Year 7 – Energy

Mastery Matrix

Topic	Course	Learning statement	RAG		
Energy	All	Describe the different energy stores (thermal (internal), chemical, kinetic, gravitational potential, elastic potential, magnetic)			
Energy	All	Describe how energy is transferred from one store to another in given scenarios			
Energy	All	Define "conservation of energy"			
Energy	Ext	Use a Sankey diagram to represent energy transfers (Extension only)			
Energy	All	Calculate efficiency using efficiency = useful energy output/total energy input			
Heating and cooling	All	Define "conduction", "convection" and "radiation"			
Heating and cooling	All	Define "thermal conductor" and "thermal insulator"			
Heating and cooling	All	Describe how conduction occurs and link to real world scenarios			
Heating and cooling	All	Describe how convection occurs and link to real world scenarios			
Heating and cooling	All	Describe how radiation occurs and link to real world scenarios			
Heating and cooling	All	Compare and contrast the three ways that thermal energy can be transferred			
Heating and cooling	All	Investigate the best materials for preventing heat loss			
Heating and cooling	All	Explain how heat loss can be prevented in the real world			
Heating and cooling	All	Define "temperature" and "thermal energy"			
Energy Sources	All	Define "renewable" and "non-renewable" energy resource			
Energy Sources	All	Recall 4 examples of non-renewable and 6 examples of renewable energy resources			
Energy Sources	All	Explain the advantages and disadvantages of each energy resource			
Energy Sources	All	Define "power"			
Energy Sources	All	Calculate the cost of energy at home using the formula cost = power (kW) x time (hours) x price (per kWh)			

The Knowledge

	Topic:	**Energy (P.7)**
1	Name seven energy stores	Thermal (internal), chemical, kinetic, gravitational potential, elastic potential, electrostatic potential, magnetic
2	Define "conservation of energy"	Energy cannot be created or destroyed; it can only be transferred, stored or dissipated
3	Define "dissipated"	Spread out wastefully
4	State the equation for efficiency	Efficiency= useful energy output/total energy input
5	Define "energy transfer"	Energy being converted from one energy store to another
6	Define "kinetic energy store"	The energy of a moving object
7	Define "internal (thermal) energy store"	Total kinetic and potential energy of the particles in an object
8	Define "gravitational potential energy store"	The energy of an object at height
9	Define "elastic potential energy store"	The energy stored when an object is stretched or squashed

10	Name the diagram used to represent energy transfer (Ext)	Sankey diagram
	Topic:	**Heating and cooling (P.8)**
1	Define "conduction"	Transfer of thermal energy by the vibration of particles
2	Define "convection"	Transfer of thermal energy when particles in a heated fluid (liquid or gas) rise
3	Define "radiation"	Transfer of thermal energy as a wave
4	Define "thermal conductor"	Material that allows heat to move quickly through it
5	Define "thermal insulator"	Material that allows heat to travel slowly though it
6	In which states can convection occur?	Liquids and gases (fluids)
7	Define "temperature"	A measure of the motion and energy of the particles
8	State the standard unit of temperature	Degrees Celsius (oC)
9	Define "thermal (internal) energy"	Quantity of energy stored in a substance due to the vibration of its particles
10	State the standard unit of thermal (internal) energy	Joules
	Topic:	**Energy Sources (P.9)**
1	Define "renewable energy resource"	An energy resource that can be replaced and will not run out.
2	Define " Non renewable energy resource"	An energy resource that cannot be replaced and will be used up
3	State four examples of non-renewable energy resources	Coal, oil, natural gas, nuclear power
4	State six examples of renewable energy resources	Solar, wind, waves, hydroelectric, geothermal, biomass
5	State the three fossil fuels	Coal, oil, natural gas
6	State two disadvantages of using fossil fuels to generate electricity	Releases greenhouse gases, non-renewable
7	Define "power"	How quickly energy is transferred by a device
8	State the standard unit of power	Watt
9	State the equation to calculate the cost of energy at home	Cost=power(kw) x time(hours) x price(per kWh)
10	How do you convert watts into kilowatts?	Divide by 1000

HW	*Topic*	*Mark*	*Mark with extension*

1	*Balanced and unbalanced forces recap*	/20	/27
2	*Energy transfers & Sankey diagrams*	/20	/24
3	*Efficiency calculations*	/19	/24
4	*Renewable & non-renewable energy sources*	/19	/22
5	*Power calculations*	/19	/26

Homework 1 - Balanced and unbalanced forces recap

1) What is the unit of measurement for forces? (make sure you include the symbol)

.....

(2 marks)

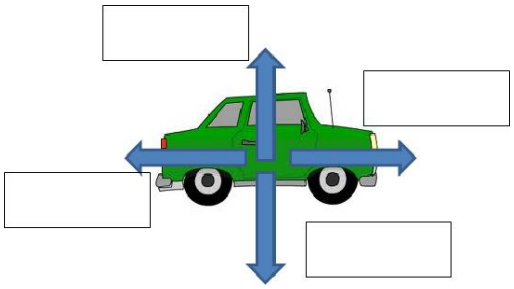
2) Name two examples of contact forces

.....

.....

(2 marks)

3) (a) Label the forces acting on this car:



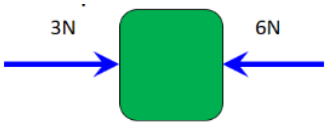
(4 marks)

(b) Are the forces acting on the following objects balanced or unbalanced?

.....

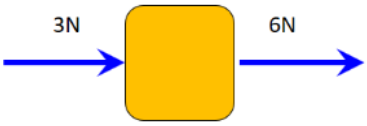
(1 mark)

(c) Calculate the resultant force for each object and state the direction in which it will move.



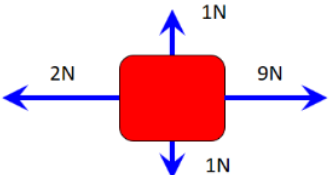
Resultant Force: ……

Direction: …….



Resultant Force: ……

Direction: …….



Resultant Force: ……

Direction: …….

(5 marks)

4) (a) What effect does friction have on the speed of a moving object? In which direction does friction always act?

.....

.....

(2 marks)

(b) Describe two ways in which the friction felt between two objects could be reduced.

.....

.....

(2 marks)

5) Circle the object which would be most streamlined when moving from left to right:

(1 mark)

Total Marks: / 20

Extension:

6) (a) State the equation for calculating speed, include the units.

.....

(1 mark)

(b) Mo Farah runs 100m in 12 seconds, what is his speed?

.....

(2 marks)

(c) Rachel walks 22.5km in 5 hours, what is her speed?

.....

(2 marks)

(d) A cheetah runs at a speed of 33m/s in 15 seconds. How far has it ran?

.....

(2 marks)

Total Marks: / 27

<u>Homework 2 – Energy stores and transfers</u>

Remember: Energy cannot be created or destroyed, it just changes from one type into other types.

State the energy transfer for each energy store change.

E.g
An object thrown upwards:
Kinetic store → gravitational store
<u>Via mechanical transfer</u>

1) An elastic band –
The energy transfer here is: elastic → kinetic

_____

2) A moving object hitting an obstacle – eg the train hitting the buffers on the track
The energy transfer here is: Kinetic → elastic
→ thermal

_____ Hint: there are two energy transfers

3) Bike at the bottom of a steep hill, moving up the hill–
The energy transfer here is: kinetic → gravitational potential

_____

4) Draw an energy transfer diagram for a vehicle slowing down

_____ → _____ via _____ (3)

5) Complete the table below of energy from the following key words: Kinetic, Gravitational, Thermal, Elastic, Chemical, Nuclear, electrostatic, magnetic

Type of Energy Store	Description
	Stored in fuel, oxygen and chemicals
	Stored in a moving object
	Stored in an object due to the position of the object in a gravitational field
	stored in a stretched or compressed spring
	stored in a warm object or cold object
	stored in two separated magnets that are attracting, or repelling
	stored in two separated electric charges that are attracting, or repelling
	stored and released through radioactive decay, fission or fusion

8 marks

6 (a) 250J of electrical energy is input into the radio. If it converts 75J into thermal energy and 50J into light, calculate the amount of sound energy which is output.

.....

.....(2 marks)

(b) A kettle transfers energy into the water it is boiling. Identify the useful Energy store output by the kettle.

..... (1 mark)

(c) Over 5 minutes, the lightbulb gives out 85J of light energy, 60J of sound energy and 120J of thermal energy. Calculate the amount of energy transferred electrically over 5 minutes.

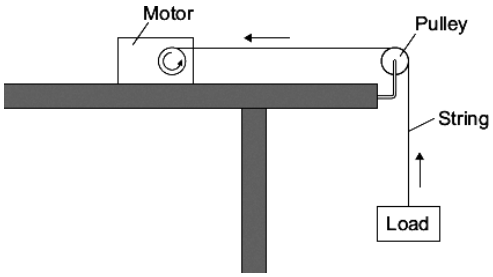
.....

.....

(2 marks)

Total Marks: / 20

Extension:



1) A student uses an electric motor to lift a load.

In the motor, the electrical energy is transferred into other types of energy. Some of this energy is useful and the rest of the energy is wasted.

(a) (i) Name the useful energy output from the electric motor.

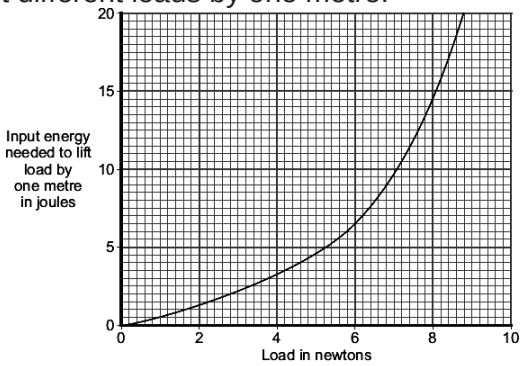
.....**(1)**

(ii) What eventually happens to the wasted energy?

.....

.....**(1)**

(b) The graph shows the input energy the motor needs to lift different loads by one metre.



What can you conclude from the graph about the relationship between the load lifted and

the input energy needed?

.....

.....**(2)**

Total Marks: / 24

<u>Homework 3 – Efficiency calculations</u>

Remember: To calculate the efficiency of a device, you can use the following equation:

Efficiency= (useful energy transferred / energy input) x 100

e.g. a street lamp uses 100 joules of electrical energy. 75 Joules of this are wasted as heat energy and only 25 Joules are converted into light (the useful energy). The example below shows how to calculate the efficiency of this street lamp:

Efficiency= (25J/ 100J) x 100
Efficiency= 25%

1) Calculate the efficiency for each of the appliances in the table below. Make sure that you show your workings in the end column.

Appliance	**Input Energy store/transfer**	**Wasted energy store/transfer**	**Useful energy store/transfer**	**Efficiency: working out and answer**

Street lamp	100 J	75 J	25 J	Efficiency= (25J/ 100J) x 100 Efficiency= 25%
	Electrically	Heat	Radiation (Light)	
iPhone	400 J	175 J	225 J	
	Electrically	Heat	Radiation (Light)	
Lamp	100 J	75 J	25 J	
	Electrically	Heat	Radiation (Light)	
Torch	75 J	25 J	50 J	
	Chemical	Heat	Radiation (Light)	
Microwave	500 J	150 J	350 J	
	Electrically	Sound	Heat and kinetic	
Matches	50 J	25 J	25 J	
	Chemical	Radiation (Light)	Heat	

(5 marks)

2) (a) Write down the equation which links efficiency, energy input and useful energy output. Make sure that you include all units.

..... (2 marks)

(b) A bike uses 20J of energy. 2J are wasted as sound. What is the efficiency of the bike?

..... (2 marks)

(c) A vacuum uses 150 J of energy, 10 J is wasted in sound, what is the efficiency of the vacuum?

..... (2 marks)

(d) A petrol engine has a total output of 80 kW and a useful output of 28 kW what is the efficiency of the engine?

..... (2 marks)

3) (a) State two benefits of using energy-efficient lightbulbs, compared to regular ones.

.....

.....(2 marks)

(b) A games console has a useful output of 200 J and an efficiency of 2%. What is the total energy input for the fan?

.....

.....(2 marks)

(c) A gas boiler has a total energy input of 1000 J and an efficiency of 10%. What is the useful output of the boiler?

.....

.....(2 marks)

Total Marks: / 19

Extension:

4) The image shows a man using a leaf blower to move some leaves.

The leaf blower is powered by an electric motor connected to a battery.

(a) Energy transfers take place when the leaf blower is being used. Use the correct answer from the box to complete each sentence.

chemical	**thermal**	**kinetic**	**nuclear**	**electrostatic**

The battery stores ..... energy which is transferred into electrical energy.
The electric motor transfers electrical energy usefully into ..... energy.
The motor wastes energy as ..... energy and as energy that heats the surroundings.

(2 marks)

(b) The total power input to the leaf blower is 750J. The useful power output of the leaf blower is 360J. Calculate the efficiency of the leaf blower.

.....

.....

(2 marks)

Total Marks: / 24

<u>Homework 4 – Renewable & non-renewable energy sources</u>

1) Define each of the key terms below:

(a) Non-renewable energy

.....

(1 mark)

(b) Renewable energy

.....

(1 mark)

2) (a) Name 3 fossil fuels

.....

.....

.....

(3 marks)

(b) Give 3 examples of how fossil fuels are used in the home (e.g. a fireplace uses coal)

.....

.....

.....(3 marks)

3) Name the gas released by burning fossil fuels and the environmental problem linked with it being released.

.....

.....(2 marks)

4) State four sources of renewable energy:

(i) .....

(ii) .....

(iii) .....

(iv) .....

(4 marks)

5) Give one advantage **and** one disadvantage of using solar cells.

Advantage:

.....

Disadvantage:

.....

(2 marks)

6) Give one advantage **and** one disadvantage of using wind turbines.

Advantage:

.....

Disadvantage:

.....

(2 marks)

Total Marks: / 19
Extension:

8) Wind and tides are renewable energy sources that are used to generate electricity.
(a) Complete each sentence by putting a tick (✓) in the box next to the correct answer.
(i) The wind is:

a predictable energy source. ☐

a constant energy source. ☐

an unreliable energy source. ☐

(1 mark)

(ii) The tides are:

a predictable energy source. ☐

a constant energy source. ☐

an unreliable energy source. ☐

(1 mark)

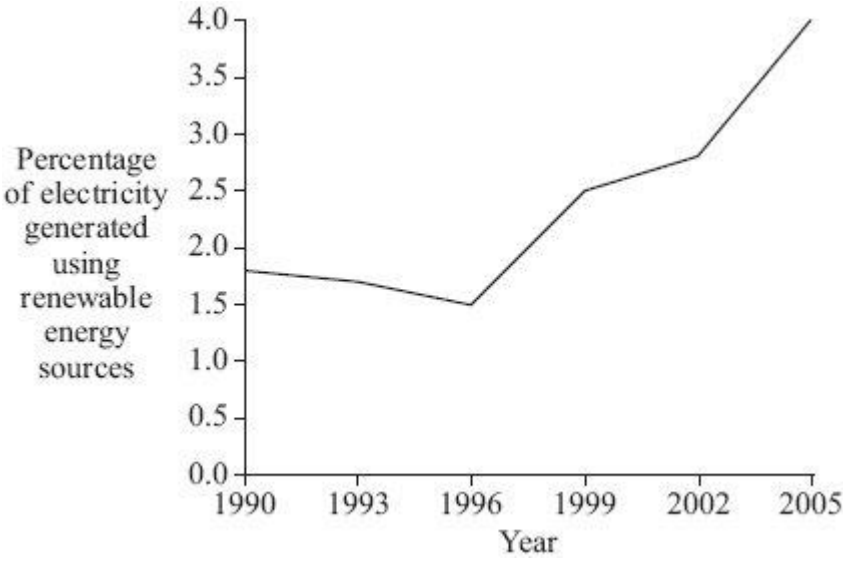
(b) If wood is to be used as a renewable energy source, what must be done each time a tree is chopped down?

.....

.....

(1 mark)

(c) In the UK, electricity is generated using renewable and non-renewable energy sources. The graph shows the percentage of electricity generated using renewable energy sources between 1990 and 2005.



Complete the following sentence by drawing a ring around the correct line in the box.

In 2015, the percentage of electricity generated using renewable energy sources is most likely to be

greater than 4%
equal to 4%
less than 4%

.

(1 mark)

Total Marks: / 25

Homework 5 – Power calculations

Power (W) = energy transferred (J) ÷ time (s)

Power (W) = work done (J) ÷ time (s)

1) (a) Rearrange the information above to give the equation for calculating 'time', using 'power' and 'energy transferred'.

.....

(1 mark)

(b) State the equation for calculating 'energy transferred', using 'power' and 'time'.

.....

(1 mark)

(b) Calculate the missing value in each column. Show your workings in the end column, and make sure to include any units.

Q	Power	Energy transferred (work done)	Time	Working out
(a)	30W	20J		
(b)		32J	16s	
(c)	202W	38J		
(d)	1.2kW		15s	
(e)		17J	1 minute 42 seconds	
(f)	3.2kW		2 minutes 10 seconds	

(6 marks)

2) Give a definition for power and the units used to measure it

.....

.....(2 marks)

3) (a) An electric lamp transforms 500 J in 5 s. What is its power?

..... (2 marks)

(b) A runner exerts 350J of work to produce 125W of power. How long must they have been running for in

order to achieve this?

..... (2 marks)

(c) 100, 000 J of energy passes through a microwave every minute. What is its power rating?

..... (2 marks)

(d) How much energy is transferred through a 100W lightbulb over the course of half an hour? (Hint: Make sure that you transfer the time into seconds first).

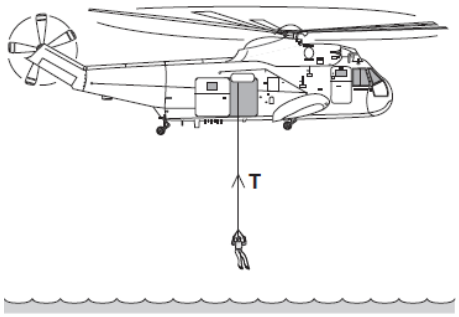
.....

..... (3 marks)

Total Marks /17

Extension:

4) The diagram shows a helicopter being used to rescue a person from the sea.



(a) (i) The mass of the rescued person is 72 kg.
Use the equation in the box to calculate the weight of the rescued person.

weight = mass × gravitational field strength

Gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

.....

Weight = ... N

(2 marks)

(ii) An electric motor is used to lift the person up to the helicopter.
The motor lifts the person at a constant speed.
State the size of the force, **T**, in the cable.

Force **T** = ... N (1 mark)

(b) To lift the person up to the helicopter, the electric motor transformed 21 600 joules of energy usefully.

(i) Use a form of energy from the box to complete the following sentence.

gravitational potential	thermal	electrostatic

The electric motor transforms electrical energy to kinetic energy. The kinetic energy is then transformed into useful ..... energy.(1 mark)

(ii) It takes 50 seconds for the electric motor to lift the person up to the helicopter.
Use the equation in the box to calculate the power of the electric motor.

$$\text{power} = \frac{\text{energy transformed}}{\text{time}}$$

Show clearly how you work out your answer and give the unit. Choose the unit from the list below.

coulomb (C) **hertz (Hz)** **watt (W)**

Power = ... (3 marks)

Total Marks: / 26