Assessment schedule: practice paper 2026

AS 91524 Demonstrate understanding of mechanical systems · Vertex Academy practice paper, not an NZQA paper

QUESTION ONE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$r = 6.79 \times 10^6$ m $g = GM \div r^2 = 3.98 \times 10^{14} \div (6.79 \times 10^6)^2$ $g = 8.64$ N kg^{-1}	$g = 8.64$ N kg^{-1}, with r measured from the Earth's centre.		
(b)	$v^2 = GM \div r = 3.98 \times 10^{14} \div 6.79 \times 10^6$ $v = 7.66 \times 10^3$ m s^{-1}	$v = 7.66 \times 10^3$ m s^{-1}.		
(c)	$T = 2\pi \times 6.79 \times 10^6 \div 7.66 \times 10^3 = 5570$ s T = 92.9 minutes gravity = centripetal force same acceleration	T = 92.9 minutes (5570 s), OR states that the astronauts and station are in free fall.	Period correct AND explains weightlessness: gravity is the centripetal force, all fall with the same acceleration, so there is no support force.	
(d)	top: $mg = mv^2 \div r$ (tension zero) $v = \sqrt{(9.81 \times 0.90)} = 2.97$ m s^{-1} bottom: $T - mg = mv^2 \div r$ $T = 19.6 + 45.0 = 64.6$ N	$v = 2.97$ m s^{-1}, OR the weight 19.6 N with a correct force diagram at the bottom.	$v = 2.97$ m s^{-1} with $mg = mv^2 \div r$, OR T = 64.6 N.	$v = 2.97$ m s^{-1} explained (weight alone gives the centripetal force; slower and the water falls inside the path) AND T = 64.6 N.

QUESTION TWO

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	f = 15 ÷ 60 = 0.25 Hz $\omega = 2\pi \times 0.25 = 1.57$ rad s^{-1} $v = 40 \times 1.57 = 62.8$ m s^{-1}	$\omega = 1.57$ rad s^{-1} AND $v = 62.8$ m s^{-1}.		
(b)	$\alpha = (0 - 1.57) \div 30$ $\alpha = -0.0524$ rad s^{-2}	$\alpha = -0.0524$ rad s^{-2} (or 0.0524 rad s^{-2} slowing down).		

(c)	$\tau = I\alpha = 4.0 \times 10^6 \times 0.0524 = 2.1 \times 10^5$ N m $\theta = (1.57 + 0) \div 2 \times 30 = 23.6$ rad $23.6 \div 2\pi = 3.75$ revolutions	$\tau = 2.1 \times 10^5$ N m, OR $\theta = 23.6$ rad.	$\tau = 2.1 \times 10^5$ N m AND 3.75 revolutions.	
(d)	$I_i = 1.8 + 2 \times 2.0 \times 0.70^2 = 3.76$ kg m² $I_f = 1.8 + 2 \times 2.0 \times 0.15^2 = 1.89$ kg m² $3.76 \times 2.0 = 1.89 \times \omega$ $\omega = 3.98$ rad s⁻¹ Ek: 7.52 J to 15.0 J	Correct rotational inertia before (3.76 kg m²) or after (1.89 kg m²).	$\omega = 3.98$ rad s⁻¹ using conservation of angular momentum (no outside torque).	$\omega = 3.98$ rad s⁻¹ AND both kinetic energies (7.52 J and 15.0 J) AND explains the increase as work done by the arms pulling the weights in.

QUESTION THREE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$T = 2\pi\sqrt{(0.25 \div 40)}$ $T = 0.497$ s	$T = 0.497$ s.		
(b)	$T = 2\pi\sqrt{(2.4 \div 9.81)}$ $T = 3.11$ s	$T = 3.11$ s.		
(c)	$\omega = \sqrt{(40 \div 0.25)} = 12.6$ rad s⁻¹ $v_{max} = 0.060 \times 12.6 = 0.759$ m s⁻¹ $a_{max} = 0.060 \times 160 = 9.6$ m s⁻² F = −ky: zero at equilibrium, largest at the ends	$\omega = 12.6$ rad s⁻¹, OR one of v_{max} or a_{max} correct.	$v_{max} = 0.759$ m s⁻¹ AND $a_{max} = 9.6$ m s⁻² AND where each happens, explained with the restoring force proportional to displacement.	
(d)	$0.030 = 0.060 \cos \omega t$ $\omega t = \pi \div 3 = 1.047$ rad $t = 1.047 \div 12.6 = 0.0828$ s $v = 0.759 \times \sin(\pi \div 3) = 0.657$ m s⁻¹ $T \div 4 = 0.124$ s; $t = T \div 6$	$\omega t = \pi \div 3$ (1.047 rad), OR the period 0.497 s.	$t = 0.0828$ s, OR $v = 0.657$ m s⁻¹, with working in radians.	$t = 0.0828$ s AND $v = 0.657$ m s⁻¹ AND explains that it is slow near the extreme so the first half of the distance takes $T \div 6$ of the $T \div 4$.

Judgement for each question

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a.	2a, or 1m.	3a, or 1a and 1m.	4a, or 2a and 1m.	2m, or 1e.	2a and 2m, or 1m and 1e.	1e and 1m, with a minor error or omission elsewhere.	2a, 1m and 1e: every part correct.

Grade score out of 24 (each question's grade: N0 = 0 to E8 = 8): Not Achieved 0 to 6, Achieved 7 to 12, Merit 13 to 18, Excellence 19 to 24 (the 2025 exam's cut scores).