# Acceleration and speed- time graphs worksheet answers

With speed on the y-axis and time on the x-axis, a speed-time graph tells us someone's speed/something has changed over a period of time. 1) Line gradient = Acceleration 2) Negative gradient = Deceleration 3) Flat section means constant speed (NO OFF) 4) Area below graph = Distance travelled A skill you will need to learn describes a speed time graph. Example: The speed-time graph shows a 50-second drive ride. Describe the 50-second journey. Step 1: Divide the chart into separate sections, they can be seen in the image as A, B, C, and D. Step 2: Describe in detail each part of the journey, making sure that the numeric values are used throughout. Section A – The machine accelerated from 0 to 15 m/s in the first 10 seconds (because the line is straight, the acceleration is constant). Section B – The line is flat, which means that the speed of the car has not changed for 10 seconds – which means that it is moving at a constant speed. Section C – The machine accelerated up to 25 m/s in the next 10 seconds, Section D – Finally spent the last 20 seconds deceleration back up to 0 m/s. The acceleration is calculated as the change of speed over time. Example: The speed-time graph shows a 50-second car journey, find which section of the chart has the highest acceleration. We know, line gradient = Acceleration We need to find the gradient of each section. Section \bf{A}: Acceleration between 0s and 10s = gradient=\dfrac{15-0}{10-0}=1.5 m/s^2 Section \bf{B}: This section is flat, which means that the acceleration will be 0 Section \bf{C}: Acceleration between 20s and 30s = =\dfrarac{25-15}{30-20}=1 m/s^2 Section \bf{D}: Acceleration between 30 and 50s = gradient =\dfrac{0-25}{50-30}=\dfrac{-25}{20} = -1.25 m/s^2 Section \bf{A} has the highest acceleration, thus the maximum acceleration is 1,5 m/s^2 Note: acceleration units are expressed in distance/time\bold{^2}, which in this case is m/s\bold{^2}. Calculating the total distance travelled is one of the most common exam questions you can see. Example: The speed-time graph shows a 50-second drive ride, Calculate the total distance travelled in the 50 seconds. We know, The area under the graph = Distance traveled To work in the area under this graph, we break into 4 shapes: A, B, C, and D. This offers two triangles, a rectangle, and a trapezoid, which are all shapes that we can work in the area. \text{A}=\dfrac{1}{2}\times10 \times15=75 m \text{B}=10\times15=150 m C=\dfrac{1}{2}(15+25)\times10=10=10=10=15 0 200 m D=\dfrac{1}{2}\times20\times25=250 m The total distance travelled: 75+150+200+250=675 m Finding the average gradient is the gradient over a period of time. Example: A graph of the speed time of the first 4 seconds of a person running a race is displayed. Calculate the average acceleration over the 4 seconds. We know: The Gradient = Acceleration To work on the average acceleration over the 4 seconds, we will draw a line from where the graph is at 0 s to where the graph is at 4 s and we will find of her. So we get the average acceleration to be, \text{gradient}=\dfrac{6-0}{4-0}=1.5 m/s^2 Finding the gradient instantly, is the gradient tangent to a point. Example: A graph of the speed time of the first 4 seconds of a person running a race is displayed. Calculate the instantaneous acceleration to 2 seconds. To do this we draw a tangent to the line after 2 seconds and work on the gradient of that. This is shown above. Then we get instant acceleration to be, \text{gradient}=\dfrac{5.8-3.2}{3.5-1.0} = 1.04 m/s^2 (3 sf). So we first shoot a straight from the origin to (12, 4) because after 12 seconds, it is reached 4 m /s. Then for the next part we are told the deceleration is 0.1 m/s^2 for 20 seconds. So if the speed decreases by 0.1 every second, after 20 seconds it will be 0.1 \times 20=2 m/s Therefore, with 32 seconds in the speed is 2 m/s, so we draw a straight line from (12, 4) to (32, 2). Finally, a constant speed will be represented by a flat line that goes up to the point of 50 seconds, still at 2 m/s. The result should look like the chart below. We need to find the area under the graph. To do this, we will divide it into shapes that we know how to calculate, as seen below. A is a triangle, B and C are trapezoids, and D is a rectangle. So we receive \text{A}=\dfrac{1}{2}\times10\times15=75 m \text{B}=\dfrac{1}{2}\times(10+15)\times5=062.5 m \text{C}=\dfrac{1}{2}\times(10+20)\times5=75 m \text{D}=30\times20 = 600 m Therefore, the total distance travelled by the cyclist is 75+62.5+75+600=812.5 m To determine the average acceleration, we draw a line from the origin to the end point of the graph, as shown below. The average acceleration is given by the gradient of this line. Therefore, the average acceleration is, \text{gradient}=\dfrac{4-0}{50-0}= 0.08 m/s^2 Try a review sheet on this topic. Related Topics: More Lessons for a Math Level Math Worksheets Videos, Tasks, Solutions, and Worksheets that are suitable for a Math Level to help students answer questions on speed-time graphs. Speed-time graph: M1 Edexcel June 2013 Q5(a)(b) Download question document 5. A car is moving on a straight horizontal road. The car has 120s to travel between two sets of traffic lights, which are 2145m away. The car starts from rest to the first set of traffic lights and moves with constant acceleration for 30 years until its speed is 22ms-1. The machine maintains this speed for 1 second. The machine then moves with constant deceleration, coming to rest at the second set of traffic lights. (a) Sketch, in the space below, a speed graph for the movement of the machine between the two sets of traffic lights. (b) Find the value of T Show Step-by-Step Speed Solutions - Time Chart: M1 Edexcel June 2013 Q5(c) question document 5. A motorcycle leaves the first set of traffic lights 10 years after the car left the first set of traffic lights. Motorcycle moves from rest with constant acceleration, an ms-2, and passes the car car point A, which is 990m from the first set of traffic lights. When the motorcycle passes the car, the car moves at 22 ms–1. (c) Find the time it takes for the bike to move from the first set of traffic lights to point A. Show Step by Step Velocity Solutions - Time Charts: M1 Edexcel June 2012 Q4 Download Question Paper 4. A car is moving on a straight horizontal road. At time t = 0, the car is travelling at 20 ms–1 and is at point A. The car maintains a speed of 20 ms–1 for 25 s. The machine then moves with constant deceleration 0.4 ms–2, reducing its speed from 20 ms–1 to 8 m s–1. The machine then travels at constant speed 8 ms–1 for 60 s. The machine then moves with constant acceleration until it travels at 20 ms–1 at point B. (a) Sketch a speed graph to represent the movement of the machine from A to B. (b) Find the time for which the machine is decelerate. Since the distance from A to B is 1960 m, (c) find the time it takes for the car to move from A to B. Show Step-by-Step Speed Solutions - Time Chart: A-Level Mechanics Edexcel June 2008 Q4 Download Question of Paper 4. A car is moving along a straight horizontal road. The speed of the car as it passes point A is 25 ms-1 and the car maintains this speed for 30 years. The machine then decelerates evenly at a speed of 10 ms–1. The speed of 10 ms–1 is maintained until the machine passes point B. The time it takes to travel from A to B is 90 years and AB = 1410m. (a) Sketch, in the space below, a speed-time graph to show the movement of the machine from A to B. (b) Calculate the deceleration of the machine, as it decelerate from 25 ms–1 to 10 ms–1. 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