Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) (i) Tension minimum at extremities or maximum at middle / bottom

Tension depends on (component of) weight and required centripetal force / velocity

Increases as acrobat moves downwards

Tension at bottom = $mg + mv^2/r$ or Tension = weight + centripetal force

Tension at extremity = $mg/\cos\theta$ (θ is angle between rope and vertical)

Max 3

3

(ii) Use of $T = 2\pi\sqrt{(l/g)}$

3.6 (3.59) (m)

Allow for change of subject for use

2

(b) (i) Frequency of swing = 0.26 Hz

Use of $v = 2\pi fA$

3.0 or 2.97 (m s^{-1})

alternative method
Change in pe = gain in ke
Calculating Δh by geometry from swing = 0.48 m
3.1 or 3.06 (m s^{-1})

3

(ii) Use of $s = ½\ at^2$

time to reach safety net = 1.11 s

s = their answer to **(b)(i)** × their time to reach the net = answer

(answer is 3.3 m if all correct)

Allow for change of subject for use

3

(c) (i) Attempt at valid test:

Fractional change in amplitude for same time interval

or use of 'half life' method

or use of exponential formula ($A = A_o e^{-kt}$) to show that *k* is constant

Correct calculation for one pair of amplitudes

Correct for second pair and conclusion

for half life method must see curve through peaks or other indication to find values between peaks

3

(ii) Period shorter

Centre of mass of trapeze artist was lower than the bar

Effective length of the pendulum is lower

Bar likely to be low mass now have a pendulum with distributed mass / no longer a simple pendulum / centre of mass is half way along suspending rope

Calculates new effective length of the pendulum (2 m)

Max 2

2

[16]

Q2.

(a) 2 smooth curves to show envelope of exponential decay waveform; lines to be continuous from first to fifth points, maximum deviation from best-fit lines thorough each set of 5 points must not be greater than 1 mm ✔

1

equilibrium position marked on grid with horizontal line at A = 15.7 ± 0.1 cm ✔

1

(b) evidence of **valid** working (using the line(s) and/or the equilibrium position) established in (a)(iii) to **test for** the exponential nature of the decay (working may be shown on the graph): do not penalise confusion between *n* and time

either

evidence of relevant A values [2A ie A–(–A)] measured from graph (correct to nearest mm) or deduced from difference between tabulated values and equilibrium position of pointer) **or 0/3** $_1$ ✔

at least two half life measurements (expect evidence of working) $_2$ ✔

values obtained giving $n_{½}$ = 6.3 ± 0.3 from **either or both** curves **confirming exponential decay** $_3$ ✔

or

$_1$ ✔ as above; evaluates at least two ratios of successive amplitudes [or the fractional change in successive amplitudes], eg

$\frac{A_0}{A_1}$ and $\frac{A_1}{A_2}$ $\left[\frac{A_0 - A_1}{A_0} \text{ and } \frac{A_1 - A_2}{A_1}\right]_2$ ✔; ratios obtained giving consistent results to

± 5% **confirming exponential decay** $_3$ ✔

or

1 ✔ as above; evaluates difference between natural logs of <u>at least</u> two successive amplitudes, eg ln(A_0) – ln(A_1) and ln(A_1) – ln(A_2) ✔ differences obtained giving results consistent to ± 10% **confirming exponential decay** 3 ✔

3

5