
2. A cyclist is braking hard to avoid a collision.
Describe the energy store changes as the bicycle and rider decelerate to a stop. (3)

- **Rider and bicycle have a store of kinetic energy (1)**
- **The energy store shifts to heat energy in the brakes and wheel rims due to friction (1)**
- **When the bicycle stops the heat store is dissipated into the environment (1)**

3. When a battery stops working people often say the energy has been used up. Explain why this statement is not correct. (2)

Energy cannot be used up as it cannot be created or destroyed (1)
The energy has been transferred into a less useful energy store (1)

4. The Sankey diagram shows the simple energy store transfers for a car.



Chemical energy from the petrol = 20 000 J

a. Calculate the amount of useful energy transferred by the engine. (1)

4000 J (1) (each small square equates to 2000 J)

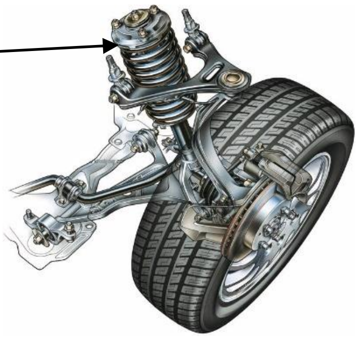
b. What is the total amount of "wasted" energy in the system? (1)

18 000 J (1) (thermal and sound)

5. An eagle has a mass of 4 kg and is flying at a velocity of 35 m/s. Calculate the kinetic energy of the bird. (3)

$E_k = ½ m v^2$ (1) **$E_k = ½ (4 \times 35^2)$ (1)** **$E_k = 2450$ J (1)**

6. The spring on a car wheel extends by 0.05 m when the wheel goes down a pothole in the road.



$$E_e = ½\ k\ e^2$$

If the spring constant is 20 kN/m, calculate the elastic potential energy in the spring when it is extended. (2)

E_e = ½ x 20 000 x 0.05^2 (1) **E_e = 25 J (1)**

7. A 48 kg person diving off a cliff has 3500 J of stored gravitational potential energy. Calculate the height of the cliff (3)

E_p = m g h **$h = \frac{E_p}{m\,g}$ (1)** **$h = \frac{3500}{48 \times 10}$ (1)** **Height of cliff = 7.3m (1)**

B. Energy changes and energy store part 2 – energy changes in systems and power

8. A swimming pool contains 30 000 kg of water at 8 ^{O}C.

Specific heat capacity of water = 4181 J/kg ^{O}C

$$\Delta E = m \times c \times \Delta\theta$$

a. How much thermal energy is needed to raise the temperature of the water to 15^{O}C? (3)

Temperature rise = 15 – 8 = 7^{O}C (1) E = 30 000 x 4181 x 7 (1)

thermal energy required = 878 010 000 J (1) or 878.01MJ

b. On a sunny day, the concrete at the side of the pool feels much hotter than the water even though both have received the same thermal energy from the sun. Explain fully why the concrete is hotter. (2)

Concrete has a lower specific heat capacity (*c*) than water (1)
So, the temperature of the concrete will rise more than the water for the same thermal energy input. (1)

9. The lift in the world's tallest building takes 64 s to reach a height of 828 m.

The maximum mass of the lift and passengers is 900 kg.

a. Calculate the power of the lift. (3)

$\text{Power} = \frac{\text{work done}}{\text{time}}$ (1)   work = f x d = 9000 x 828 = 7 452 000 J (1)

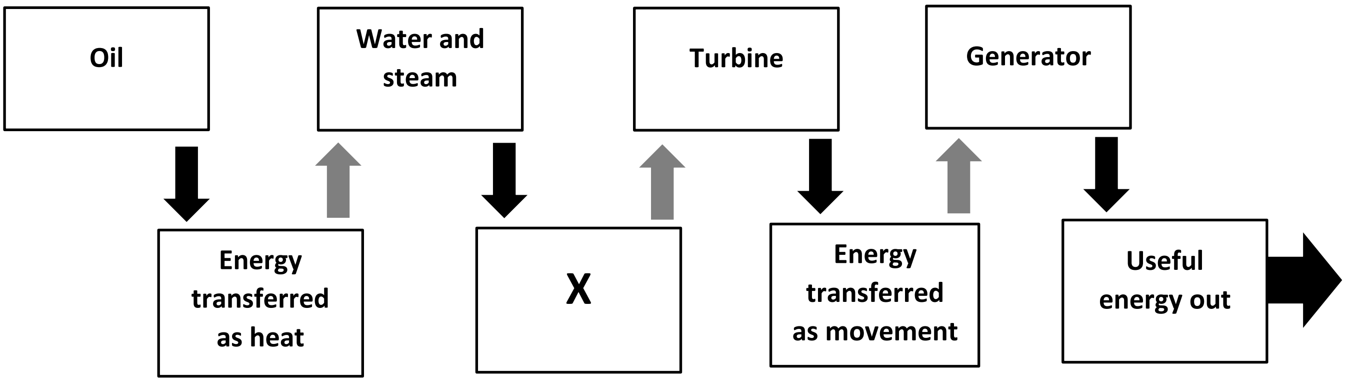
$\text{Power} = \frac{7\,452\,000}{64} = 116\,438$ W   or 116.438 kW

b. A service lift in this building is used to move furniture to apartments in the tower. This lift has a 130 kW motor. If the maximum load for this lift is 2000 kg, how long will it take to reach the top of the building? (3)

$\text{Power} = \frac{\text{work done}}{\text{time}}$ (1) $\text{time} = \frac{\text{work done}}{\text{power}}$ (1) $\text{time} = \frac{20\,000 \times 828}{130\,000}$ = 127s (1)

C. Conservation and dissipation of energy – Energy transfers and efficiency

10. The diagram represents the energy transfers for an oil-fired power station.



a. What is the useful energy out? (1)

Electrical energy (1)

b. In what form will energy be "wasted" in this process? (1)

Thermal (internal) energy (1)

c. What useful energy store is represented by the box labelled **X**? (1)

Movement or kinetic (1)

11. Loft insulation reduces heat loss from a home.
Loft insulation can be made out of many different materials.
Give two properties of the insulating material that will affect the amount of heat lost through the roof. (2)

Thermal conductivity (1) and thickness (1) of the material

12. A company sells two types of electric drill.

Drill A

Drill B

Drill A is a 300 W drill with an output power of 165 W.
Drill B is a 1100 W drill with an output power of 520 W.
Explain which drill is the more efficient at transferring useful energy? (3)

Efficiency = $\frac{\text{useful power output}}{\text{Total power input}}$ **(1)**

Drill A efficiency = $\frac{165}{300} = 0.55$ **Drill B efficiency =** $\frac{520}{1100} = 0.47$ **(1)**

Drill A is more efficient at transferring useful energy (1)

13. Describe two ways you could increase the efficiency of a household central heating system. (2)

Lag pipes carrying hot water to reduce thermal energy loss

Buy a more efficient boiler

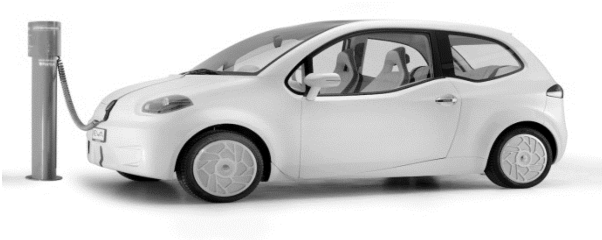
Re-use the waste thermal energy to pre-heat water (any 2 valid answers) (2)

D. National and global energy resources – renewable and non-renewable energy resources and patterns in energy use

14. Name four renewable and four non-renewable energy resources. (2)

Energy Resources	
Renewable resources	Non-renewable resources
Wind, wave	Coal
Hydro – electric, tidal	Oil
Bio – fuel, solar	Gas
Geothermal (1)	Nuclear, peat (1)

15. An electric car uses no fossil fuels to turn its motor.



The manufacturer claims that this car does not contribute to carbon dioxide emissions into the atmosphere.
Explain why the manufacturer's claim is not true. (3)

Electrical energy store to run the car may have been produced by burning fossil fuels (1)

Burning fossil fuels releases carbon dioxide into the atmosphere (1)

Carbon dioxide emissions from the manufacture and transport of the electric car (1)

16. Explain why fossil fuels are considered to be a more reliable energy resource for electricity production than the use of wind turbines. (3)

Fossil fuels deliver a consistent electricity supply from a power station (1)

Wind turbines do not produce electricity when the wind is not blowing so they are less reliable (1)

Wind turbines do not produce electricity when it is too windy (1)

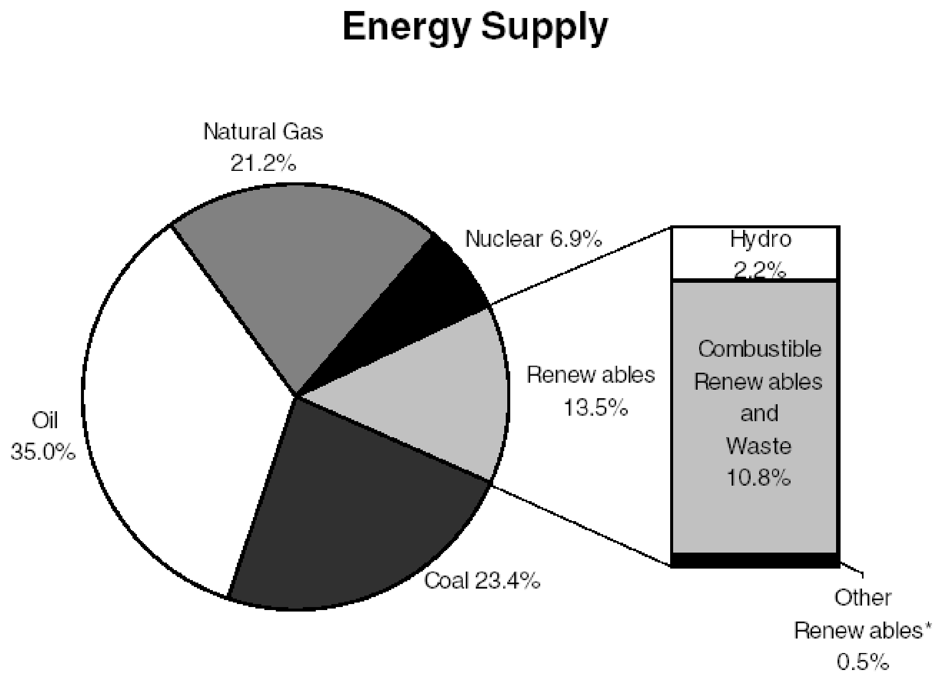
17. Name an appropriate energy source for each of the following uses and briefly describe how it is used for this purpose. (3)

Use	Energy source	How it is used
Producing electricity	Coal, oil, gas, bio-fuel, Nuclear Wind, wave, hydro – electric Geothermal	Burning fuel used in the production of electricity Nuclear reaction provides heat for the production of electricity Movement of air or water turns a turbine to produce electricity Steam from hot rocks used to produce electricity (any one source and simple description 1)
Transport	Oil (petrol, diesel, fuel oil, LPG) Renewable resources may supply electricity	Burning fuel drives an engine Electricity to drive a motor (any one source and simple description 1)
Heating a hospital	Coal, oil, gas, bio-fuel, Renewable resources may supply electricity	Burnt to heat water Electricity to run electric heating (any one source and simple description 1)

18. Worldwide agreements to reduce CO_2 emissions are intended to slow down climate change. Describe how CO_2 emissions contribute to climate change. (4)

CO_2 is released from burning fossil fuels
This CO_2 builds up in the atmosphere
Increased CO_2 in the atmosphere causes the atmosphere to heat up (retain heat)
This occurs because longer wavelength IR heat re-radiated from the Earth's surface cannot easily penetrate the CO_2 rich atmosphere / greenhouse gases can absorb this longer wavelength IR.
Higher global temperatures result
This can lead to reduced ice, changing weather patterns and expanding oceans.
(any four valid points) (4)

19. The chart shows the world's energy resources usage for 2015.



*Other Renewables: Geothermal, Wind, Solar, Tide.

Discuss the likely changes to the worlds energy supplies over the next 50 years. (6)

Fossil fuels will become more difficult to find and extract
Use of fossil fuels is likely to reduce
Fossil fuels release carbon dioxide into the atmosphere
Governments likely to put policies in place to reduce fossil fuel usage
Nuclear fuel power stations are becoming safer, so more are being built which will increase energy from this resource
Combustible renewables (wood, bio-fuel) and burning waste also increases CO_2 so is likely to reduce
Other renewables are likely to increase to replace some fossil fuel usage
However, energy production from renewables is limited as they often provide only small quantities of energy

(Credit any reasonable responses) (6)