New Document 1

Name: _____

Class: _____

Date: _____

Time: **90 minutes**

Marks: **89 marks**

Comments:

Q1. All European Union countries are expected to generate 20% of their electricity using renewable energy sources by 2020.

The estimated cost of generating electricity in the year 2020 using different energy sources is shown in **Table 1**.

Table 1

Energy source	Estimated cost (in the year 2020) in pence per kWh
Nuclear	7.8
Solar	25.3
Tidal	18.8
Wind	10.0

France generated 542 billion kWh of electricity using nuclear power stations in 2011. France used 478 billion kWh of electricity and sold the rest of the electricity to other countries in 2011.

(a) France may continue generating large amounts of electricity using nuclear power stations instead of using renewable energy resources.

Suggest **two** reasons why.

1. .....

.....

2. .....

.....

(2)

(b) Give **two** disadvantages of generating electricity using nuclear power stations.

1. .....

.....

2. .....

.....

(2)

(c) A panel of solar cells has an efficiency of 0.15.

The total power input to the panel of solar cells is 3.2 kW.

Calculate the useful power output of this panel of solar cells in kW.

.....

.....

.....

.....

Useful power output = ... kW

(2)

(d) **Table 2** shows the manufacturing cost and efficiency of different types of panels of solar cells.

Table 2

Type of Solar Panel	Cost to manufacture a 1 m^2 solar panel in £	Efficiency in %
A	40.00	20
B	22.50	15
C	5.00	10

Some scientists think that having a low manufacturing cost is more important than improving the efficiency of solar cells.

Use information from **Table 2** to suggest why.

.....

.....

.....

.....

.....

.....

(2)

(Total 8 marks)

Q2. The electric kettle shown below is used to boil water.

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(a) After the water has boiled, the temperature of the water decreases by 22 °C.
The mass of water in the kettle is 0.50 kg.
The specific heat capacity of water is 4200 J/kg °C.

Calculate the energy transferred to the surroundings from the water.

.....

.....

.....

Energy = ... joules

(2)

(b) Why is the total energy input to the kettle higher than the energy used to heat the water?

Tick (✓) **one** box.

	Tick (✓)
Energy is absorbed from the surroundings.	
Energy is used to heat the kettle.	
The kettle is more than 100% efficient.	

(1)
(Total 3 marks)

Q3. 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	**electrical**	**kinetic**	**nuclear**	**sound**

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.

(3)

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

Calculate the efficiency of the leaf blower.

.....

.....

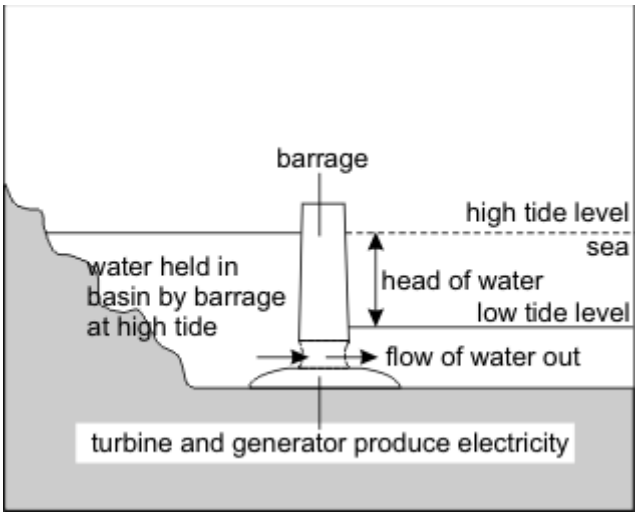
.....

.....

Efficiency = ...

(2)
(Total 5 marks)

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 1.2×10^9 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?

.....

.....

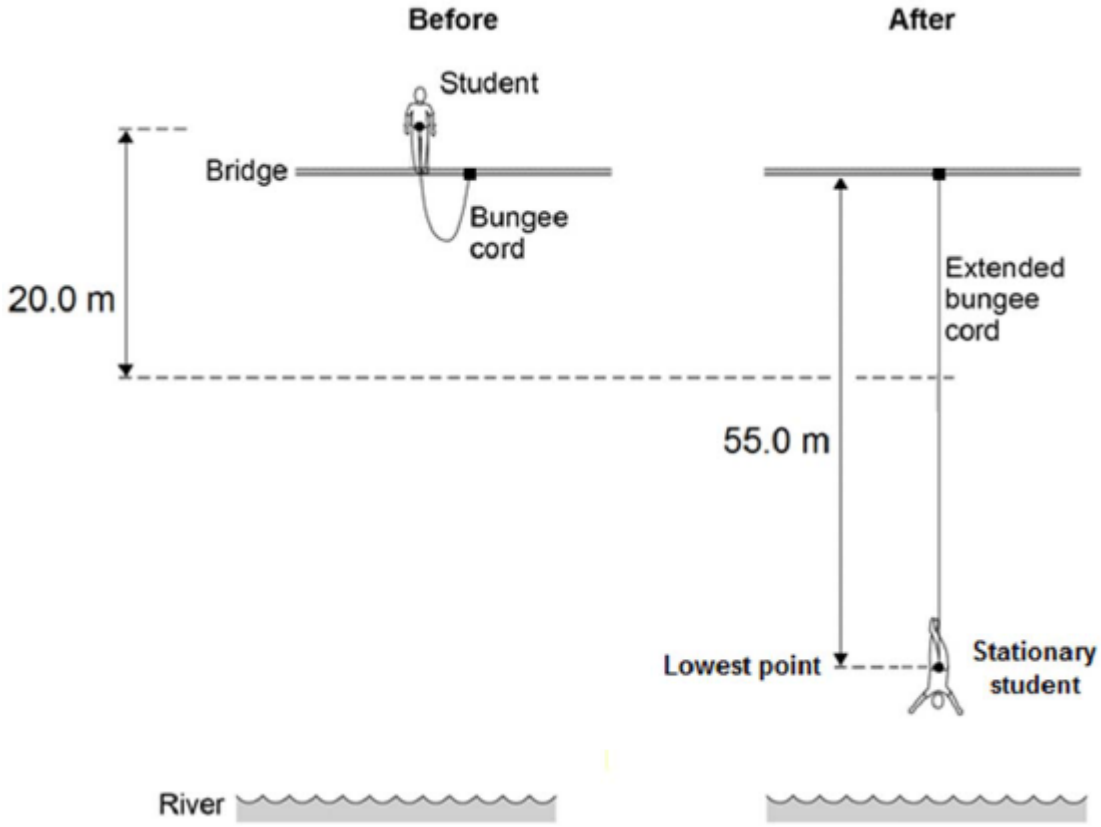
.....

.....

(5)
(Total 8 marks)

Q5. The figure below shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20.0 m.



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.

.....

.....

.....

.....

.....

.....

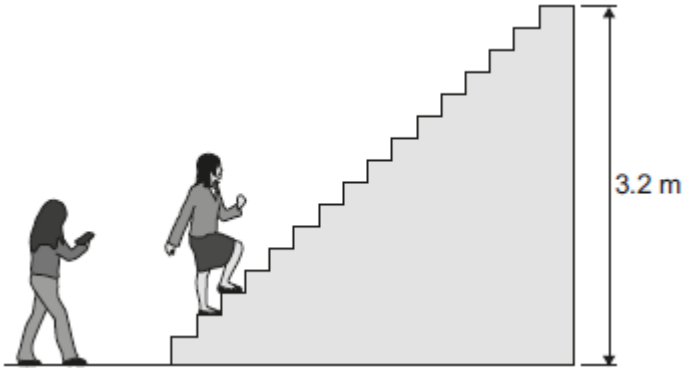
Spring constant = ... N / m

(3)

(Total 11 marks)

Q6. A student did an experiment to calculate her power.
The diagram below shows how she obtained the measurements needed.

The student first weighed herself and then ran up a flight of stairs. A second student timed how long it took her to go from the bottom to the top of the stairs. The height of the stairs was also measured.



(a) Complete the following sentence.

To run up the stairs the student must do work against

the force of ..... .

(1)

(b) The student did 2240 J of work going from the bottom of the stairs to the top of the stairs.

The student took 2.8 seconds to run up the stairs.

(i) Calculate the power the student developed when running up the stairs.

.....

.....

Power = ... W

(2)

(ii) How much gravitational potential energy did the student gain in going from the bottom to the top of the stairs?

Tick (✓) **one** box.

much more than 2240 J ☐

2240 J ☐

much less than 2240 J ☐

(1)

(c) Another four students did the same experiment.

The measurements taken and the calculated values for power are given in the table.

Student	Weight in newtons	Time taken in seconds	Power in watts
A	285	3.8	240
B	360	2.4	480
C	600	3.4	560
D	725	4.0	580

(i) To make a fair comparison of their powers the students kept **one** variable in the experiment constant.

What variable did the students keep constant?

.....

(1)

(ii) From the data in the table a student wrote the following conclusion.

'The greater the weight of the student the greater the power developed.'

Suggest why this conclusion may **not** be true for a larger group of students.

.....

.....

(1)
(Total 6 marks)

Q7. The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ... joules

(1)
(Total 2 marks)

Q8. 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)

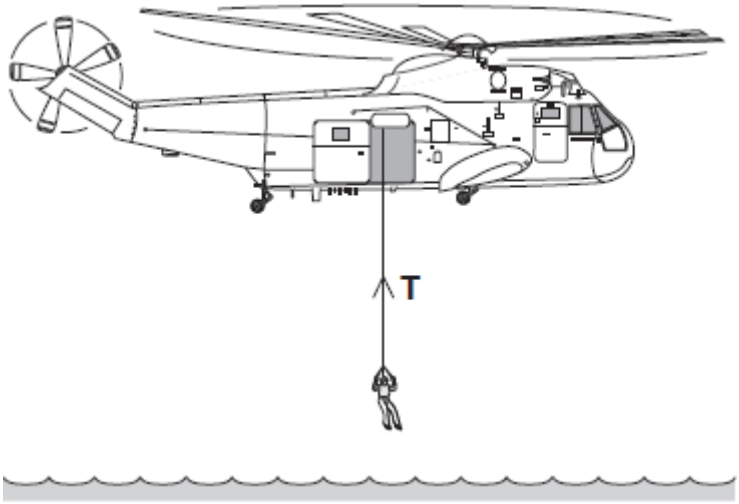
(iii) State **one** factor, other than efficiency, that is important when considering the choice of a bulb for lighting in the home.

.....

.....

(1)
(Total 10 marks)

Q9. 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)

(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)

(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	heat	sound

The electric motor transforms electrical energy to kinetic energy. The kinetic energy

is then transformed into useful ..... energy.

(1)

(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)

(Total 7 marks)

Q10.(a) Solar energy is a *renewable* energy source used to generate electricity.

(i) What is meant by an energy source being *renewable?*

.....

.....

(1)

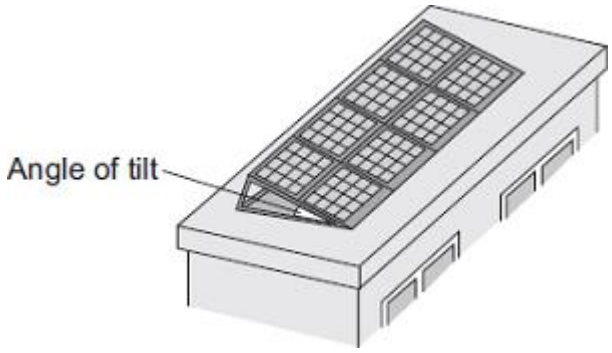
(ii) Name **two** other renewable energy sources used to generate electricity.

1 .....

2 .....

(1)

(b) A householder uses panels of solar cells to generate electricity for his home. The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	Angle of tilt			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600

June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

(i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

.....

.....

.....

.....

(2)

(ii) The total area of the solar cell panels used by the householder is 5 m^2.

The efficiency of the solar cells is 0.18.

Calculate the average **maximum** electrical energy available from the solar cell panels each second in June.

Show clearly how you work out your answer.

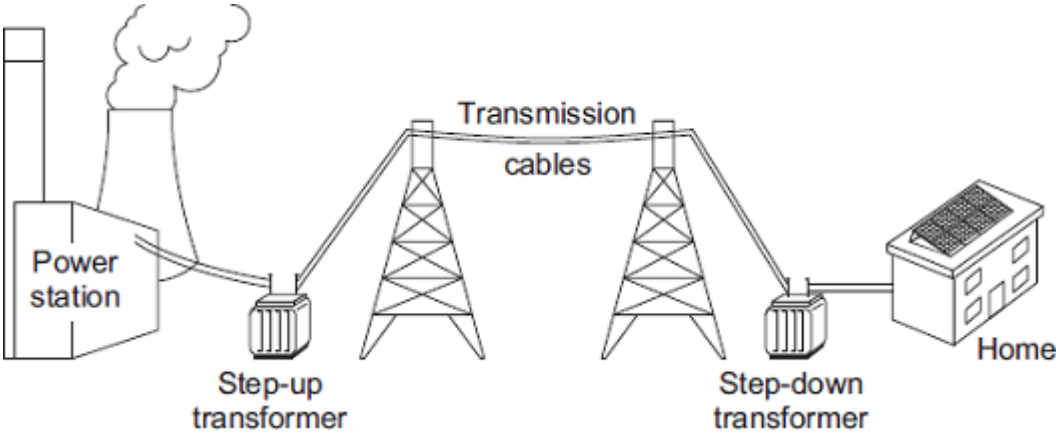
.....

.....

Maximum energy = ... joules/second

(3)

(c) The diagram shows part of the National Grid.



(i) Even though the householder uses solar cells to generate electricity for his home, the home stays connected to the National Grid.

Give **one** reason why the householder should stay connected to the National Grid.

.....

.....

(1)

(ii) The step-up transformer increases the efficiency of the National Grid.

Explain how.

.....

.....

.....

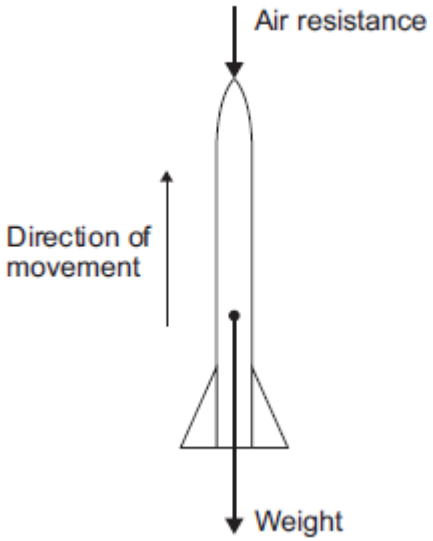
.....

(2)

(Total 10 marks)

Q11.(a) **Figure 1** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 1



(i) How does the velocity of the rocket change as the rocket moves **upwards**?

.....

Give a reason for your answer.

.....

.....

(2)

(ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

.....

.....

.....

(1)

(b) The speed of the rocket just after being launched is 12 m / s.
The mass of the rocket is 0.05 kg.

(i) Calculate the kinetic energy of the rocket just after being launched.

.....

.....

.....

Kinetic energy = ... J

(2)

(ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

Maximum gravitational potential energy = ... J

(1)

(iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N / kg.

.....

.....

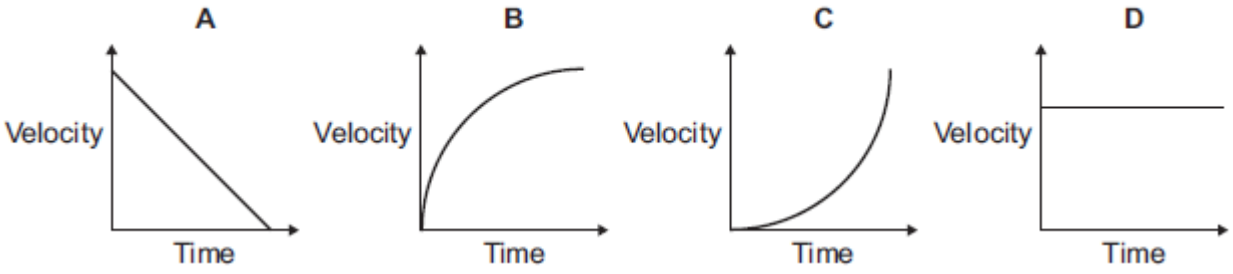
.....

Maximum height = ... m

(2)

(iv) **Figure 2** shows four velocity−time graphs.

Figure 2



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

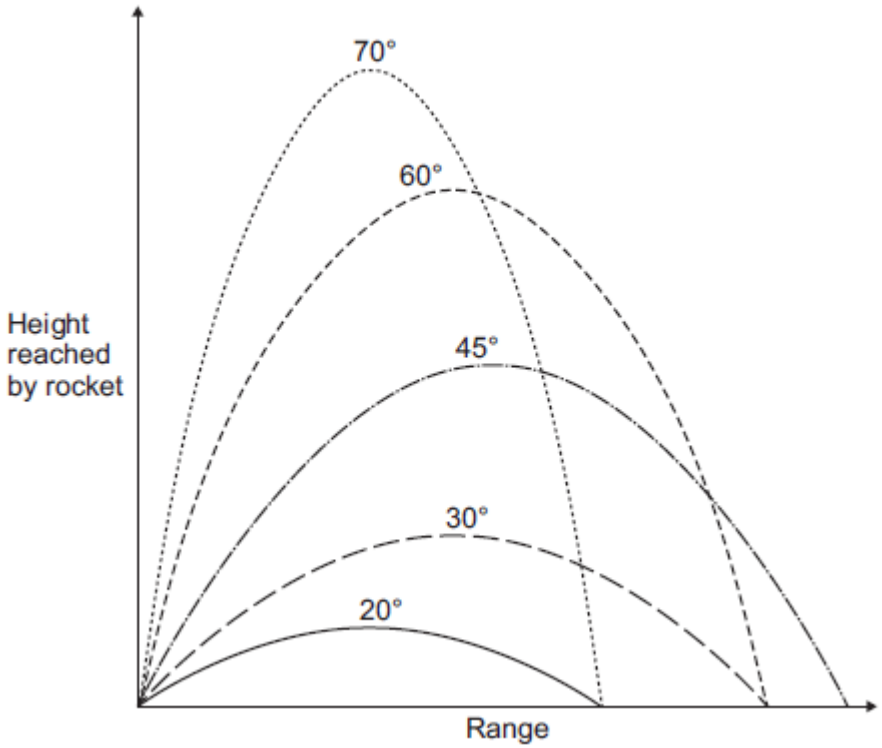
Write the correct answer in the box. ☐

(1)

(c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 3 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 3



What pattern links the angle at which the rocket is launched and the range of the rocket?

.....

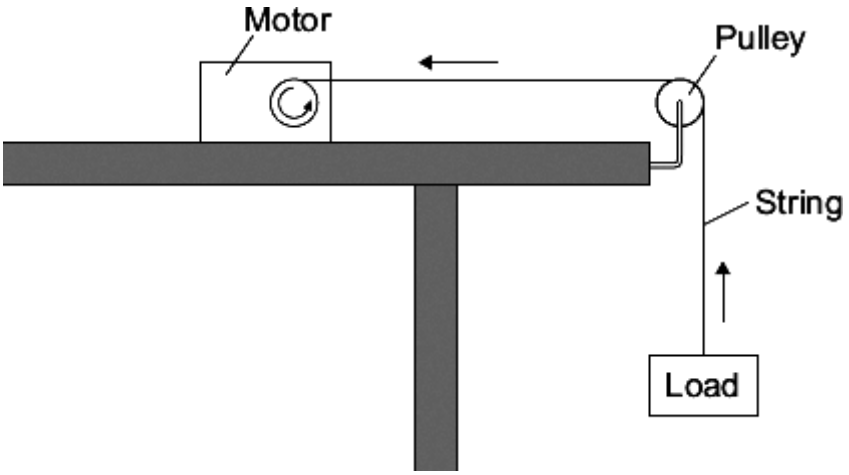
.....

.....

.....

(2)
(Total 11 marks)

Q12. 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)

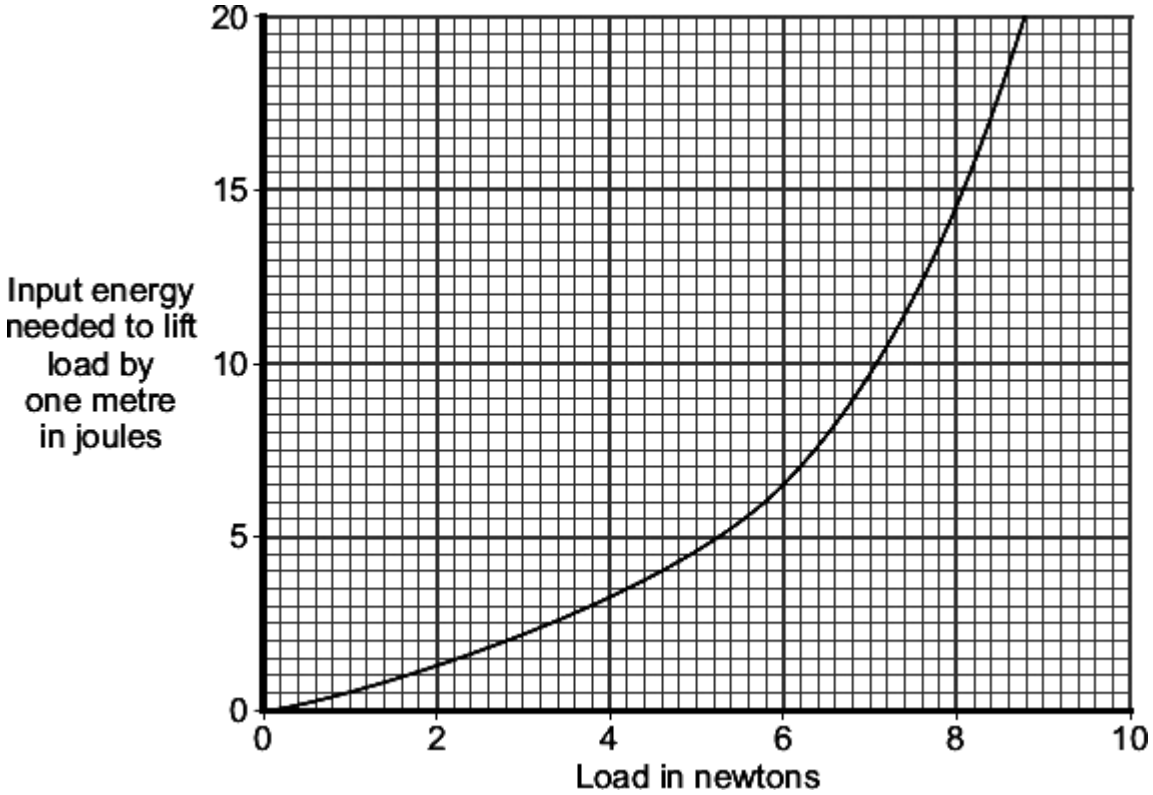
(ii) What eventually happens to the wasted energy?

.....

.....

(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?

.....

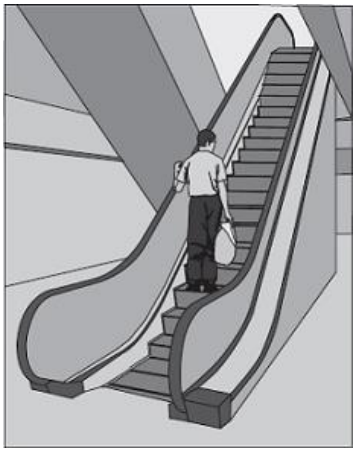
.....

.....

.....

(2)

(c) A shop uses escalators to lift customers to different floor levels. The escalators use electric motors. When the shop is not busy some escalators are turned off. A sign tells the customers that the escalators are turned off to save energy.



(i) Each escalator has one motor with an average power of 4000 W. The motor is turned on for an average of 8 hours each day, 6 days each week. Electricity costs 15 pence per kilowatt-hour.

Calculate the cost of the electricity used in an average week to run **one** escalator.

Show clearly how you work out your answer.

.....

.....

.....

.....

Cost = ... pence

(3)

(ii) Give **one** environmental advantage to turning off electrical appliances when they are not being used.

.....

.....

(1)

(Total 8 marks)

M1.(a) any **two** from:

- cost per kWh is lower (than all other energy resources)
  allow it is cheaper
  ignore fuel cost
  ignore energy released per kg of nuclear fuel

- infrastructure for nuclear power already exists
  accept cost of setting up renewable energy resources is high
  accept many renewable power stations would be needed to replace one nuclear power station
  accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future
  accept France benefits economically from selling electricity

- more reliable (than renewable energy resources)
  accept (nuclear) fuel is readily available
  ignore destruction of habitats for renewables

2

(b) any **two** from:

- non-renewable
  allow nuclear fuel is running out

- high decommissioning costs
  accept high commissioning costs

- produces radioactive / nuclear waste
  allow waste has a long half-life

- long start-up time

- nuclear accidents have widespread implications
  allow for nuclear accident a named nuclear accident
  eg Fukushima, Chernobyl
  ignore visual pollution

2

(c) 0.48 (kW)

*allow **1** mark for correct substitution*
ie 0.15 = P / 3.2
*an answer of 480 W gains **2** marks*

*an answer of 48 or 480 scores **1** mark*

2

(d) the higher the efficiency, the higher the cost (per m^2 to manufacture)

accept a specific numerical example

1

more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels
or
(reducing the cost) allows more solar panels to be bought

accept a specific numerical example

1

[8]

M2.(a) 46 200

accept 46 000
*allow **1** mark for correct substitution*
ie 0.5 × 4200 × 22 provided no subsequent step

2

(b) Energy is used to heat the kettle.

1

[3]

M3.(a) chemical

correct order only

1

kinetic

1

sound

1

(b) 48% or 0.48

*an answer of 0.48 with a unit gains **1** mark*
*an answer of 0.48% gains **1** mark*
*an answer of 48 with or without a unit gains **1** mark*

2

[5]

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) 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]

M6.(a) gravity

accept weight for gravity
air resistance is insufficient

1

(b) (i) 800

*allow **1** mark for correct substitution ie*

$$P = \frac{2240}{2.8}$$

provided no subsequent step

2

(ii) 2240 J

1

(c) (i) (vertical) height

accept (height of) stairs

1

(ii) a fast / short time (for a lighter student) may give the greatest power

accept time is a factor

or

a slow / long time (for a heavy student) may give the least power

fitness is insufficient

1

[6]

M7. (i) kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{speed}^2$

accept velocity for speed

accept KE = $\frac{1}{2} mv^2$

1

(ii) 32 000

accept 32 kJ

1

[2]

M8.(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]

M9. (a) (i) 720

*allow **1** mark for correct substitution,*
ie 72 × 10 provided no subsequent step shown

2

(ii) 720**or**their (a)(i)

1

(b) (i) gravitational potential

allow gravitational
allow potential

1

(ii) 432

*allow **1** mark for correct substitution, ie* $\frac{21600}{50}$ *provided no subsequent step shown*

2

watt / W

1

[7]

M10.(a) (i) replaced faster than it is used

accept replaced as quick as it is used
accept it will never run out
*do **not** accept can be used again*

1

(ii) any **two** from:

two *sources required for the mark*

- wind
- waves
- tides• fall of water
  *do **not** accept water / oceans*
  accept hydroelectric
- biofuel
  accept a named biofuel eg wood
- geothermal

1

(b) (i) any **two** from:

- increases from 20° to 30°
- reaches maximum value at 30°
- then decreases from 30°
- same pattern for each month
  *accept peaks at 30° for **both** marks*
  *accept goes up then down for **1** mark*
  ignore it's always the lowest at 50°

2

(ii) 648

*an answer of 129.6 gains **2** marksallow **1** mark for using 720*
value <u>only</u> from table
*allow **2** marks for answers 639, 612, 576, 618(.75)*
*allow **1** mark for answers 127.8, 122.4, 115.2, 123.75*

3

(c) (i) (sometimes) electricity demand may be greater than supply (of electricity from the system)

accept cloudy weather, night time affects supply

or

can sell (excess) electricity (to the National Grid)

1

(ii) decreases the current

accept increases the voltage

1

reducing energy loss (along cables)

accept less heat / thermal energy lost / produced

1

[10]

M11.(a) (i) decreases (to zero)

1

resultant force acts in opposite direction to motion

accept air resistance and weight for resultant force

accept resultant force acts downwards

*do **not** accept air resistance increases*

1

(ii) velocity includes direction

or

velocity is a vector (quantity)

1

(b) (i) 3.6

allow 1 mark for correct substitution i.e.

½ × 0.05 × 12^2 provided no subsequent step

2

(ii) 3.6 **or** their (i)

1

(iii) 7.2

or

their (ii) ÷ 0.5 correctly calculated

*allow **1** mark for correct substitution i.e.*

3.6 or their (ii) = 0.05 × 10 × h

2

(iv) **B**

1

(c) range increases up to 45°

1

range decreases from 45°

the range is a maximum at 45° gains both marks

for any two angles that add up
to 90° the range is the same gains both marks
*the range increases then decreases gains **1** mark*

1

[11]

M12. (a) (i) kinetic (energy)
allow <u>gravitational</u> potential (energy) / gpe
movement is insufficient

1

(ii) dissipates into the surroundings
allow warms up the surroundings / air / motor
accept lost to the surroundings
accept lost as heat
ignore reference to sound
it is lost is insufficient

1

(b) energy (required) increases with load
accept positive correlation
*do **not** accept (directly) proportional*

1

further amplification eg increases slowly at first (or up to 4 / 5 N), then increases rapidly
simply quoting figures is insufficient
an answer that only describes the shape of the line gains no marks

1

(c) (i) $E = P \times t$

2880
*accept <u>£</u>28.80 for all **3** marks*
*an answer £2880 gains **2** marks*
*allow **1** mark for obtaining 48 h **or** converting to kW*
*allow **2** marks for correct substitution*
ie 4 × 48 × 15

note: this substitution may be shown as two steps
*an answer 2 880 000 gains **2** marks*
*an answer £4.80 / 480 gains **2** marks*
*an answer of 192 (ie calculation of energy without subsequent calculation of cost) gains **1** mark)*

3

(ii) any sensible suggestion eg

conserves fossil fuels

less (fossil) fuels burned

less pollutant gas (produced)
accept a named pollutant gas

less greenhouse gas (produced)
saves energy is insufficient

1

[8]