**Calculator Assumed**

**Applications of Differentiation – Rectilinear Motion**

Time: 45 minutes

Total Marks: 45

Your Score: / 45



**Question One: [1, 1, 1 = 3 marks]**

1. If the displacement of an object is modeled by a quadratic function, what type of function will model the velocity of the object?
2. If the velocity of an object is modeled by a quadratic function, what type of function will model the displacement of the object?
3. If the velocity of an object is modeled by a quadratic function, what type of function will model the rate of change of the velocity?

**Question Two: [3 marks]**

The velocity, in m/s , of a particle is modeled by . Determine the function which models the displacement of the particle if at 5 seconds the displacement is -48 m.

**Question Three: [2, 1, 1, 3, 2 = 9 marks]**

The displacement of a particle moving in linear motion is graphed below, where *t* is time in seconds, and *x* is displacement in metres.



1. What is the initial displacement of the particle? Interpret your answer.
2. Determine when .
3. When does the particle pass the origin?
4. What is the distance travelled by the particle in the first 8 seconds?
5. Determine the approximate speed of the particle at .

**Question Four: [1, 3, 3, 2, 1, 2, 3 = 14 marks]**

A particle moves in linear motion and its displacement, *d* m, from the origin is given by , where *t* is time in seconds.

1. Determine the displacement of the particle after 3 seconds.
2. When will the particle be at a distance of 1 m from the origin?
3. Determine, using calculus methods, when the particle changes direction.
4. Determine when the particle is at the origin.
5. Calculate the velocity of the particle at *t =* 5 seconds.
6. Calculate the total distance travelled by the particle in the 7th second.
7. Calculate when the speed of the particle is 5m/s.

**Question Five: [5 marks]**

The displacement of an object moving in linear motion is given by , where *x* is the displacement of the object in metres from the origin and *t* is the time in seconds.

If  when initially at the origin and , find the values of *a* and *b*.

**Question Six: [4 marks]**

Sketch, on the same set of axes, a possible graph of the instantaneous rate of change of displacement if the displacement of an object moving in linear motion is graphed below.

**Question Seven: [1, 2, 1, 3 = 7 marks]**

The velocity, in m/s, of a particle moving in linear motion is monitored and its velocity at various times is given below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| t | 0 | 1 | 2 | 3 | 4 |
| v | 5 | 3 | -3 | -13 | -27 |

1. Determine the initial velocity of the particle.
2. Determine when the particle has a speed of 3 m/s.
3. During which second does the particle change direction?
4. Determine the equation of the function which models the velocity of this particle.

**SOLUTIONS**

**Calculator Assumed**

**Applications of Differentiation – Rectilinear Motion**

Time: 45 minutes

Total Marks: 45

Your Score: / 45



**Question One: [1, 1, 1 = 3 marks]**

1. If the displacement of an object is modeled by a quadratic function, what type of function will model the velocity of the object?

linear

1. If the velocity of an object is modeled by a quadratic function, what type of function will model the displacement of the object?

 cubic

1. If the velocity of an object is modeled by a quadratic function, what type of function will model the rate of change of the velocity?

 linear

**Question Two: [3 marks]**

The velocity, in m/s , of a particle is modeled by . Determine the function which models the displacement of the particle if at 5 seconds the displacement is -48 m.



**Question Three: [2, 1, 1, 3, 2 = 9 marks]**

The displacement of a particle moving in linear motion is graphed below, where *t* is time in seconds, and *x* is displacement in metres.

1. What is the initial displacement of the particle? Interpret your answer.

  The particle is initially 6m from the origin.

1. Determine when .



1. When does the particle pass the origin?



1. What is the distance travelled by the particle in the first 8 seconds?

 

1. Determine the approximate speed of the particle at .



**Question Four: [1, 3, 3, 2, 1, 2, 3 = 14 marks]**

A particle moves in linear motion and its displacement, *d* m, from the origin is given by , where *t* is time in seconds.

1. Determine the displacement of the particle after 3 seconds.



1. When will the particle be at a distance of 1 m from the origin?

 

1. Determine, using calculus methods, when the particle changes direction.

 

1. Determine when the particle is at the origin.

 

1. Calculate the velocity of the particle at *t =* 5 seconds.

 

1. Calculate the total distance travelled by the particle in the 7th second.

 

1. Calculate when the speed of the particle is 5m/s.



**Question Five: [5 marks]**

The displacement of an object moving in linear motion is given by , where *x* is the displacement of the object in metres from the origin and *t* is the time in seconds.

If  when initially at the origin and , find the values of *a* and *b*.



**Question Six: [4 marks]**

Sketch, on the same set of axes, a possible graph of the instantaneous rate of change of displacement if the displacement of an object moving in linear motion is graphed below.



**Question Seven: [1, 2, 1, 3 = 7 marks]**

The velocity, in m/s, of a particle moving in linear motion is monitored and its velocity at various times is given below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| t | 0 | 1 | 2 | 3 | 4 |
| v | 5 | 3 | -3 | -13 | -27 |

1. Determine the initial velocity of the particle.



1. Determine when the particle has a speed of 3 m/s.

 

1. During which second does the particle change direction?

During the 2nd second.

1. Determine the equation of the function which models the velocity of this particle.

 