Name of the Student:_____

Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• distance between at least two pairs of images (1) • distances between images are the same in x direction (1) • distance between images varies in y direction showing a changing velocity (1) • velocity in the x direction is constant so x direction is independent of y direction (1)	MP1 and 2 could come from marks on the diagram	4
(ii)	• use of $v^2 = u^2 + 2as$ or $s = ut + \frac{1}{2}at^2$ (1) • initial vertical component velocity = 0.47 m s^{-1} (1) • use of $v_H = d/t$ in the horizontal (1) • Use of Pythagorus with v_H and u_V (1) • Resultant velocity = 1.1 m s^{-1} (1)	alt to MP2 : 0.5 m s^{-1} (allow 0.4 to 0.6) if using distance taken from first two images and $v_H = d/t$ Example of calculation: $0 = u^2 - 2 \times 9.81\ \text{m s}^{-2} \times 0.011\ \text{m}$ $u_V = 0.465\ \text{m s}^{-1}$ $v_H = \frac{0.08\ \text{m}}{0.08\ \text{s}}$ $v_H = 1.0\ \text{m s}^{-1}$ $v = \sqrt{(0.47^2 + 1.0^2)}$ Resultant velocity = 1.1 m s^{-1}	5

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(iii)	• Use of $\Delta W = F\ \Delta s$ (1) • Use of $E_k = ½\ mv^2$ (1) • $F = 0.015$ N (1) Alternative • Use of $v^2 = u^2 + 2as$ (1) • Use of $F = ma$ (dependent on MP1) (1) • $F = 0.015$ N (1)	Allow ECF from (a)(ii) Example of calculation: $2 \times F \times 0.003\text{m}$ $= \frac{1}{2} \times 150 \times 10^{-6}\text{kg} \times 1.1^2\ (\text{m s}^{-1})^2$ $F = 0.015$ N "show that" value gives $F = 0.013$ N Alternative $1.1^2\ (\text{ms}^{-1})^2 = 2 \times a \times 0.003$ m $a = 202\ \text{m s}^{-2}$ $2 \times F = 150 \times 10^{-6}\ \text{kg} \times 202\ \text{ms}^{-2}$ $F = 0.015$ N	3

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(a)	• use of density = mass / volume (1) • use of $V = 4/3\ \pi r^3$ (1) • $r = 1720$ m (1)	Example of calculation: $V = 1.0 \times 10^{13}\ \text{kg} \div 470\ \text{kg m}^{-3}$ $= 2.13 \times 10^{10}\ \text{m}^3$ $= 4/3\ \pi r^3$ $r = \sqrt[3]{(2.13 \times 10^{10}\ \text{m}^3 \times 3) \div 4\pi}$ $= 1720$ m	**(3)**

Question Number	Acceptable answers	Additional guidance	Mark
(b)	• use of $g = GM/r^2$ (1) • $g = 2.3 \times 10^{-4}\ \text{N kg}^{-1}$ (1)	Example of calculation: $g = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2} \times 1.0 \times 10^{13}\ \text{kg} / (1720\ \text{m})^2$ $g = 2.25 \times 10^{-4}\ \text{N kg}^{-1}$	**(2)**

Question Number	Acceptable answers	Additional guidance	Mark
(c)	• use of $s = ½\ gt^2$ (1) • $s = 1.2 \times 10^3$ m (1)	Example of calculation: $s = 0.5 \times 2.25 \times 10^{-4}\ \text{m s}^{-2} \times (3300\ \text{s})^2$ $= 1.2 \times 10^3$ m	**(2)**

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Question Number	Acceptable answers	Additional guidance	Mark
(d)	An explanation that makes reference to the following: • the calculated height is comparable with the radius (of asteroid) (1) • the field should be considered as radial rather than parallel, so the gravitational field strength is decreasing significantly for the probe (1) OR $g = GM/r^2$ (1) the change in r is comparable with the radius, so there will be a significant change in g • acceleration is less, so the actual height would be less (1)		**(3)**

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