Name:

Date:

P1 - Test 6
ENERGY
Advanced

GCSE
PHYSICS
AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

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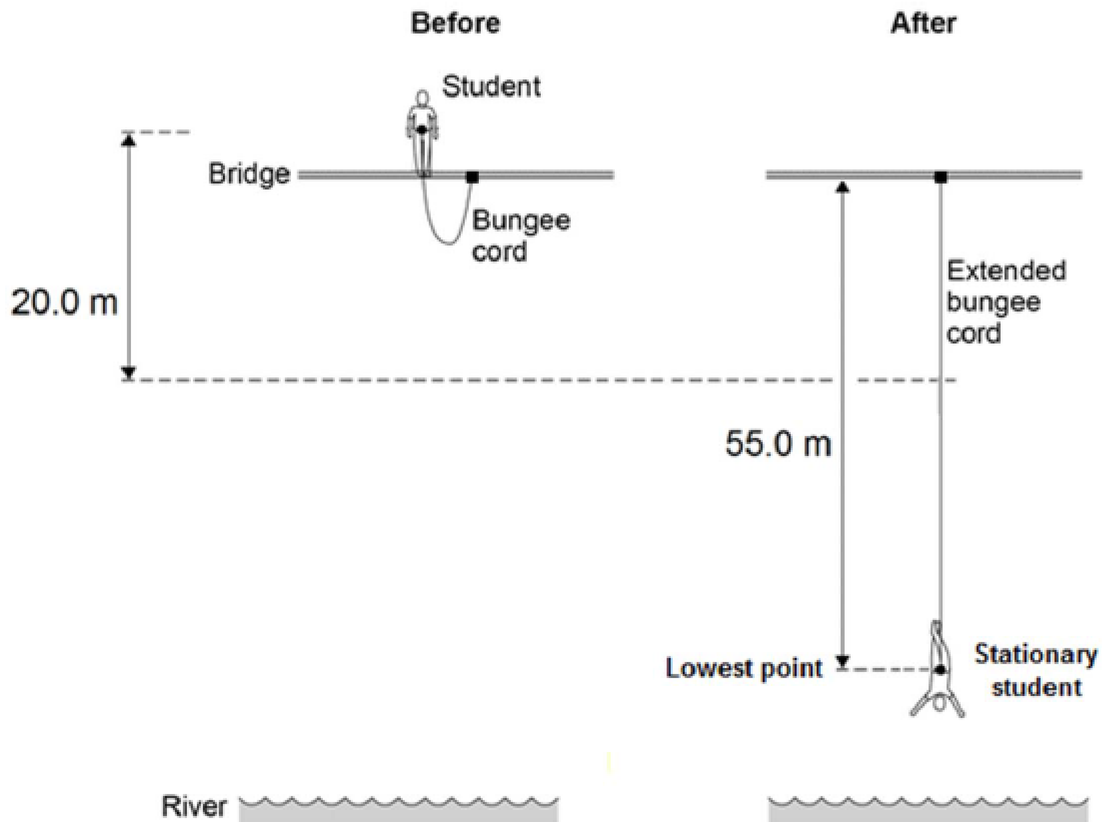
1. The figure below shows a student before and after a bungee jump.

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.

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(1)

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

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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.

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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.

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Spring constant = ________________________ N / m

(3)

(Total 11 marks)

2. **Figure 1** shows a cyclist riding along a straight, level road at a constant speed.

Figure 1

(a) Complete the sentences.

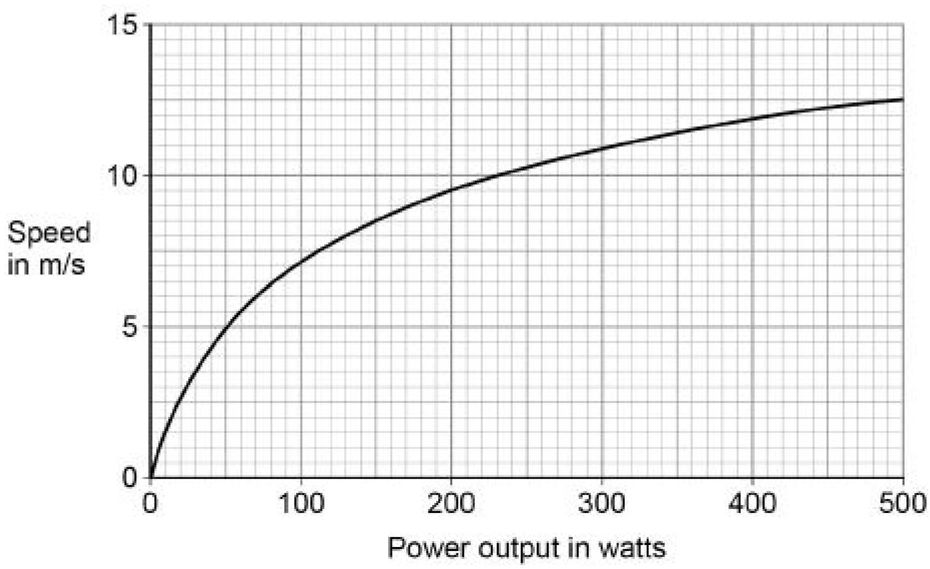
As the cyclist rides along the road, the ______________________ energy store in the cyclist's body decreases.

The speed of the cyclist is constant when the work done by the cyclist is ______________________ the work done against air resistance.

(2)

Figure 2 shows how the speed changes as the power output of the cyclist changes.

Figure 2



(b) Write down the equation that links power, time and work done.

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(1)

(c) Calculate the work done by the cyclist when his power output is 200 W for 1800 seconds.

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Work done = ______________________ J

(3)

(d) Calculate the percentage increase in speed of the cyclist when the power output changes from 200 W to 300 W.

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Percentage increase in speed = ____________

(2)

(e) The maximum speed this cyclist can travel on a level road is 14 m/s.

How does cycling uphill affect the maximum speed of this cyclist?

Explain your answer.

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(3)
(Total 11 marks)

3. Nuclear power stations generate electricity through nuclear fission. Electricity can also be generated by burning shale gas.

(a) Shale gas is natural gas trapped in rocks. Shale gas can be extracted by a process called fracking. There is some evidence that fracking causes minor earthquakes. Burning shale gas adds carbon dioxide to the atmosphere.

Describe the advantages of nuclear power compared with the use of shale gas to generate electricity.

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(3)

(b) What is the name of **one** fuel used in nuclear power stations?

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(1)

(c) Describe the process of nuclear fission.

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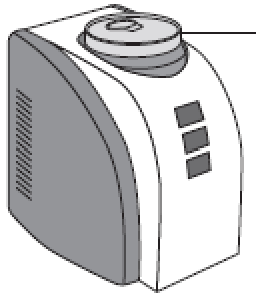
(4)
(Total 8 marks)

4. A 'can-chiller' is used to make a can of drink colder.

The image below shows a can-chiller.



(a) The initial temperature of the liquid in the can was 25.0 °C.
The can-chiller decreased the temperature of the liquid to 20.0 °C.
The amount of energy transferred from the liquid was 6930 J.
The mass of liquid in the can was 0.330 kg.

Calculate the specific heat capacity of the liquid.

Give the unit.

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Specific heat capacity = ____________________ unit _______________

(4)

(b) Energy is transferred through the metal walls of the can of drink by conduction.
Explain how.

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(4)

(c) The energy from the can of drink is transferred to the air around the can-chiller. A convection current is set up around the can-chiller. Explain how.

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(3)

(d) The can-chiller has metal cooling fins that are designed to transfer energy quickly to the surroundings.

Give **two** features that would help the metal cooling fins to transfer energy quickly to the surroundings.

1. ___

2. ___

(2)

(Total 13 marks)

5. 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. ____

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2. ____

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(2)

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

1. ____

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2. ____

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(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.

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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.

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(2)
(Total 8 marks)

6. The photograph below shows a coffee machine. The coffee machine uses an electric element to heat water.

(a) The coffee machine has a metal case.

Why would it be dangerous for the live wire of the electric cable to touch the metal case?

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(1)

(b) The power output of the coffee machine is 2.53 kW.

The mains potential difference is 230 V.

Calculate the current in the coffee machine.

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Current = ____________________ A

(3)

(c) The coffee machine heats water from 20 °C to 90 °C.

The power output of the coffee machine is 2.53 kW.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the mass of water that the coffee machine can heat in 14 seconds.

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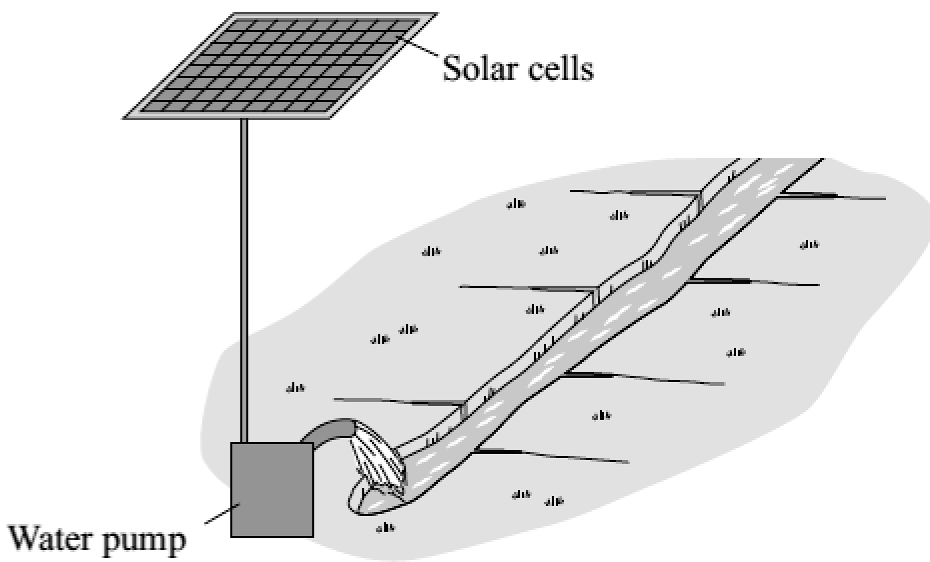
Mass = ____________________ kg

(5)

(Total 9 marks)

7. The farmers in a village in India use solar powered water pumps to irrigate the fields.



On average, a one square metre panel of solar cells receives 5 kWh of energy from the Sun each day.
The solar cells have an efficiency of 0.15

(a) (i) Calculate the electrical energy available from a one square metre panel of solar cells.

Show clearly how you work out your answer.

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Electrical energy = __________________________ kWh

(2)

(ii) On average, each solar water pump uses 1.5 kWh of energy each day.

Calculate the area of solar cells required by one solar water pump.

Area = ____________________________ square metres

(1)

(b) Give **one** reason why the area of solar cells needed will probably be greater than the answer to part (a)(ii).

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(1)

(Total 4 marks)

8. The diagram below shows a wind turbine.

(a) At a particular wind speed, a volume of 2.3×10^4 m^3 of air passes the blades each second.

The density of air is 1.2 kg/m^3.

Calculate the mass of air passing the blades per second.

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Mass of air per second = ____________________ kg

(3)

(b) The power output of the turbine is directly proportional to the kinetic energy of the air passing the blades each second.

Describe the effect on the power output when the wind speed is halved.

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(3)

(c) At a different wind speed, the wind turbine has a power output of 388 kW.

The mass of air passing the wind turbine each second is 13 800 kg.

Calculate the speed of the air passing the blades each second.

Assume that the process is 100% efficient.

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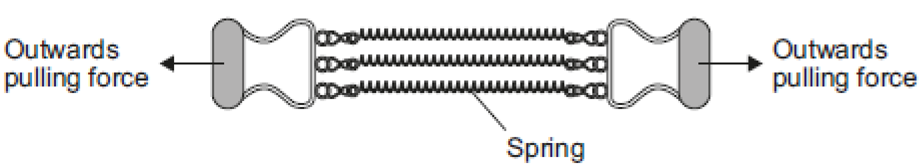
Speed of air = ____________________ m/s

(3)

(Total 9 marks)

9. **Figure 1** shows an exercise device called a chest expander. The three springs are identical.

Figure 1



A person pulls outwards on the handles and does work to stretch the springs.

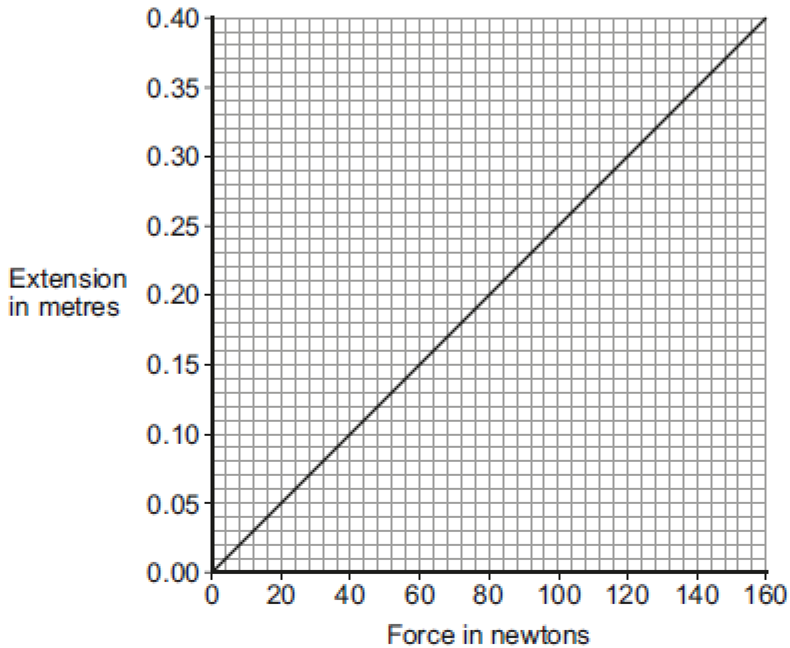
(a) Complete the following sentence.

When the springs are stretched ___________ ___________ energy is stored in the springs.

(1)

(b) **Figure 2** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 2



(i) How can you tell, from **Figure 2**, that the limit of proportionality of the spring has not been exceeded?

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(1)

(ii) Use data from **Figure 2** to calculate the spring constant of the spring.
Give the unit.

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Spring constant = ____________ Unit ____________

(3)

(iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 2** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

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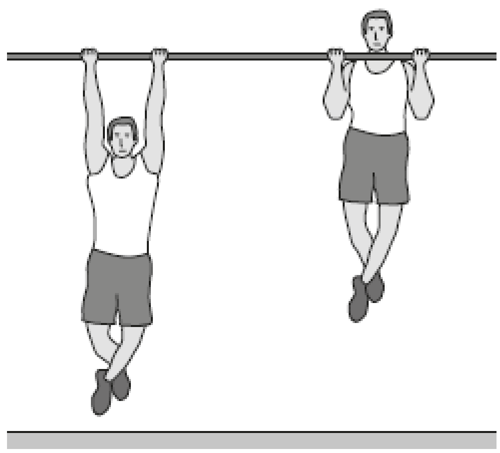
Total force = ___________ N

(2)

(c) The student in **Figure 3** is doing an exercise called a chin-up.

Figure 3



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

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Power = ___________ W

(3)

(Total 10 marks)