GCSE

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APPLIED SCIENCE (Double Award)

UNIT 2: Space, Health and Life

Resource Folder

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For use with:
GCSE Applied Science (D/A) Unit 2 Foundation Tier (3445U20-1)
GCSE Applied Science (D/A) Unit 2 Higher Tier (3445UB0-1)

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Preparing for a triathlon

What is a triathlon?
A triathlon is a race that consists of swimming, cycling, and running over various distances. Triathletes compete for the fastest overall completion time. Each leg of the race occurs one after the other. The time of the transitions between the legs is included.

What is a transition?
These are the two parts of the race that get you from one sport to the next. The first transition is the switch from the swim to the cycle leg. This is where the wetsuit, cap and goggles are removed, and the helmet and cycle shoes are put on. The second transition is where the bike is placed in a rack, the helmet is removed and the shoes are changed. Competitors can then start the final section of the triathlon, which is the run leg.

There are different types of triathlons as shown in **Table 1**.

Table 1: Distances in triathlons

Leg	Distance (km)						
	Super sprint	Sprint	Olympic	Middle distance	Half Ironman	Long distance	Ironman
Swim	0.4	0.75	1.5	2.5	1.9	4.0	3.8
Bicycle ride	10.0	20.0	40.0	80.0	90.0	120.0	180.0
Run	2.5	5.0	10.0	20.0	21.1	30.0	42.2

Training for a triathlon

In general, when aiming to complete a first sprint triathlon, plan for at least 12 weeks of training.

During training, Jake produced the data shown in **Table 2**.

Table 2: Heart rate, breathing rate and airflow before, during and after exercise

Time (minutes)	Heart rate (beats per minute)	Breathing rate (breaths per minute)	Airflow per breath (units)
0	55	7.0	0.6
1	103	9.0	1.7
2	105	13.5	2.2
3	108	13.5	2.7
4	108	13.1	2.9
5	110	14.0	3.2
6	115	14.0	3.1
7	116	14.0	3.2
8	118	14.0	3.3
9	120	15.0	2.8
10	124	16.0	2.9
11	126	16.0	3.0
12	130	17.0	3.1
13	115	15.0	1.8
14	100	14.0	1.6
15	85	10.0	1.2

The total airflow per minute can be found using the following equation:

$$\text{air breathed in per minute} = \text{breathing rate} \times \text{airflow per breath}$$

Maximum heart rate

During training, it is very important that the maximum heart rate for a person's age is not exceeded.

The maximum heart rate is calculated by the following equation:

$$\text{Maximum heart rate} = 220 - \text{age}$$

For example, if a person is 45 years old, subtract 45 from 220 to get a maximum heart rate of 175. This is the mean maximum number of times their heart should beat per minute during exercise.

Table 3 shows maximum heart rates for selected ages, and what the heart rate would be if the heart is beating at different percentages of the maximum value.

Table 3

Age (years)	Maximum heart rate (beats per minute)	50% of maximum heart rate (beats per minute)	60% of maximum heart rate (beats per minute)	80% of maximum heart rate (beats per minute)
20	200	100	120	160
25	195	98	117	156
30	190	95	114	152
35	185	93	111	148
40	180	90	108	144
50	170	85	102	136
60	160	80	96	128
70	150	75	90	120

Exercise heart rate zones

Exercise heart rate zones are the training levels based on a person's maximum heart rate. As pace and workload increase, the demands on the heart increase.

- **Low intensity zone**: Exercise is at about 50% of maximum heart rate. In this zone, 85% of calories burnt are from fat.
- **Aerobic zone**: Exercise is at 60% to 80% of the maximum heart rate. About 45% of the calories burnt are from fat. However, a higher number of calories is burnt compared to the other heart rate zones.
- **Anaerobic zone**: Exercise is above 80% of the maximum heart rate. A person will be unable to exercise for more than 120 s until they have a burning feeling in their muscles.

Triathletes

Table 4 shows information about 8 triathletes.

Table 4

Triathlete	Age (years)	Body mass (kg)	Height (cm)
Sharon	33	75	175
Robert	29	60	166
Malcolm	23	76	170
Helen	25	72	175
Llinos	25	66	177
Karen	30	68	170
Brian	38	80	185
Steve	24	82	175

The triathletes each have a different body mass index (BMI). BMI is calculated by using the equation:

$$\text{BMI} = \frac{\text{mass}}{\text{height}^2}$$

In this equation, mass is measured in kg and height in m.

Triathlon times

The mean time to complete the **Ironman** triathlon is 12.8 h.
The swim leg lasts 10% of this time (or 1.28 h), the bike leg lasts 50% (6.40 h), the run leg lasts 38% (or 4.86 h), and finally, the transitions last 2% (0.26 h).

The mean time to complete the **Half Ironman** triathlon is 6.08 h.
The swim leg lasts 11% of this time (0.67 h), the bike leg lasts 50% (3.04 h), the run leg lasts 36% (or 2.19 h), and finally, the transitions last 3% (0.18 h).

The mean time to complete the **Olympic** triathlon is 2.88 h.
The swim leg lasts 18% of this time (0.52 h), the bike leg lasts 44% (1.27 h), the run leg lasts 33% (or 0.95 h), and finally, the transitions last 5% (0.14 h).

The mean time to complete the **Sprint** triathlon is 1.67 h.
The swim leg lasts 18% of this time (0.30 h), the bike leg lasts 46% (0.77 h), the run leg lasts 28% (or 0.47 h), and finally, the transitions last 8% (0.13 h).

Triathlon data for the cycle leg

Table 5 shows the time to reach maximum cycle speed after leaving the transition zone, and how it is affected by gradient.

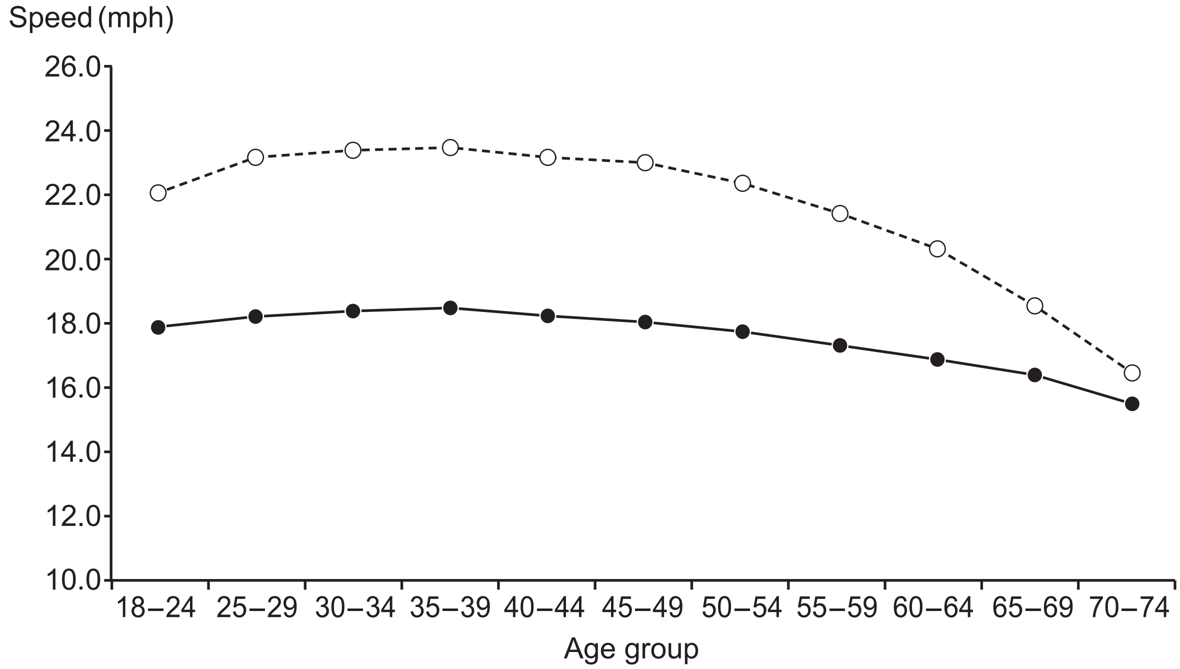
Table 5

Gradient (%)	Maximum speed (m/s)	Time to reach maximum speed (s)
−5 (downhill)	8.1	20
0 (level ground)	6.2	26
5 (uphill)	4.3	24

Graph 1 shows the mean cycle speed in the Ironman triathlon for each age group in a race.

The dashed line shows the mean speed for the winner in each age group. The solid line shows the mean speed for all competitors in each age group.

Graph 1



Analysing performance

Performance in triathlons can be analysed using the information below.

$$1\,\text{km} = 1000\,\text{m}$$

$$10\,\text{mph} = 16\,\text{km/h}$$

$$\text{speed in km/h} = 1.6 \times \text{speed in mph}$$

The speeds in different legs can be calculated using the equation:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

Acceleration can be calculated using the equation:

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time}}$$

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