Q1. (2020)

0 5 Ice cream is made by cooling a mixture of liquid ingredients until they freeze.

0 5 . 2 How do the kinetic energy and the potential energy of the particles change as a liquid is cooled and frozen?

[1 mark]

Tick (✓) **one** box.

Kinetic energy	**Potential energy**	
Decreases	Decreases	☐
Decreases	Does not change	☐
Does not change	Decreases	☐
Does not change	Does not change	☐

Q2. (2020)

0 7 Kangaroos are large animals that travel by jumping.

Figure 8 shows a kangaroo.

Figure 8

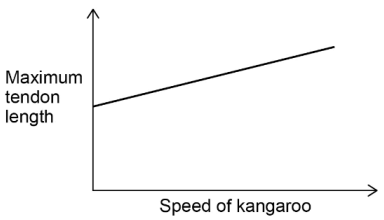
Each leg of a kangaroo has a tendon connected to a muscle. Each tendon can be modelled as a spring.

When a jumping kangaroo lands on the ground, the tendons stretch.

a)

0 7 . 1 **Figure 9** shows a sketch graph of how the maximum tendon length during a jump changes with the speed of the kangaroo.

Figure 9



Explain why a kangaroo can jump higher as its speed increases.

[3 marks]

b)

0 7 . 2 A kangaroo has a maximum gravitational potential energy during one jump of 770 J

When the kangaroo lands on the ground 14% of the maximum gravitational potential energy is transferred to elastic potential energy in one tendon.

The tendon has an unstretched length of 35.0 cm

When the kangaroo lands on the ground the tendon stretches to a length of 42.0 cm

Calculate the spring constant of the tendon.

[5 marks]

Q3. (2021)

0 3 **Figure 4** shows a sailing boat crossing an ocean.

Figure 4

There is a wind turbine on the boat.

a)

0 3 . 4 The kinetic energy of the boat is 81 kJ.

mass of boat = 8000 kg

Calculate the speed of the boat.

[4 marks]

b)

0 3 . 5 As the boat passes over a wave, the gravitational potential energy of the boat increases by 19 600 J.

mass of boat = 8000 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the centre of mass of the boat as it passes over the wave.

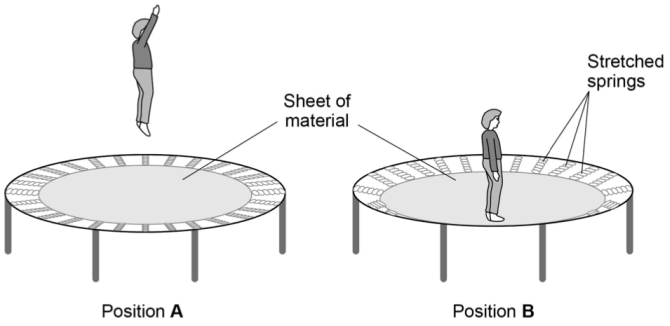
[3 marks]

Q4. (2022)

0 3 A trampoline is made from a sheet of material held in place by stretched springs.

Figure 5 shows a child on a trampoline.

Figure 5



0 3 . 2 When the child is at position **A**, each trampoline spring is stretched by 0.056 m

The elastic potential energy of each spring is 4.9 J

When the child is at position **B**, the elastic potential energy of each spring increases to 8.1 J

Calculate the extension of each spring when the child is at position **B**.

Use the Physics Equations Sheet.

[5 marks]

Q5. (2023)

0 5 **Figure 10** shows a child's toy.

A child pushes down on the toy to compress the spring. The spring then launches the toy into the air.

Figure 10

0 5 . 2 The greatest height reached by the toy was 64 cm.

The gravitational potential energy of the toy at this height was 0.049 J.

gravitational field strength = 9.8 N/kg

Calculate the mass of the toy.

Use the Physics Equations Sheet.

Give your answer to 2 significant figures.

[5 marks]

Q6. (2024)

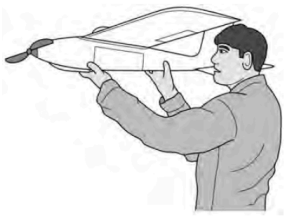
0 4 A drone is a miniature aircraft that has a remote control.

An inventor designed a battery powered drone.

The inventor tested what would happen if the battery runs out of charge during a flight.

Figure 5 shows the inventor about to launch the drone.

Figure 5



When the drone reached a height of 840 m the motor was switched off.

The motor was switched back on after a short time, when the drone had fallen to a lower height above the ground.

The change in gravitational potential energy of the drone during the fall to this lower height was 3920 J.

The mass of the drone is 2.5 kg.

gravitational field strength = 9.8 N/kg

a)

0 4 . 2 Calculate the height above the ground of the drone when the motor was switched back on.

Use the Physics Equations Sheet.

[4 marks]

b)

0 4 . 3 When the motor was switched off, the kinetic energy of the drone was 150 J.

Calculate the maximum possible speed of the drone when the motor was switched back on.

Use the Physics Equations Sheet.

Give your answer in km/s.

[5 marks]