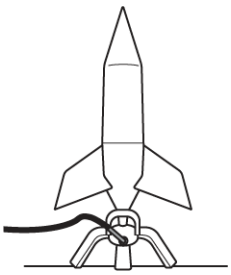
1(a). The diagram shows a water rocket on the ground.



i. The rocket is stationary on the ground.

What are the names of the upwards force and the downwards force on the rocket?

Use words from the list.

normal contact force	**tension**	**thrust**	**thrust**

Upwards force: .....

Downwards force: .....

[2]

ii. The rocket lifts off the ground when water is pushed out of the bottom of the rocket.

Explain how Newton's third law applies to the rocket as it lifts off the ground.

Use ideas about the force of the water and the force of the rocket.

[2]

iii. Describe the conditions needed for the rocket to accelerate upwards.

Use ideas about the upwards force and the downwards force.

[1]

(b).

i. The rocket has a mass of 5.0 kg and rises a vertical distance of 45 m.

Calculate the gravitational potential energy gained by the rocket.

Use the equation: gravitational potential energy = mass × gravitational field strength × height

Gravitational field strength = 10 N / kg

Gravitational potential energy = ... J **[2]**

ii. A different water rocket does 12 500 J of work in 5 seconds when it rises upwards.

Calculate the power of this water rocket.

Use the equation: $\text{power} = \frac{\text{work done}}{\text{time}}$

Include the correct unit.

Power = ... Unit ..... **[3]**

2. A student wants to estimate a typical value for the accelerating force on a car.

The student writes down **three** possible values for the car's acceleration.

3 m / s^2 **50 m / s^2** **100 m / s^2**

i. Put a ring around the value the student should use as the car's acceleration.

[1]

ii. The car has a mass of 1800 kg.

Use the value for the acceleration you chose in **(i)** to estimate the accelerating force on a car.

Use the equation: force = mass × acceleration

Force = ...N **[2]**

3. What is 15 J converted into newton-metres?

A 0.15 N m
B 1.5 N m
C 15 N m
D 150 N m

Your answer ☐ **[1]**

4. Person **Q** has a mass of 50 kg and climbs a vertical distance of 6 m in 6 s.

Person **R** has a mass of 60 kg and climbs a vertical distance of 6 m in 5 s.

Who has the most power and why?

A Person **Q** because they have a smaller mass.
B Person **Q** because they transfer more energy in a longer time.
C Person **R** because a greater mass always means a greater power.
D Person **R** because they transfer more energy in a shorter time.

Your answer ☐ **[1]**

5. In which of these situations is the **most** work done?

A 5 kg cat climbing 5 m vertically upwards
B 10 kg dog climbing 10 m vertically upwards
C 50 kg boy climbing 10 m vertically upwards
D 75 kg man climbing 5 m vertically upwards

Your answer ☐ **[1]**

6. When a car crashes, it undergoes a very large **deceleration**.

Which row describes the crash?

	Forces involved	**Time for the car to decelerate**
A	large	large
B	large	small
C	small	large
D	small	small

Your answer ☐ **[1]**

7. The diagram shows a swimmer in a pool.

Their forward force is 50 N and the resistive force is 50 N.

i. Describe the motion of the swimmer.

_____ **[1]**

ii. Explain what happens to the swimmer if their forward force increases but the resistive force remains constant.

_____

_____

_____ **[2]**

8. Which is a **contact** force?

A Electrostatic
B Gravity
C Magnetism
D Upthrust

Your answer ☐ **[1]**

END OF QUESTION PAPER