Question Number	Scheme	Marks
4(a)	Length of string/half string = 10 m / 5 m (or extension = 5 m / 2.5 m)	B1
	Hooke's Law	M1
	$T = \frac{\lambda x}{l} = \frac{20 \times 5}{5}, \ = 20$	A1
	Resolve vertically	M1
	$2 \times "20" \times \frac{4}{5} = W$	A1ft
	Weight = 32 (N)	A1
		(6)
(b)	Conservation of Energy	M1
	$\frac{1}{2}"m"v^2 = "32" \times 4 - \left(\frac{20 \times 5^2}{2 \times 5} - \frac{20 \times 1^2}{2 \times 5} \right)$	A1ft A1ft
	Substitute $m = \frac{32}{9.8}$ and solve	DM1
	$v = 7$ (m s^{-1})	A1
		(5)
		(11 marks)

Notes	
(a) B1	Correct length of complete or half string or correct extension(s) (seen or implied)
M1	Apply Hooke's law. Condone mixed approach (E.g. two strings with $x = 2.5$ but $l = 5$)
A1	Correct tension seen or implied
M1	Resolving vertically. Must have both tensions. Condone sin/cos confusion.
A1ft	Correct equation with their tension substituted. Allow mg for weight.
A1	Cao (allow labelling as mg and isw if they give an answer of 32 but go on to find m)
(b) M1	Energy Equation with all four terms. Condone sin/cos confusion and sign errors. The equation must be dimensionally correct.
A1ft	Unsimplified equation with at most one error. Ft their W or m and allow with W or mg. An incorrect natural length or missing 2 on the denominator of both epe terms is one error.
A1ft	Correct equation. Ft their W or m and allow with W or mg
DM1	Substitutes their mass (not weight) into their equation. Dependent on first M1 in (b).
A1	Cao (7, 7.0 or 7.00 only)

5. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

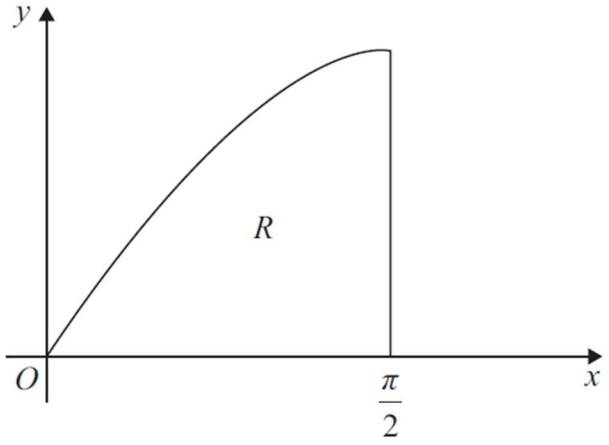


Figure 1

Figure 1 shows the finite region R which is bounded by part of the curve with equation $y = \sin x$, the x-axis and the line with equation $x = \frac{\pi}{2}$

A uniform solid S is formed by rotating R through 2π radians about the x-axis.

Using algebraic integration,

(a) show that the volume of S is $\frac{\pi^2}{4}$

(4)

(b) find, in terms of π, the x coordinate of the centre of mass of S.

(7)

(Total for Question 5 is 11 marks)