

**Mathematics Specialist Units 3 & 4
Test 7 2016**

Section 1 Calculator Free

Rectilinear Motion (including SHM) and Statistical Inference.

STUDENT'S NAME: _____

DATE: Thursday 8th September

TIME: 20 minutes

MARKS: 23

INSTRUCTIONS:

Standard Items: Pens, pencils, pencil sharper, eraser, correction fluid/tape, ruler, highlighters,
Formula Sheet.

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

1. (6 marks)

A particle oscillates 1.2 m either side of a central position with simple harmonic motion. The period of the motion is 8 seconds.

(a) What is the maximum acceleration? [4]

(b) What is the maximum speed? [2]

2. (8 marks)

A particle moves in a straight line. Its displacement (metres) from a fixed point is given by $x(t)$ where t , is time in seconds. The acceleration of the particle is given by $a(t) = 2 - 4x$, where $x(0) = v(0) = 0$ and $v(t) \geq 0 \forall t$.

(a) Determine v in terms of x . [4]

(b) Hence, determine the range of values for x and v . [4]

3. (9 marks)

The time taken to complete a task has mean μ minutes and standard deviation 10 minutes. For Z as the standard normal variable, $P(-2.5 < Z < 2.5) \approx 0.988$.

(a) A sample of 100 students completed the task with a mean time of 102 minutes. State a 98.8% confidence interval for μ .

[2]

(b) Another sample of n students (where $n \geq 30$) is chosen. Determine n if we are to be 98.8% confident that the sample mean is to differ from μ by no more than 1.25 minutes.

[3]

(c) Given that $\mu = 100$ minutes, estimate the probability that a sample of 100 students will complete the task with a mean time exceeding 102.5 minutes.

[4]

End of Questions

Mathematics Specialist Units 3 & 4
Test 7 2016

Section 2 Calculator Assumed

Rectilinear Motion (including SHM) and Statistical Inference.

STUDENT'S NAME: _____

DATE: Thursday 8th September

TIME: 30 minutes

MARKS: 34

INSTRUCTIONS:

Standard Items: Pens, pencils, pencil sharper, eraser, correction fluid/tape, ruler, highlighters, Formula Sheet retained from Section 1.

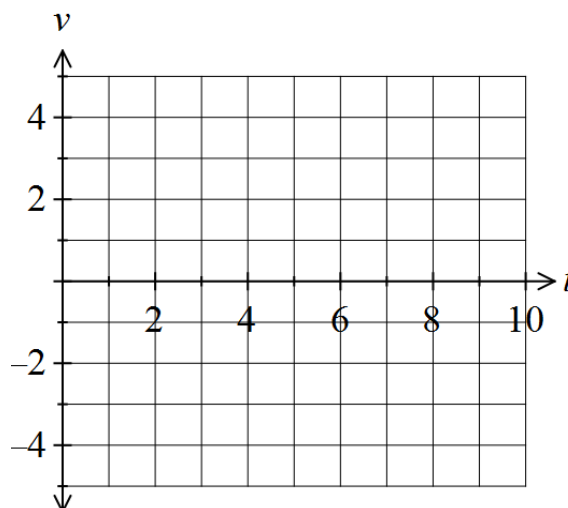
Special Items: Drawing instruments, templates, three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment).

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

4. (7 marks)

An object, travelling in a straight line, has an initial velocity of $v = -1$ m/s and is capable of a maximum speed of 3 m/s. During its travels it reaches its maximum speed, stops twice but changes direction only once, before coming to rest after 10 seconds.

(a) Sketch on the axes below, a possible graph of $v = f(t)$ for $0 \leq t \leq 10$. [4]



(b) Indicate on your graph when the object is subject to maximum retardation. [1]

(c) Provide a mathematical statement for calculating the distance travelled in the 10 seconds. [2]

5. (10 marks)

A vehicle travels along a straight stretch of highway. The driver notices a car stalled on the highway k meters ahead and applies the brakes of the vehicle. The acceleration of the vehicle t seconds after the breaks are applied is given by $a = -10e^{-0.1t}$

- (a) Determine an expression for the displacement of the vehicle t seconds after the brakes are applied.

[5]

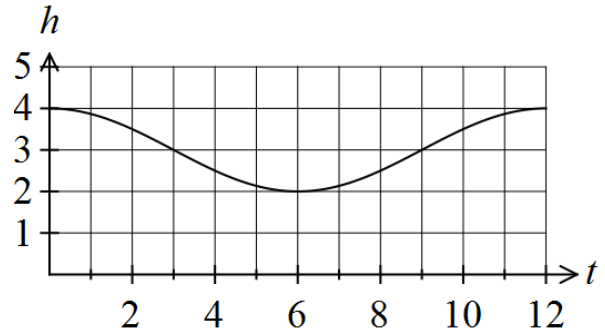
- (b) The vehicle comes to a complete stop after 3 seconds just behind the stalled car. Determine k and the initial speed of the vehicle.

[5]

6. (9 marks)

The depth of water $h(t)$ metres at a jetty is graphed against time (t hours) as shown in the accompanying diagram. The height, y , of the water surface above the mean water level

satisfies the equation $\frac{d^2y}{dt^2} = -n^2y$.



(a) State the depth of the mean water level. [1]

(b) Determine an expression for $y(t)$ and hence, determine an expression for $h(t)$ in terms of $y(t)$. [3]

(c) Calculate the time interval between two consecutive occasions when the water level is at a depth of 3.5 m. [2]

(d) For 60% of the *period*, the water level exceeds k metres. Determine k . [3]

7. (8 marks)

The time taken for a child to complete a particular puzzle is normally distributed with a mean 3 minutes and standard deviation 20 seconds.

(a) A sample of fifty children of the same age collectively took 2 hours and 35 minutes to complete the puzzle. Calculate the mean time, in seconds, for this sample. [2]

(b) Estimate the probability that a second sample of 50 students of the same age will take a total of more than 2 hours and 35 minutes to complete the puzzle. [4]

(c) Children who complete the puzzle under k seconds are classified 'highly gifted'. If 0.01% of all children are classified highly gifted, determine the value of k . [2]

End of Questions