LC 2015: Paper 1

Question 1 (25 marks)

Question 1 (a)

Bounce 1 is obtained by multiplying 2 m by $\frac{3}{4}$ to give a height of $\frac{3}{2}$ m.

This process is repeated up until the fourth bounce.

Bounce	0	1	2	3	4
Height (m)	$\frac{2}{1}$	$\frac{2}{1}\times\frac{3}{4}=\frac{3}{2}$	$\frac{3}{2}\times\frac{3}{4}=\frac{9}{8}$	$\frac{9}{8}\times\frac{3}{4}=\frac{27}{32}$	$\frac{27}{32}\times\frac{3}{4}=\frac{81}{128}$

Marking Scheme Notes
Question 1 (a) [Scale 5C (0, 2, 4, 5)]
2: • Any term correct
4: • Any two terms correct
Note: Dividing by $\frac{3}{4}$ gets high partial credit at most. Correct decimal values high partial at most.

Question 1 (b)

Add up the distances travelled by the ball going up and down. Make sure you multiply the distances moved by the bounced balls by 2 (up and down).

$S = 2 + 2(\frac{3}{2}+\frac{9}{8}+\frac{27}{32}+\frac{81}{128}) = \frac{653}{64}$ m [Using calculator]

or

$S = 2 + 2(\frac{3}{2}+\frac{9}{8}+\frac{27}{32}+\frac{81}{128}) = 2 + (3+\frac{9}{4}+\frac{27}{16}+\frac{81}{64})$

$[a = 3,\ r = \frac{3}{4},\ n = 4]$

$$S = 2 + S_4 = 2 + \frac{3(1-(\frac{3}{4})^4)}{1-\frac{3}{4}} = \frac{653}{64} \text{ m}$$

Formulae and Tables Book
Sequences and series:
Geometric series [page 22]

$$S_n = \frac{a(1-r^n)}{1-r}$$

a is the first term
r is the common ratio

Marking Scheme Notes
Question 1 (b) [Scale 10C (0, 4, 8, 10)] NOTE: two solutions
1st solution
4: • Indicates addition of terms
8: • Recognises double distance after first hop
• Sum of all rises or drops

or

2nd solution
4: • Indicates addition of terms
• Indicates Geometric Progression
8: • Correct Geometric Progression formula with correct substitution

Question 1 (c)

$S_\infty = 2 + (3 + \frac{9}{4} + \frac{27}{16} + \frac{81}{64} + ...)$ ← This bracket is an infinite geometric series with $|r| < 1$.

$[a = 3,\ r = \frac{3}{4}]$

$$S_\infty = 2 + \frac{3}{1 - \frac{3}{4}} = 14 \text{ m}$$

Formulae and Tables Book
Sequences and series:
Geometric series [page 22]

$$S_\infty = \frac{a}{1-r},\ |r| < 1$$

a is the first term
r is the common ratio

Marking Scheme Notes
Question 1 (c) [Scale 10C (0, 4, 8, 10)]
4: • Recognition of sum to infinity
• S_∞ formula
8: • Correct formula with correct substitution
• Sum of all rises or drops