# Revision Pack Physics Topic 1 - Energy

Do now

List the 8 different types of energy:

Describe what a 'closed system' is:

Describe the 4 ways that energy can be transferred:

1)

2)

3)

4)

# Revision Pack Physics Topic 1 - Energy

## Calculating Energy and Electricity Usage

Important

Kilo (k) as in KiloWatt (kW) means x1000 e.g. 1kW = 1000 Watts

Mega (M) as in Mega Watt means x 1000 000 1MW = 1000 0000 Watts

**Energy Transferred (Joules) = power (W) x time (s)**

Worked Example

Calculate the energy used by a 1800W heater in one hour.

i) Convert time into seconds

*1 hour = 60 minutes x 60 seconds = 3600 seconds*

ii) Multiply power x time

*Energy Transferred = power x time*

*= 1800 x 360*

*= 6480 000 J*

Examples

1. Calculate the energy used by a 900W heater in three hours

2. Calculate the energy used by a 5kW heater in four hours

# Revision Pack Physics Topic 1 - Energy

**Q1.** Under the same conditions, different materials heat up and cool down at different rates.

(a) What is meant by specific heat capacity?

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**(2)**

(b) Quenching' is a process used to change the properties of steel by cooling it rapidly.

The steel is heated to a very high temperature and then placed in a container of cold water.

(i) A metalworker quenches a steel rod by heating it to a temperature of 900 °C before placing it in cold water. The mass of the steel rod is 20 kg.

The final temperature of the rod and water is 50 °C.

Calculate the energy transferred from the steel rod to the water.

Specific heat capacity of steel = 420 J / kg °C.

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Energy transferred = ..... J

**(3)**

(ii) The temperature of the steel rod eventually returns to room temperature.

Compare the movement and energies of the particles in the steel rod and in the air at room temperature.

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**(3)**

(iii) When the steel rod is being quenched, the temperature of the water rises to 50 °C. After a few hours the water cools down to room temperature.

Some of the cooling of the water is due to evaporation.

Explain in terms of particles how evaporation causes the cooling of water.

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**(4)**
**(Total 12 marks)**

# Revision Pack Physics Topic 1 - Energy

**Q2.** A car which is moving has kinetic energy.


The faster a car goes, the more kinetic energy it has. The kinetic energy of this car was 472 500 J when travelling at 30 m/s.
Calculate the total mass of the car.
Show clearly how you work out your answer and give the unit.

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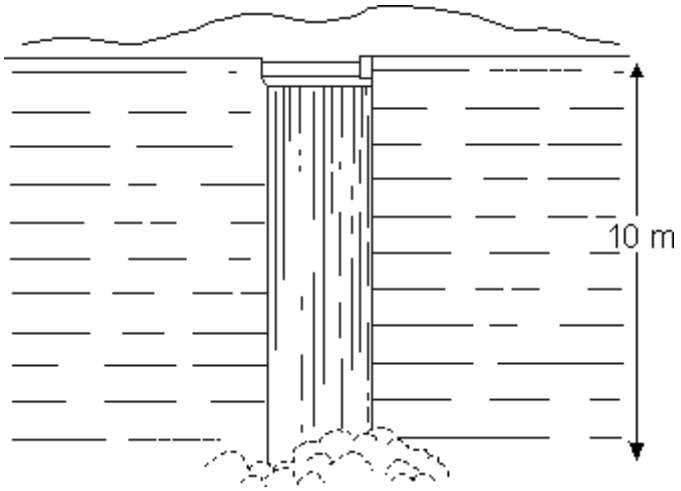
Mass of the car = .....

**(Total 5 marks)**

# Revision Pack Physics Topic 1 - Energy

**Q3.** The diagram below shows water falling over a dam at the end of a reservoir. The water falls a vertical distance of 10 m.




(a) Calculate the potential energy of 1 kg of water at the top of the waterfall.

.....

.....

Answer ..... J

**(2)**

(b) What will be the kinetic energy of 1 kg of the water just before it lands in the pool?

.....

Answer ..... J

**(1)**

(c) Use your answer to (b) to calculate the speed of the water as it lands at the bottom of the waterfall.

.....

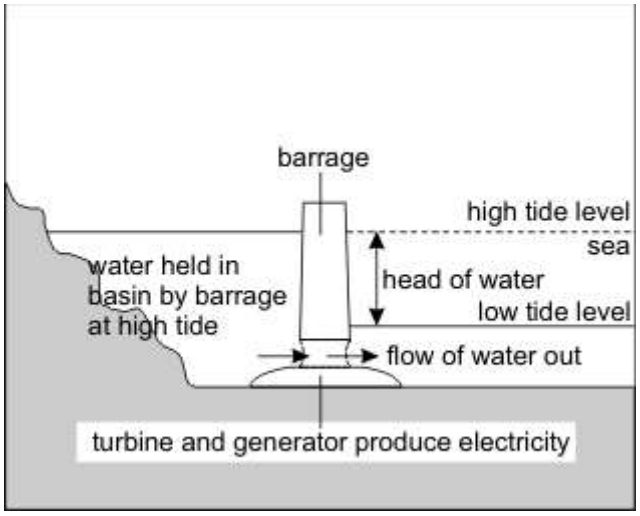
.....

.Answer ..... m/s

**(3)**

# Revision Pack Physics Topic 1 - Energy

**Q4.** The outline diagram below shows a tidal power generating system.




Gates in the barrage are open when the tide is coming in and the basin is filling to the high tide level. The gates are then closed as the tide begins to fall.

Once the tide outside the barrage has dropped the water can flow through large turbines in the barrage which drive generators to produce electrical energy.

In one second $1.2 \times 10^9$ kg of water flows through the turbines at a speed of 20 m/s.

(a) Calculate the total kinetic energy of the water which passes through the turbines each second.

.....

.....

.....

**(3)**

(b) As the height of water in the basin falls, the water speed through the turbines halves.

(i) What mass of water will now pass through the turbines each second?

.....

(ii) By how much will the power available to the generators decrease?

.....

.....

.....

.....

**(5)**
**(Total 8 marks)**

**Q5.** Energy resources can be renewable or non-renewable.

(a) Coal is a non-renewable energy resource.

Name **two** other non-renewable energy resources.

1 .....

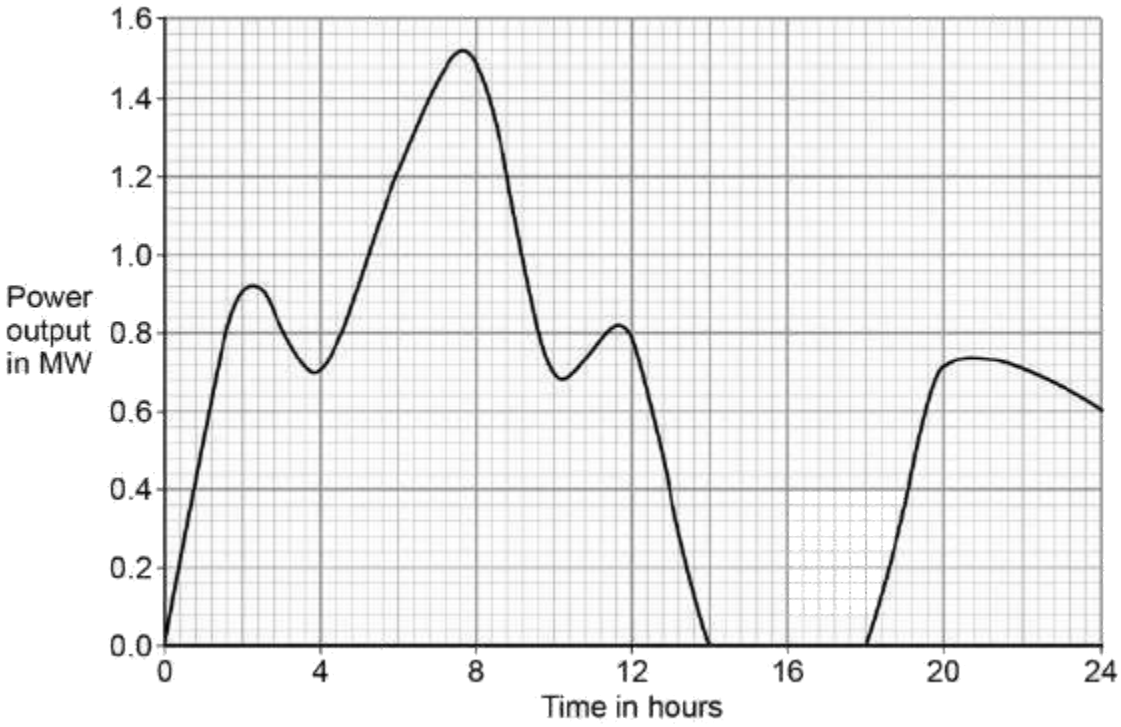
2 .....

**(2)**

(b) Wind turbines are used to generate electricity.

The graph below shows how the power output of a wind turbine changes over one day.

# Revision Pack Physics Topic 1 - Energy




A wind turbine does not generate electricity constantly.

For how many hours did the wind turbine generate no electricity?

.....

Time = ..... hours

**(1)**

(c) Electrical power is transferred from power stations to the National Grid.

What is the National Grid?

Tick **one** box.

a system of cables and pylons ☐

a system of cables and transformers ☐

a system of cables, transformers and power stations ☐

**(1)**

(d) An island has a large number of wind turbines and a coal-fired power station.

The island needs to use the electricity generated by the coal-fired power station at certain times.

Choose **one** reason why.

Tick **one** box.

Wind is a renewable energy resource. ☐

Wind turbine power output is constant. ☐

The power output of wind turbines is unpredictable. ☐

The fuel cost for wind turbines is very high. ☐

**(1)**

(e) A wind turbine has an average power output of 0.60 MW.

A coal-fired power station has a continuous power output of 1500 MW.

Calculate how many wind turbines would be needed to generate the same power output as one coal-fired power station.

.....

.....

Number of wind turbines = .....

**(2)**

# Revision Pack Physics Topic 1 - Energy

(f) It is important that scientists develop new energy resources.

Choose **one** reason why.

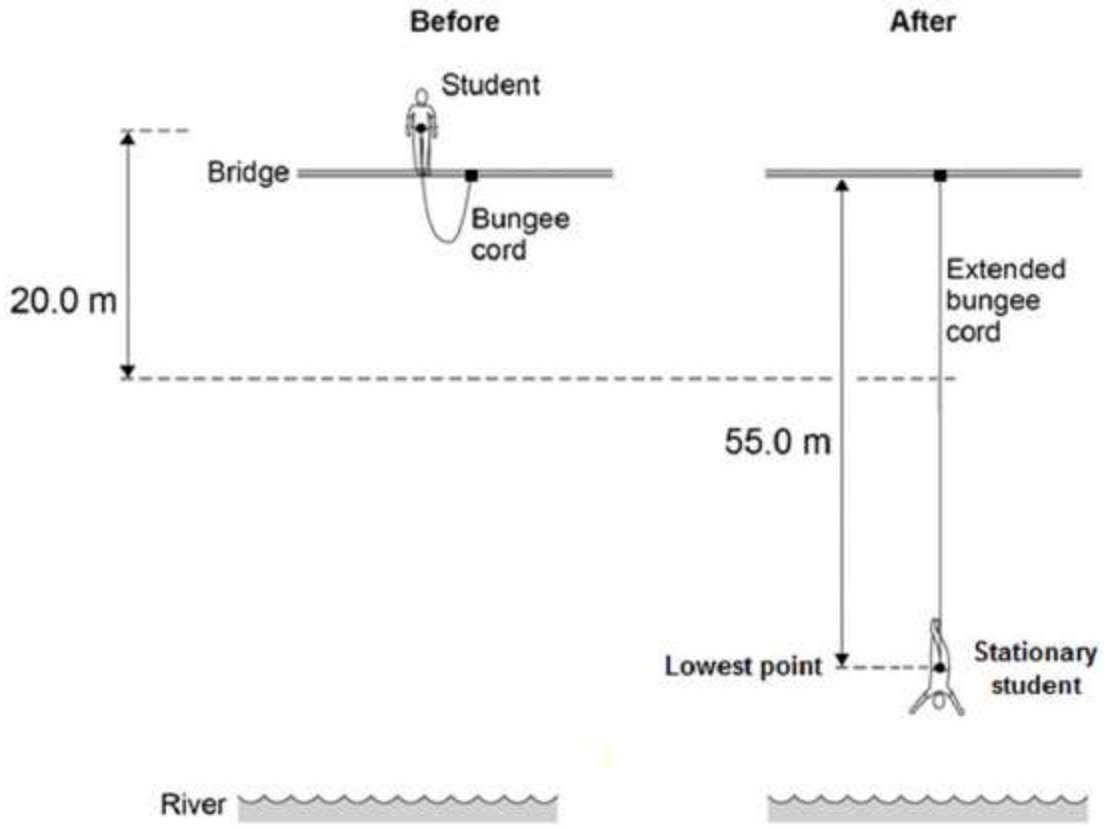
Tick **one** box.

| | |
|---|---|
| All energy resources are running out. | ☐ |
| All energy resources are used to generate electricity. | ☐ |
| Most energy resources have negative environmental effects. | ☐ |

**(1)**
**(Total 8 marks)**

**Q6.** The figure below shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20.0 m.



# Revision Pack Physics Topic 1 - Energy

The mass of the student is 50.0 kg.

The gravitational field strength is 9.8 N / kg.

(a) Write down the equation which links gravitational field strength, gravitational potential energy, height and mass.

.....

**(1)**

(b) Calculate the change in gravitational potential energy from the position where the student jumps to the point 20.0 m below.

.....

.....

.....

Change in gravitational potential energy = ..... J

**(2)**

(c) 80% of this change in gravitational potential energy has been transferred to the student's kinetic energy store.

How much has the student's kinetic energy store increased after falling 20.0 m?

Kinetic energy gained = ..... J

**(1)**

(d) Calculate the speed of the student after falling 20.0 m.

Give your answer to two significant figures.

.....

.....

.....

.....

Speed = ..... m / s

**(4)**

(e) At the lowest point in the jump, the energy stored by the stretched bungee cord is 24.5 kJ.

The bungee cord behaves like a spring.

Calculate the spring constant of the bungee cord.

Use the correct equation from the Physics Equation Sheet.

.....

.....

.....

.....

.....

.....

Spring constant = ..... N / m

**(3)**

**(Total 11 marks)**

**Q7.** A student finds some information about energy-saving light bulbs.

(a) A 30W light bulb uses 600J of electrical energy in a certain period of time. In that time, it produces 450 J of light energy. The rest of the energy is wasted.

(i) Calculate the energy wasted by the light bulb in this period of time.

.....

Wasted energy = ..... J

**(1)**

(ii) What happens to the energy wasted by the light bulb?

.....

.....

**(1)**

(iii) Calculate the efficiency of this light bulb.

.....

.....

Efficiency = .....

**(2)**

(iv) Calculate the period of time, in seconds, during which the 600 J is provided to the 30 W light bulb.

.....

.....

Time = ..... s

**(2)**

(b) A company that makes light bulbs provides information about some of their products.

The table shows some of this information.

| | **Power in watts** | **Lifetime in hours** | **Cost of bulb in £** |
|---|---|---|---|
| **Filament bulb** | 60 | 1250 | 2.00 |
| **LED bulb** | 12 | 50 000 | 16.00 |

(i) Suggest why it is important to confirm this information independently.

.....

**(1)**

(ii) A homeowner is thinking about replacing his filament bulbs with LED bulbs.

A 12 W LED bulb gives the same light output as a 60 W filament bulb.

Suggest reasons why the homeowner is likely to choose LED bulbs.

Use the information given in the table.

.....

.....

.....

.....

**(2)**

(iii) State **one** factor, other than efficiency, that is important when considering the choice of a bulb for lighting in the home.

.....

.....

**(1)**
**(Total 10 marks)**

**Q8.** (a) Coal, gas, oil and wood are all examples of fuels.

(i) What are fuels?

.....

**(1)**

(ii) Write the names of these fuels in the table below to show which are renewable and which are non-renewable.

# Revision Pack Physics Topic 1 - Energy

| RENEWABLE FUELS | NON-RENEWABLE FUELS |
|---|---|
| | |
| | |
| | |
| | |

**(2)**

(b) The list below shows energy resources which are not fuels.

**geothermal nuclear solar tides wind**

Write the names of the energy resources in the table below to show which are renewable and which are non-renewable.

| RENEWABLE FUELS | NON-RENEWABLE FUELS |
|---|---|
| | |
| | |
| | |
| | |
| | |

**(2)**

(c) Why is it better to use more renewable energy resources rather than non-renewable resources?

.....

.....

.....

.....

**(2)**
**(Total 7 marks)**

# Revision Pack Physics Topic 1 - Energy

**M1.**(a) energy required to raise the temperature of a substance by 1 °C

*accept heat for energy*

**1**

unit mass / 1 kg

**1**

(b) (i) 7 140 000 (J)

*allow 2 marks for a correct substitution, ie*
*E = 20 × 420 × 850*
*provided no subsequent step*
*850 gains **1** mark if no other mark awarded*

**3**

(ii) particles in the air have more (kinetic) energy than the particles in the steel

*allow particles in the air have a greater speed.*

**1**

**steel**
particles vibrate (about fixed positions)

**1**

**air**
particles move freely

**1**

(ii) the most energetic particles

*accept molecules for particles throughout*
*accept the fastest particles*

**1**

have enough energy to escape from (the surface of) the water

**1**

therefore the mean energy of the remaining particles decreases

*accept speed for energy*

**1**

as energy decreased, temperature has decreased

**1**

**[12]**

# Revision Pack Physics Topic 1 - Energy

**M2.** 1050

kg

*if answer incorrect then kinetic energy = $\frac{1}{2}$ $mv^2$ or*
*accept indication by correct substitution for 1 mark*
*accept 900 for 1 mark*

*accept m = $\frac{2KE}{v^2}$ or indication by correct substitution for 1 mark*

**4** **1** **[5]**

**M3.** (a) 100

*gains 2 marks*

else working

*gains 1 mark*

**2**

(b) 100 ecf

*for 1 mark*

**1**

(c) rounds to 14 (accept 14.142 or 14.14) ecf

*gains 3 marks*

else working to $v^2 = 200$

*gains 2 marks*

else initial working v = 200

*gains 1 mark*

**3** **[6]**

# Revision Pack Physics Topic 1 - Energy

**M4.** (a) $k = 1/2mv^2$
$k = 1/2.1.2.109.202$
$k = 2.4.1011$
*for one mark each*

**3**

(b) (i) 0.6.109

(ii) mass halved
speed halved
(speed)2 quartered
ke and/or power cut to one eight
*for 1 mark each*

**5**

**[8]**

**M5.**(a) any **two** from:

- nuclear
- oil
- (natural) gas

**2**

(b) 4 (hours)

**1**

(c) a system of cables and transformers

**1**

(d) The power output of wind turbines is unpredictable

**1**

(e) 1500 / 0.6

1

2500 (wind turbines)

1

*allow 2500 with no working shown for **2** marks*

(f) Most energy resources have negative environmental effects.

1

**[8]**

**M6.**(a) g.p.e. = mass × gravitational field strength × height

*accept $E_p = mgh$*

1

(b) $E_p = 50 \times 9.8 \times 20$

1

9800 (J)

*allow 9800 (J) with no working shown for **2** marks*
*answer may also be correctly calculated using W = Fs*
*ie allow W = 490 × 20 for **1** mark*
*or answer of 9800 (J) using this method for **2** marks*

1

(c) 7840 (J)

*allow ecf from '11.2'*

1

(d) $7840 = ½ \times 50 \times v^2$

1

$$v = \sqrt{\frac{7840}{1/2 \times 50}}$$

*allow* $v^2 = \frac{7840}{(1/2 \times 50)}$ *for this point*

1

17.7(0875) (m / s)

1

18 (m / s)

*allow ecf from '11.3' correctly calculated for **3** marks*
*allow 18 (m / s) with no working for **2** marks*
*answer may also be correctly calculated using* $v^2 - u^2 = 2as$

1

(e) extension = 35 (m) and conversion of 24.5 kJ to 24500 J

1

24 500 = ½ × k × $35^2$

1

40

1

*allow 40 with no working shown for **3** marks*
*an answer of '16.2' gains **2** marks*

**[11]**

**M7.**(a) (i) 150

1

(ii) transferred to the surroundings by heating

*reference to sound negates mark*

**1**

(iii) 0.75

*450 / 600 gains **1** mark*
*accept 75% for **2** marks*
*maximum of **1** mark awarded if a unit is given*

**2**

(iv) 20 (s)

*correct answer with or without working gains **2** marks*
*correct substitution of 600 / 30 gains **1** mark*

**2**

(b) (i) to avoid bias

**1**

(ii) use less power and last longer

**1**

1 LED costs £16, 40 filament bulbs cost £80

**or**

filament costs (5 times) more in energy consumption

**1**

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

**1**

**[10]**

# Revision Pack Physics Topic 1 - Energy

**M8.** (a) (i) sources of energy

*for 1 mark*

(ii) wood coal
oil
gas

*all correct gains 2 marks*
*3 correct gains 1 mark*

**3**

(b) geothermal nuclear
tides
wind
solar

*all correct gains 2 marks*
*4 correct gains 1 mark*

**2**

(c) non-renewable fuels cause pollution (or reverse)
conserve/limit use of coal/gas/oil;
so supplies last longer/renewable sources can be replaced

*any 2 from 4 for 1 mark each*

**2**

**[7]**