Questions

Q1.

An athlete uses a training machine in a gym.

The display on the machine shows the time spent on the machine and the amount of energy transferred during a training session.

Figure 5 shows the displays for two different sessions by the same athlete.

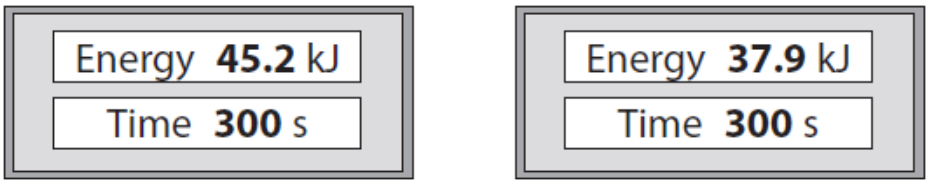

Figure 5

Explain what the displays show about the average power of the athlete in each of these two sessions.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q2.

(i) Complete the equation that relates efficiency, useful energy transferred by a device and total energy supplied to the device.

(1)

efficiency .....

(ii) In one second an engine has a total energy input of 7500 J.

In one second 3200 J is transferred to the surroundings as wasted energy.

Calculate the useful energy transferred by the engine.

(1)

useful energy transferred = ...

(iii) Calculate the efficiency of this engine.

(2)

efficiency of the engine = ...

(Total for question = 4 marks)

Q3.

This photograph shows a fan.

The blades of the fan are turned by an electric motor.

In one second, the motor gets 200 J of electrical energy from the mains supply.
Only 180 J of this energy is used to turn the blades of the fan.

The rest of the energy is wasted.

(i) Calculate how much of the 200 J of energy is wasted.

(1)

wasted energy = ... J

(ii) State what happens to the wasted energy.

(1)

.....

.....

(iii) Calculate the efficiency of the motor.

(2)

efficiency = ...

Q4.

Figure 21 shows a bicycle.

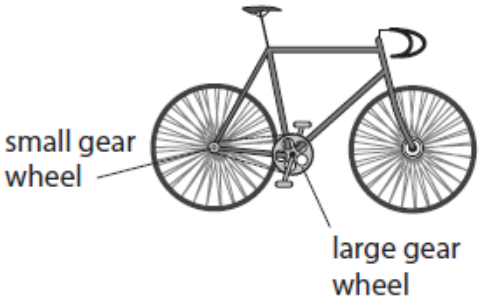

Figure 21

(i) The rider uses the pedals to make the large gear wheel turn.

The large gear wheel moves the chain.

The chain turns the small gear wheel.

The large gear wheel has 48 teeth.

The small gear wheel has 12 teeth.

The large gear wheel turns 2 times each second.

Calculate the number of times that the small gear wheel turns each second.

(2)

..... turns each second

(ii) Oil is applied to the wheel of a bicycle at the point shown in Figure 22.

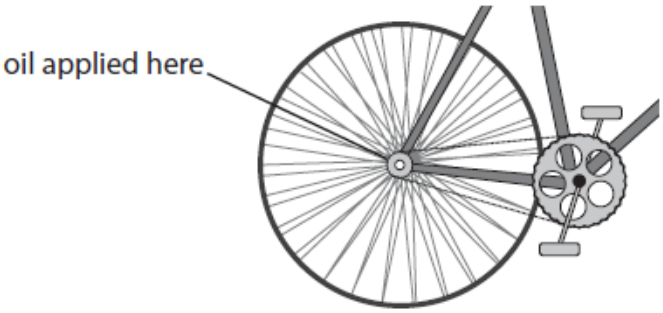

Figure 22

Explain how the oil improves the efficiency of the bicycle.

(3)

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

Q5.

Figure 14 shows an athlete using a fitness device.

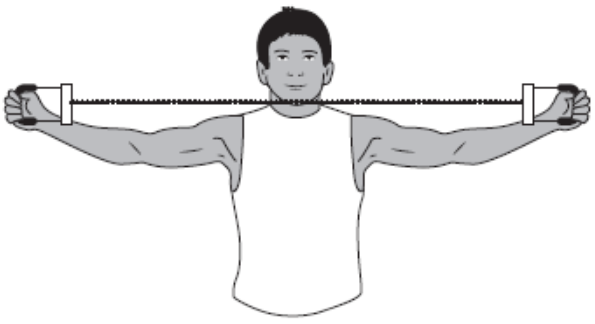

Figure 14

The athlete stretches the spring in the device by pulling the handles apart.

The spring constant of the spring is 140 N/m.

The athlete does 45 J of work to extend the spring.

The athlete takes 0.6 s to expand the spring.

(i) Calculate the useful power output of the athlete when stretching the spring.

(2)

useful power output of the athlete = ... W

(ii) Calculate the extension of the spring.

Use an equation selected from the list of equations at the end of this paper.

(3)

extension of the spring = ... m

(Total for question = 5 marks)

Q6.

Figure 14 shows the vertical forces on an aeroplane.

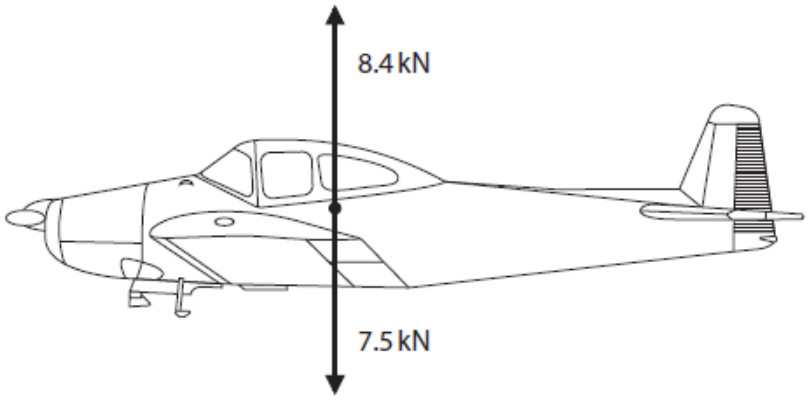

Figure 14

The aeroplane is powered by an engine that burns fuel.

The fuel supplies a total of 6500 kJ of energy every minute.

The efficiency of the engine is 0.70 (70%).

(i) Calculate the power output of the engine.

Give your answer in kW.

(4)

power = ... kW

(ii) Explain why the efficiency of the engine is less than 1 (100%).

(2)

.....

.....

.....

.....

(Total for question = 6 marks)

Q7.

Some students investigate the efficiency of electric motors.

(i) The students find that one electric motor has an efficiency of 60%.

Explain in terms of energy what is meant by an efficiency of 60%.

(2)

.....

.....

.....

.....

(ii) The students use some motors to lift weights.

The students measure the input power and output power of two motors.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The power of a motor is the rate at which it transfers

(1)

☒ **A** current

☒ **B** energy

☒

C voltage

☒ **D** charge

(iii) The first motor has a power rating of 20 W.

The motor is used for 15 s.

Calculate the energy supplied to the motor.

(2)

energy supplied to the motor =..... .J

(iv) In the second motor, the useful output power was 18 W when the input power was 24 W.
Calculate the efficiency of this motor.

(2)

efficiency =..... .%

Q8.

The International Space Station (ISS) has several solar panels called wings.

(a) The wings convert energy from the Sun into a form useful in the ISS.

(1)

☒ **A** transverse and electromagnetic

☒ **B** electromagnetic but not transverse

☒ **C** transverse but not electromagnetic

☒ **D** neither transverse nor electromagnetic

(b) In one second, the useful energy available from one wing is 34.3 kJ.
The energy incident on the wing from the Sun is five times this amount.

What is the percentage efficiency of the wing?

(3)

efficiency = ... %

(c) A wing is in direct sunlight.
The ISS is not receiving energy from the wing.
The temperature of the wing remains constant.

Explain why the temperature of the wing remains constant in these conditions.

(2)

.....

.....

.....

.....

Q9.

A cyclist is riding a bicycle at a steady velocity of 12 m/s.

The cyclist and bicycle have a total mass of 68 kg.

* A class of students investigate the power output of each student in the class.

The class must decide whether they use a method using steps or a method using weights.
The whole class must use the same method.

Plan what measurements the students should take and how these can be used to calculate and compare the power output of each student.

You may draw a diagram to help with your plan.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q10.

(a) A father pushes his child in a cart. The cart starts to move.

Scientists can use many physical quantities to describe what is happening.

Four of these are shown in the box.

energy	momentum	power	work

(i) Which one of these can be measured in joules per second?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** energy

☒ **B** momentum

☒ **C** power

☒ **D** work

(ii) Complete the sentence using words from the box.

(1)

The ..... transferred to the cart is equal to the ..... done on the cart.

(iii) The child and cart have a total mass of 50 kg. They travel at a velocity of 4 m/s.

Calculate the momentum of the child and cart.

(2)

momentum = ... kg m/s

(iv) The father applies a steady force for a time of 1.5 s. The momentum of the child and cart increases by 450 kg m/s.

Calculate the force which the father applies.

(2)

force = ... N

(v) Momentum is a vector quantity.

State what is meant by a vector quantity.

(1)

.....

.....

(b) The photograph shows a mother and her daughter stationary on an ice rink.

The mother and daughter push each other away.
They move in opposite directions with different speeds.

Explain why they have different speeds.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question = 10 marks)