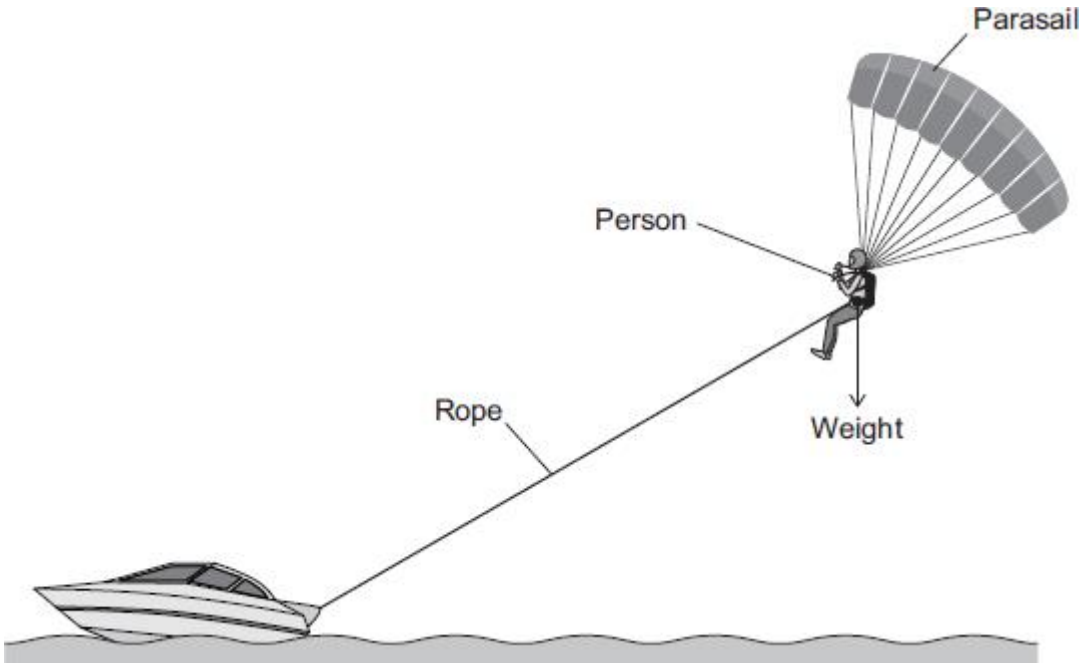
P1 Energy Conservation and dissipation Homework task 2

Q1.

The figure below shows a boat pulling a person parasailing. A rope attaches the person to the boat.



(a) What type of force is the weight?

Tick (✓) **one** box.

Contact force	☐
Magnetic force	☐
Non-contact force	☐

(1)

(b) The mass of the person is 75 kg.

Calculate the weight of the person.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

_____

_____

Weight = _____ N **(2)**

(c) The resultant force acting on the person is zero.

Which of the following describes the motion of the person?

Tick (✓) **one** box.

Velocity decreasing	☐
Moving at constant velocity	☐
Velocity increasing	☐

(1)

(d) The horizontal force on the person is 4300 N.

Calculate the work done by this force in moving the person a horizontal distance of 500 m.

Use the equation:

work done = force × distance

Choose the unit from the box.

joules	**metres/second**	**watts**

Work done = _____

Unit _____

(3)

(e) The speed of the boat changes.

The height of the person above the water decreases by 18 m.

Calculate the decrease in gravitational potential energy of the person.

mass of person = 75 kg

gravitational field strength = 9.8 N/kg

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

_____

_____

_____

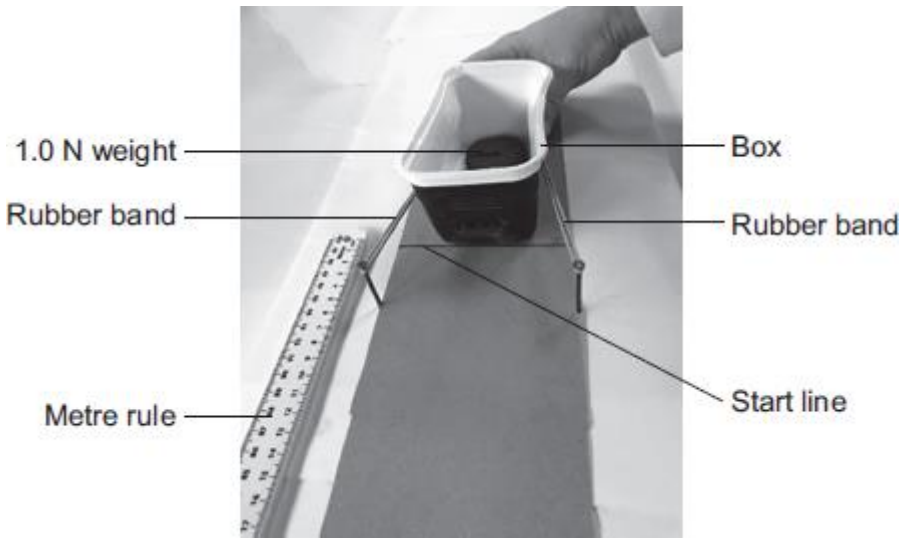
Decrease in gravitational potential energy = _____ J

(2)

(Total 9 marks)

Q2.

The figure below shows the equipment a student used to investigate the effect of weight on the distance a box slides.



This is the method used.

1. Put a 1.0 N weight in the box.
2. Pull the box backwards until it reaches the start line, extending the rubber band by 10 cm.
3. Release the box.
4. When the box stops moving, measure the distance the box has slid using the metre rule.
5. Repeat steps 2 to 4 using a weight of 2.0 N and then 3.0 N.

(a) Identify the variables in the investigation.

Independent variable _____

Dependent variable _____

(2)

(b) The extension of the rubber band was a control variable in the investigation.

Suggest **one other** control variable in the investigation.

_____

_____

(1)

(c) **Table 1** shows the results when the weight inside the box was 1.0 N.

Table 1

Weight inside box in N	**Distance the box slides in cm**			
	Trial 1	**Trial 2**	**Trial 3**	**Mean**
1.0	12.6	13.1	13.4	13.0

What was the uncertainty in the distance measurements when the weight inside the box was 1.0 N?

Tick (✓) **one** box.

±0.1 cm ☐ ±0.4 cm ☐ ±0.8 cm ☐ ±1.0 cm ☐

(1)

(d) The rubber band was extended by 10 cm.

The rubber band behaves like a spring with a spring constant of 36 N/m.

Calculate the elastic potential energy stored by the rubber band.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

Elastic potential energy = _____ J

(3)

(e) What is the maximum possible value for the kinetic energy of the box?

Maximum possible kinetic energy = _____ J

(1)

(f) **Table 2** shows the student's results.

Table 2

Weight inside box in N	**Distance the box slides in cm**			
	Trial 1	**Trial 2**	**Trial 3**	**Mean**
1.0	12.6	13.1	13.4	13.0
2.0	10.4	9.4	10.0	9.9
3.0	7.9	7.3	6.8	7.3

Describe improvements the student could make to the method.

Use information from:

- The figure in part (a).
- **Table 2**.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 12 marks)

Higher Tier Questions

Q3.

Heating homes and businesses using natural gas produces a third of the UK's carbon dioxide emissions.

(a) Give **one** energy resource that produces carbon dioxide when burnt.

Do **not** refer to natural gas.

_____

(2)

(b) Hydrogen can be burned to power cars.

Hydrogen can be extracted from seawater.

Burning 1 kg of hydrogen releases 142 MJ of energy.

Burning 1 kg of petrol releases 45 MJ of energy.

Give **two** advantages of using hydrogen to power cars compared with using petrol.

1 _____

_____

2 _____

_____

(1)

Scientists are investigating whether appliances that usually only burn natural gas can burn a mixture of hydrogen gas and natural gas.

(c) Give **three** environmental benefits of burning a mixture of hydrogen gas and natural gas compared to just burning natural gas.

1 _____

_____

2 _____

_____

3 _____

_____

(3)

(d) All gas appliances in the UK bought since 1996 can burn a mixture of 23% hydrogen gas and 77% natural gas.

Explain a possible problem of changing the UK gas supply to this mixture of hydrogen gas and natural gas.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q4.

Figure 1 below shows a wind turbine.

Figure 1

(a) An alternating potential difference is produced when the wind turbine spins.

What is meant by ‘alternating potential difference’?

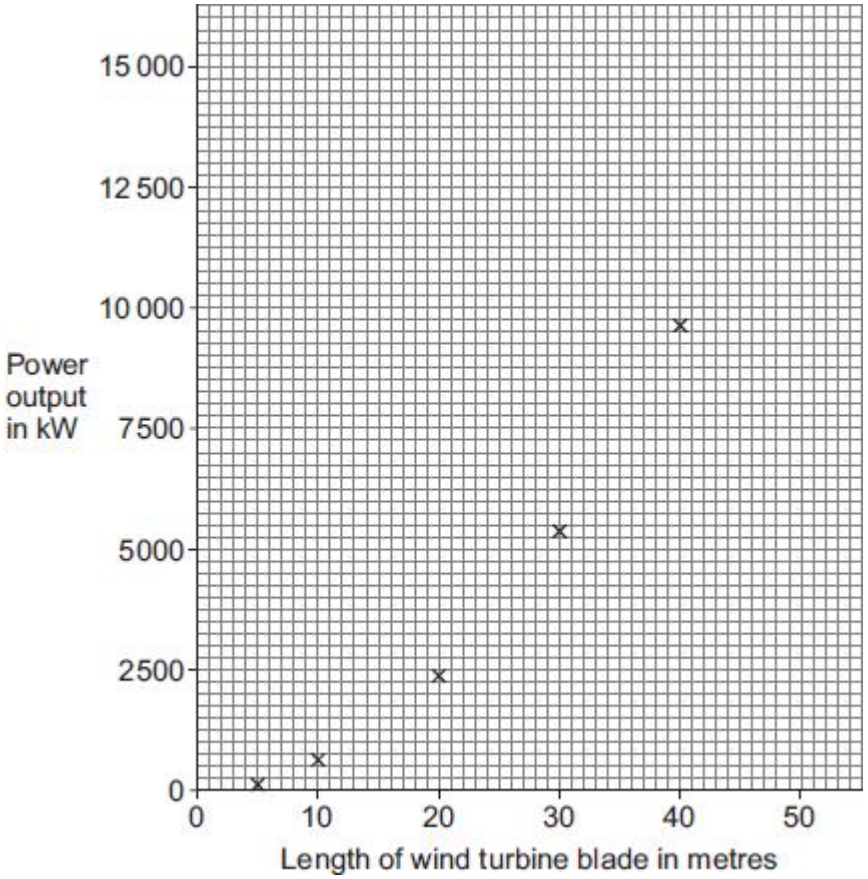
_____

_____

(1)

Figure 2 shows how the power output of a wind turbine varies with the length of the wind turbine blades when the wind speed is 20 m/s.

Figure 2



(b) It is more economical to construct and use one wind turbine with 40-metre blades than two wind turbines with 20-metre blades.

Explain why.

Use information from **Figure 2**.

_____

_____

_____

_____

(2)

(c) Predict the power output of a wind turbine with a blade length of 50 metres.

Tick (✓) **one** box.

10 000 kW ☐

12 000 kW ☐

14 000 kW ☐

15 000 kW ☐

(1)

(d) The kinetic energy of the air passing the wind turbine blades each second is 73.9 MJ.

The mass of air passing the wind turbine blades each second is 236 000 kg.

Calculate the speed of the air passing the wind turbine.

Speed = _____ m/s

(4)

(Total 8 marks)

Mark schemes

Q1.

(a) non-contact force

1

(b) W = 75 × 9.8

1

W = 735 (N)

allow 740 (N)

1

(c) moving at constant velocity

1

(d) W = 4300 × 500

1

W = 2 150 000

allow 2 200 000

1

joules / J

1

(e) E_p = 75 × 9.8 × 18

1

E_p = 13 230 (J)

allow 13 000 (J)

1

[9]

Q2.

(a) independent variable = weight (inside the box)

1

dependent variable = distance (the box slides)

1

(b) any **one** from:

- the surface
- the box

1

(c) ±0.4 cm

1

(d) e = 0.10 m

1

$E_e = 0.5 \times 36 \times 0.10^2$

allow a correct substitution of an incorrectly / not converted value of e

1

E_e = 0.18 (J)

allow a correct calculation of an incorrectly / not converted value of e

1

(e) E_k = 0.18 (J)

*allow ecf from question **(d)***

1

(f) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

3–4

Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.

1–2

No relevant content

0

Indicative content

- use a larger range of weights (allow a specified range)
- use a smaller interval (allow a specified interval)
- ensure weights are fixed to base of box
- ensure ruler is fixed in place
- move ruler closer to the surface
- use a set square to help measure the distance the box slides
- ensure same release point each time

ignore take repeat readings and calculate a mean

[12]

Q3.

(a) coal / oil / wood / biofuel

allow named biofuel

ignore fossil fuel

1

(b) any **two** from:

- hydrogen is a renewable energy resource
- less fuel needed to travel the same distance
  or
  less frequent refuelling
- no carbon dioxide produced
  or
  only water (vapour) produced

allow burning hydrogen has no negative effects on the environment

2

(c) any **three** from:

- reduces carbon dioxide emissions
- reduces particulates released
- conserves natural gas reserves
- less global warming

3

(d) consumers will have to purchase new appliances
or

appliances may be damaged by burning hydrogen

1

some appliances may have been bought from outside the UK

allow some appliances may have been bought before 1996

1

[8]

Q4.

(a) the polarity (of the supply) continuously changes

allow p.d. for potential difference allow a potential difference that changes direction

1

(b) the output of one 40 m turbine is greater than two 20 m turbines
or
the output of one 40 m turbine is more than twice as great as two 20 m turbines

1

(but) a 40 m turbine is unlikely to cost twice as much (as two 20 m turbines)

1

(c) 15 000 kW

1

(d) 73.9 MJ = 73 900 000 J

1

73 900 000 =

$0.5 \times 236\,000 \times v^2$

1

$$v^2 = \frac{73\,900\,000}{0.5 \times 236\,000}$$

or

$v^2 = 626$

1

v = 25.0 (m/s)

1

[8]