Question 1

QUESTION 1

Simple Familiar
Technology Active
2020

The position x (m) at time t (s) of a 7 kg particle moving in a straight line is given by

$$x = 3t^3 - 5t^2 + 2t - 4 \text{ for } 0 \le t \le 10$$

Determine the time when the particle has a momentum of 620 kg m s^{-1}.

(A) 1.73 s

(B) 2.60 s

(C) 3.66 s

(D) 3.71 s

Question 2

QUESTION 4

Simple Familiar
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2020

A particle is moving with simple harmonic motion described by the equation $x = 1.32\cos\left(\frac{\pi t}{2}\right)$ where x (m) is the displacement of the particle from a central position over time $t\,(\text{s})$, $t \ge 0$

The maximum speed of the particle is

(A) 2.07 m s^{-1}

(B) 4.15 m s^{-1}

(C) 4.30 m s^{-1}

(D) 5.28 m s^{-1}

Question 3

QUESTION 14 (5 marks)

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2020

The time, t, (months) that it takes before a phone owner cracks the screen on their phone can be modelled by an exponentially distributed random variable

$$f(t) = \begin{cases} 0.16e^{-0.16t}, & t \ge 0 \\ 0, & \text{otherwise} \end{cases}$$

a) Show that $f(t)$ is a probability density function. *[1 mark]*

b) Determine the probability that a phone owner cracks the screen on their phone within 1 year. *[2 marks]*

Three-quarters of phone owners take between 1 and m months before they crack the screen on their phone.

c) Determine the value of m. *[2 marks]*

Question 4

QUESTION 11 (6 marks)

Simple Familiar
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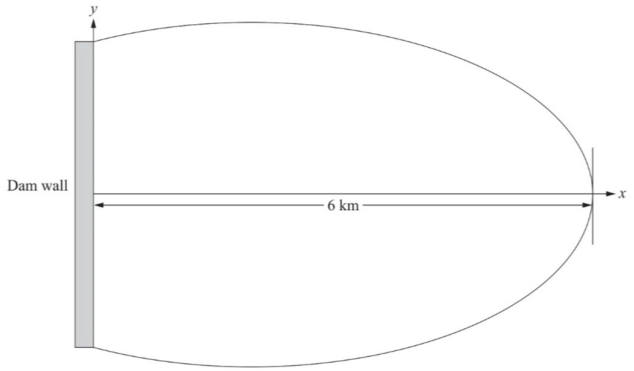
2022

An aerial view of the surface of a dam, 6 km in length, is symmetrically positioned on a Cartesian plane as shown. A dam wall is located along the y-axis.

The surrounding edge of the dam can be modelled by the ellipse $\frac{(x-2)^2}{16} + \frac{y^2}{9} = 1$, for $0 \le x \le 6$.



Not to scale

a) Use Simpson's rule with four strips to determine an approximate area of the surface of the dam. *[4 marks]*

b) Evaluate the reasonableness of this approximation. *[2 marks]*

Question 5

QUESTION 17 (7 marks)

Complex Familiar
Technology Active
2020

An object is released from rest at a height of 100 m above the ground.

The motion of the vertical descent of the object is modelled by

$$v\frac{dv}{dx} = 9.8 - 0.004v^2 \quad (v \ge 0)$$

where v is the velocity (m s^{-1}) and x is the displacement from the ground (m).

Determine the velocity of the object when it strikes the ground.