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

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	An explanation that makes reference to the following: • air molecules make collisions with the puck and transfer momentum to the puck (1) • according to Newton's 2nd law the change of momentum creates a force on the puck (1) • the rate of change of momentum by air molecules colliding with bottom of puck is greater than that due to the collisions on the top of the puck (1) • the net (upward) force balances the weight of the puck OR the greater air pressure below the puck allows the puck to be supported. (1)		**(4)**

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>* (b)</td>
<td>
This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded for indicative content.

<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th></tr>
<tr><td>6</td><td>4</td></tr>
</table>
</td>
<td>Guidance on how the mark scheme should be applied: The mark for indicative content should be added to the mark for lines of reasoning. For example, an answer with five indicative marking points which is partially structured with some linkages and lines of reasoning scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning). If there are no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for linkages).</td>
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5 - 4	3
3 - 2	2
1	1
0	0

The following table shows how the marks should be awarded for structure and lines of reasoning.

	Number of marks awarded for structure of answer and sustained line of reasoning
Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkages between points and is unstructured	0

Indicative content:

- applying Newton's 3rd law one puck (A) exerts a force on the other puck (B) and vice versa (1)
- forces equal in magnitude and opposite and direction (1)
- forces act for same time (1)
- $F\Delta t_A = - F\Delta t_B$ (1)
- applying Newton's 2nd law $F\Delta t = \Delta p$ since F is a resultant force on each puck (1)
- total change in momentum = zero, so momentum is conserved OR Δp for one puck = $-\Delta p$ for the other puck, so momentum is conserved (1)

(6)

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)(i)	• resolve velocities to find forward/sideways component (1) • apply principle of conservation of momentum (1) • v = 3.46 m s^{-1} (1)	Example of calculation: Forwards velocity components: $v\cos 30^\circ = 0.866\,v$; $2\cos 60^\circ = 1\,\text{m s}^{-1}$ $4m = m \times 0.866v + m \times 1$ $\therefore v = \frac{(4-1)\,\text{m s}^{-1}}{0.866} = 3.46\,\text{m s}^{-1}$	**(3)**
(c)(ii)	• use $KE = \frac{1}{2}mv^2$ (1) • show that final KE is equal to initial KE (1) • elastic collisions conserve KE, so collision is elastic (1)	Example of calculation: $KE_i = \frac{1}{2}m \times 4^2 = 8m$ $KE_f = \frac{1}{2}m \times 3.46^2 + \frac{1}{2}m \times 2^2$ $= 6m + 2m = 8m$	**(3)**

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(a)	• use of $F = Gm_1m_2/r^2$ (1) • force = 6.5×10^{31} N (1)	Example of calculation $F = 6.67 \times 10^{-11}$ N m^2 kg^{-2} × 29 × 1.99×10^{30} kg × 36 × 1.99×10^{30} kg / $(6.5 \times 10^{10}$ m$)^2$ force = 6.5×10^{31} N	2

Question Number	Acceptable answers	Additional guidance	Mark
(b)	**Either** • use of $F = mv^2/r$ ecf from (a) (1) • use of $v = 2\pi r/T$ (1) • $T = 1.1 \times 10^6$ s (1) **Or** • use of $F = m\omega^2 r$ ecf from (a) (1) • use of $\omega = 2\pi/T$ (1) • $T = 1.1 \times 10^6$ s (1)	Example of calculation $F = mv^2/r = m(2\pi r/T)^2/r$ $T^2 = 4\pi^2 mr/F$ $= 4\pi^2 \times 29 \times 1.99 \times 10^{30}$ kg × 3.6×10^{10} m / 6.5×10^{31} N $= 1.21 \times 10^{12}$ s^2 $T = 1.12 \times 10^6$ s = 18700 min = 312 hours = 13 days	3