Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

(a) use of $V = \frac{4}{3}\pi r^3$ to give $V = \frac{4}{3}\pi(2.5 \times 10^{-2})^3$ ✔ $= 6.5 \times 10^{-5}$ m^3

use of $\rho = \frac{m}{V}$ to give $m = \rho V = 8030 \times 6.5 \times 10^{-5}$ ✔ = 0.53 kg

use of $W = mg$ to give $W = 0.53 \times 9.81 = 5.2$ (N) ✔

the first mark is for making some attempt to calculate the volume; ignore power of ten errors.

the second mark is for the correct substitution or for the calculation of mass

the third mark is for going on to calculate the weight

allow ce for incorrect volume or mass but 2 errors = 0/3

no sf penalty but g = 10 N kg^{-1} loses mark

3

(b) distance of line of action of weight to pivot = (0.120 + 0.025) = 0.145 m ✔

moment = force × distance = 5.2 × 0.145 = 0.75 ✔

unit Nm ✔

the first mark is for identifying that the weight of the ball will act through its centre; use of 0.12 m loses this mark

the second is for correctly calculating the moment; allow ce for wrong distance; condone force = 5 N (which leads to 0.725)

allow suitable unit consistent with calculation, eg N cm

reject 'nm' or 'NM' etc

3

(c) taking moments about the pivot

clockwise moment from spring = anticlockwise moment from ball

$F \times 0.080 = 0.75$ ✔

$F = 9.4$ N ✔

use of $F = kx$ to give $x = \frac{F}{k} = \frac{9.4}{100}$ = 0.094 m ✔

allow ce from (b)

the first mark is for the use of the moment equation

the second mark is for calculating the force on the spring; condone 9.35 and 9.3

the third mark is for calculating the extension; allow calculation in cm

allow ce from the second mark ie use of wrong force; condone 1 sf 0.09 m if (1 sf) 5 N used in (b)

3

(d) the line / pen (initially) moves up; ignore subsequent motion ✔
(the downwards acceleration of the ball is much less than that of the frame and) the ball does not move (very far in the time taken for the frame to move down) ✔

the first mark is for stating the correct direction of the line / pen; allow 'diagonally up', 'up then down' but reject 'up and down'

the second mark is for an explanation which shows some understanding of the relative displacement of the ball and frame; this mark is consequential on the first being correct; condone 'ball has inertia'

2

[11]

Q2.

(a) (i) (using sin 25° = V_V/V
$V = V_V$ / sin 25°)
=5.0/sin25° ✔
11.8 (m s^{-1}) ✔
(working and answer is required)

Look out for cos 65° = sin 25° in first mark.

Also calculating the horizontal component using cos 25° followed by Pythagoras is a valid approach.

Working backwards is not acceptable.

2

(ii) (using tan 25° = V_V / V_H)
$V_H = V_V$ /tan 25° ✔
= 5 / tan 25° =11(m s^{-1}) ✔ (10.7m s^{-1})
Or (using cos 25° = V_H / V)
$V_H = V$ cos 25° ✔ = 11.8 cos 25° = 11 (m s^{-1}) ✔ (10.7 m s^{-1})
Or (using $V_H^2 + V_V^2 = V^2$)
$V_H^2 + 5^2 = 11.8^2$ ✔ (0r 12^2)
V_H = 11 (m s^{-1}) ✔ (10.7 m s^{-1})

Note 1/cos 65° = sin 25°

and tan 25° = 1/ tan 65°

Rounding means answers between 10.7 and 11 m s^{-1} are acceptable

2

(b) (i) (using $v^2 = u^2 + 2as$ with up being positive
$0 = 5.0^2 + 2 \times -9.81 \times s$)
s = 1.3 (m) ✔ (1.27 → 1.28 m)
or (loss of KE = gain of PE
½ ~~m~~ v^2 = ~~m~~ $g\ h$
½ 5.0^2 =9.81 × h)
h = 1.3 (m) ✔ (1.27 → 1.28 m)

quoted to 2 sig figs ✔

for the sig fig mark the answer line takes priority. If a choice of sig figs given and not in answer line – no sig fig mark

Sig fig mark stands alone provided some working is shown

2

(ii) (using $s = (u + v)t/2$) or horizontal distance = speed × time)
s = 11 × 1.3 = 14 (m) ✔ (using 10.7 gives the same answer)

allow CE s = (aii) × 1.3 but working must be seen

1

(c) (i) **A** marked at the point of landing or immediately before ✔

*The **A** or its marked position must not be further to the left than the 'c' in the word 'scale'*

1

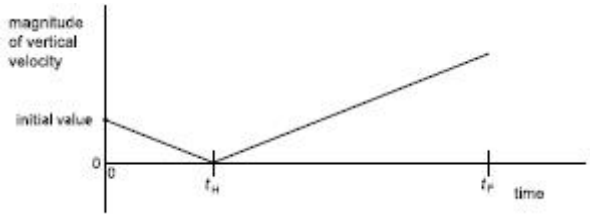
(ii) **B** marked at the maximum height of the path ✔

*The **B** must lie vertically between the 'r' and 'a' in the word 'resistance above figure 2.*

1

(d) straight line from point given down to point t_H on the axis ✔

straight line starting where first line stops (t_H) but with opposite gradient to the first line ✔



(A measure of accuracy for the second mark) The second line must end (t_H) between the height of the vertical axis and half this height.

Obviously straight lines drawn by hand are acceptable.

2

[11]