A Level AQA Physics

6 Force, energy, and momentum 1 – answers

OXFORD Revise

Question	Answers	Extra information	Mark	AO	Spec. reference
01.1	$W = mg$ and $F = ma$ $mg = ma$ and masses cancel (or doubling mass doubles force required to accelerate, but also doubles the force exerted)	Allow gravitational mass and inertial mass are the same	1 1	1	3.4.1.5
01.2	$36 \times \frac{1}{29.97} = 1.201\,\text{s}$		1	2	MS0.3
01.3	Use of $s = ut + \frac{1}{2}at^2$ **and** $u = 0$ $g = 2\frac{s}{t^2}$ $g = 2 \times \frac{1.2}{1.201^2} = 1.66\,\text{m s}^{-2}$		1 1	1 2	3.4.1.3
01.4	Vertical velocity = $50 \sin 35° = 28.7\,\text{m s}^{-1}$ Horizontal velocity = $50 \cos 35° = 41.0\,\text{m s}^{-1}$		1 1	2	3.4.1.1
01.5	$u = -28.7\,\text{m s}^{-1}$, $v = 0$, $a = 1.66\,\text{m s}^{-2}$ and use of $v = u + at$ $t = \frac{28.7}{1.66} = 17.3\,\text{s}$ Total time = $2 \times 17.3 = 35\,\text{s}$ (34.6) **OR** $28.7 = -28.7 + (1.66 \times t)$	Allow e.c.f. for initial vertical velocity Using 1.7 gives 34 s Allow any suitable *suvat* equation	1 1	2	3.4.1.4
01.6	Distance = $41.0 \times 35\,\text{s} = 1440\,\text{m}$ which is less than one mile	Allow e.c.f. here	1 1	2	3.4.1.4
02.1	Use of $s = ut + \frac{1}{2}at^2$ **and** $u = 0$ $g = 2 \times \frac{s}{t^2}$ $g = 2 \times \frac{0.45}{0.32^2} = 8.8\,(8.79)\,\text{m s}^{-2}$		1 1	1 2	3.4.1.3

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02.2	Any one from: • can identify anomalies • check if results repeatable • check precision of data • shows that g constant for different heights	Not simply more accurate	1	3	3.1.2
02.3	Suitable line of best fit drawn Large triangle or coordinates seen on graph Gradient = 4.9 ± 0.1		1 1 1	2	MS3.4
02.4	Use of $s = ut + \frac{1}{2}at^2$ **and** $u = 0$ or $s = \frac{1}{2}gt^2$ Gradient = $\frac{1}{2}g$ $g = 2 \times 4.9 = 9.8\ \text{m s}^{-2}$	Must use the gradient to gain marks Allow e.c.f. from answer to **02.3** Range = 9.6 to 10	1 1 1	1 2	4.1.3
02.5	Any one from: • ball not released quickly • centre of ball not falling through light gates • parallax errors when measuring distance between light gates • ball falling before reaching first light gate so u not equal to 0	Any sensible suggestion	1	3	3.1.2.
03.1	Points plotted correctly (within $\pm\frac{1}{2}$ square) Smooth curve line of best fit drawn	Lose mark for one mistake	1 1	2	MS 3.2
03.2	Tangent on slope within first 3 seconds Gradient = $\frac{24 - 0}{18} = 1.3\ \text{m s}^{-2}$	No marks if values from table used (allow between 0.8 and 1.9)	1 1	3	MS 3.6 and 7
03.3	Thrust = $ma + mg$ = 140 000 $(a + g)$ = 1.6×10^6 N OR $W = mg$ = 140 000 kg × 9.81 = 1 373 400 N $F = ma$ = 182 000 N Thrust = 1 373 400 N + 182 000 N = 1.6×10^6 N	Possible e.c.f. from answer to **03.2** (for both marks)	1 1	2	3.4.1.5

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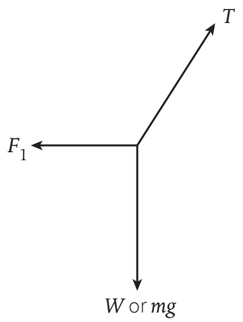
03.4	Attempt to measure area Counting squares and conversion Distance = 104 m ± 5 m	Approximating area with shapes 2 marks max	1 1	3	MS 3.8
03.5	Acceleration increasing Mass decreasing as fuel burnt		1 1	3	3.4.1.3
04.1	(sum of) clockwise moments (about a point) = (sum of) anticlockwise moments (about a point) in equilibrium		1 1	1	3.4.1.2
04.2	Clockwise moments = (0.150 × 18) + (35 × 0.360) F × 0.032 = (0.150 × 18) + (35 × 0.360) F = 480 N (478 N)	Either clockwise moment correct for 1 mark	1 1	2	3.4.1.2
04.3	F must decrease because **perpendicular distance** between biceps and weight in hand decreases	Idea of perpendicular distance needed for mark	1 1	3	3.4.1.2
04.4	$\sigma = \dfrac{F}{A}$ and $A = 22.7\times10^{-6}\ \text{m}^2$ $F = 32.5\times10^{6} \times 22.7\times10^{-6} = 740\ \text{N}$		1 1	2	3.4.2.2
05.1		Arrows must be labelled	1 1 1	2	3.4.1.5

A Level AQA Physics
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05.2	Use of correct vector triangle and solving for F_1 Correct vector triangle drawn and angle and side identified (should find $\tan\theta = \frac{F_1}{mg}$) Use of trig to find F_1 OR $T\cos\theta = mg$ or $T\sin\theta = F_1$ $\frac{T\sin\theta}{T\cos\theta} = \frac{f_1}{mg}$ $\tan\theta = \frac{F_1}{mg}$ $F_1 = \tan 30 \times 20 \times 9.81 = 110\,\text{N}\ (113\,\text{N})$		max 3 1 1 1	2	
05.3	Acceleration proportional to displacement Always in the opposite direction OR $a \propto -x$ (terms defined)		1 1	1	3.6.1.2
05.4	$T = 2\pi\sqrt{\frac{l}{g}} = 2.2\,\text{s}$		1	2	3.6.1.3
05.5	Cosine graph (negative or positive) Correct max amplitude and then decreasing amplitude At least two cycles shown		1 1 1	2	3.6.1.3
06.1	The vertical velocity is independent of the horizontal velocity Vertical velocity accelerated downwards by g Horizontal velocity constant		1 1 1	3	3.4.1.4
06.2	Use of $s = ut + \frac{1}{2}at^2$ **and** $u = 0$ $a = 2\frac{s}{t^2} = 2 \times \frac{1.50}{4.20^2} = 0.17\,\text{m}\,\text{s}^{-2}$		1 1	1 2	3.4.1.4

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06.3	$F = ma = 0.180 \times 0.17 = 0.031$ N	If 0.2 used, get 0.036	1	2	3.4.1.5
06.4	Resultant force = $F = mg$ – lift Lift = $mg - F = (0.180 \times 9.81) - 0.031$ N Lift = 1.73 N		1 1	2	3.4.1.5
07.1	$W = mg = 2.5 \times 9.81 = 25$ N (or 24.5 N) Labelled arrow drawn from centre of shelf		1 1	2	3.4.1.2
07.2	Arrow drawn upwards from point of contact of shelf and wall Line of action of arrow should cross through tension and weight		1 1	2	3.4.1.1
07.3	$0.20 \times 25\text{ N} = T \sin 50 \times 0.40$ $T = 0.2 \times \frac{25}{\sin 50} \times 0.4 = 16$ N	Either moment identified gains mark	1 1	2	3.4.1.2
07.4	The perpendicular distance to the tension would decrease but it still has to balance the same moment from the weight The tension would increase		1 1	3	3.4.1.2
08.1	Distance is a scalar quantity and has magnitude only Displacement is a vector and has both magnitude and direction	Need definition of vector/scalar stated or implied by description	1 1	1	3.4.1.1
08.2	125 m North of original position		1 1	2	3.4.1.1
08.3	Horizontal line for 25 seconds and negative horizontal line for further 45 seconds Appropriate scale, e.g., velocity for first 25 seconds = $\frac{325}{25} = 13\text{ m s}^{-1}$ velocity for remaining 45 seconds = $\frac{-450}{40} = -10\text{ m s}^{-1}$		1 1 1	3	3.4.1.3

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08.4	Vertical line when the velocity changes direction suggests infinite acceleration (or wtte), which is impossible	owtte	1	3	3.4.1.3

Skills box answers

Question	Answer
1(a)	mean values for t are: 0.64, 0.57, 0.49, 0.46, 0.40, 0.38
1(b)	gradient of graph = 4.8 m s^{-2}, so g = 9.6 m s^{-2}
2	A sheet of paper has a larger area than a tennis ball and so will experience greater air resistance – an upward force – than the ball at the same speed. However, it has a much lower mass than the tennis ball, so the force acting downwards on it – its weight – will be much less. Therefore, the resultant force acting downwards on the piece of paper is much smaller than that on the tennis ball, so it will not be accelerated as much.
3	The value for g is lower due to the lower mass of the Moon, and therefore the ball will take longer to fall through the same distance.