

# **ASSESSMENT SCHEDULE**

**Physics Level 2**

91171 Demonstrate understanding of mechanics

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

* the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging.
* the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

### Evidence Statement

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| One(a) | Total weight = 5300 + 950 = 6250 N$$m=\frac{F\_{W}}{g}=\frac{6250}{9.8}=637.755=638 kg$$ | Correct working and answer. |  |  |
| (b) | When the moose is in equilibrium, the clockwise torques equal the anticlockwise torques, and the net force is zero. | Balanced torques or balanced forces. | Balanced torques and balanced forces. |  |
| (c) | Taking the front foot as the pivot pointClockwise torques are provided by the body weight.$τ\_{clockwise}=Fd$ = 5300 × 0.85=4505 NmAnticlockwise torques are provided by the weight of the head and the force of the back legs. $τ\_{anticlockwise}$= 950 × 0.95 + $F\_{back}$×1.9 =902.5 + $F\_{back}$×1.94505=902.5 + $F\_{back}$×1.9$F\_{back}$=$\frac{3602.5}{1.9}$=1896 N = 1900 N (2 s.f.) | Calculates two torques around incorrect pivot.ORCalculates ONE correct torque. | Correct working for all torques. | Correct working and answer. |
| (d) | Forces up = forces down1896+$F\_{front}$=6250 $F\_{front}$=4354=4400 N (2 s.f.) The front legs exert a larger force than the back legs.This is because around the pivot of the back legs, both the head and body of the moose produce large anticlockwise torques as the distance from the back legs is large. Both of these torques must be balanced by the torque from the front legs, as this is the only clockwise torque and so must provide a large force to balance the torques. However, if the front legs are taken as the pivot, the head produces a clockwise torque while the body produces an anticlockwise torque. Therefore, the torque from the back legs only needs to balance the difference in torques from the head and body, neither of which is particularly large as they are close to the pivot, i.e. the front legs.Therefore the force from the front legs must be larger than the force from the back legs. | Shows calculations for front legs.ORMentions Ffront larger as most of the mass at the front. | Describes relative size of EITHER front or back legs using the idea of torques. | Full and complete explanation. |
| (e) | p=mv$v=\frac{p}{m}=\frac{7840}{650}=12.06=12.1$ms-1 | Correct working and answer. |  |  |
| (f) | pinitial=pfinal7840=2590+pmoosepmoose=7840-2590=5250 kg m s-1$v=\frac{p}{m}=\frac{5250}{540}=9.722=9.72 $ms-1 | Attempts to use conservation of momentum. | Correct working for momentum of moose. | Correct working and answer. |
| (g) | The force acting on the moose is the same as the force acting on the car. As described by Newton’s third law, which states the force of A acting on B, is equal to the force of B acting on A.  | The same. | The sameANDDescription of Newton’s third law. |  |

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| One(h) | When the car hits the bear, the change in momentum of the car occurs over a longer period of time than if the moose hits the car. This is because the bear will cause the bonnet of the car to crumple, making the time of the collision longer, whereas the moose will hit the windscreen the windscreen does not crumple, so the collision time is less.The change in momentum is equal to the average force multiplied by the time of the collision:$∆p=F∆t$.Both collisions have the same change in momentum. The bear’s collision has a longer time than the moose’s collision, so the bear’s collision has a smaller force than the moose’s collision.  | Bear’s collision has a smaller force because the collision is over a longer distance. | Bear’s collision has a smaller force because the collision is over a longer time. | Bear’s collision has a smaller force because the collision is over a longer time.ANDMentions that the change in momentum is the same. |

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| Two(a) | $$v\_{f}=v\_{i}+at$$$a=\frac{v\_{f}-v\_{i}}{t}=\frac{6.8-1.3}{5}=1.1$m s-1 | Correct working and answer. |  |  |
| (b) | $$E\_{Ki}=\frac{1}{2}mv\_{i}^{2}=\frac{1}{2}×520×1.3^{2}=439.4J$$$$E\_{Kf}=\frac{1}{2}mv\_{f}^{2}=\frac{1}{2}×520×6.8^{2}=12022.4J$$$$∆E=12022.4-439.4=11583J$$$$P=\frac{∆E}{t}=\frac{11583}{5}=2316.6=2300 W (2 s.f.)$$ | Two correct kinetic energies.ORUses power equation correctly using one kinetic energy value rather than the change. | Correct working and answer. |  |
| (c) | $v=\sqrt{6.8^{2}+5.5^{2}}=8.7459=8.7$ m s-1Angle from horizontal$$\tan(θ)=\frac{5.5}{6.8}$$$$θ=tan^{-1}\frac{5.5}{6.8}=38.967°=39°$$ | Correct speed. | Correct speed and direction. |  |
| (d) |  Gravity/Weight | Correct answer. |  |  |
| (e) | The horizontal component of velocity remains constant because there is no horizontal force acting on the horse. The vertical component is upwards at first, and is decreasing, going to zero at the top, then the component goes downwards and increases. This is due to the force of gravity acting downwards. | States that the horizontal component stays the same and the vertical component changes. | The vertical component changes because of gravity.ORStates that the horizontal component stays the same because there are no horizontal forces. | States that the horizontal component stays the same because there are no horizontal forces.ANDThe vertical component changes because of gravity. |
| (f) | Vertical components for the upwards part:$$v\_{f}=v\_{i}+at$$$$t=\frac{v\_{f}-v\_{i}}{a}=\frac{0-5.5}{-9.8}=0.56122$$Total time $t=0.56122×2=1.12244$sHorizontal components:$∆d=v∆t=6.8×1.12244=7.632=7.6$ m | Attempts to calculate time in the air with minor problem (e.g. not doubling, using incorrect velocity component). | Correct working but does not multiply time or distance by two. | Correct working and answer. |

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| Three(a) | $a\_{c}=\frac{v^{2}}{r}=\frac{3.3^{2}}{22}=0.495=0.50$ ms-2 | Correct working and answer. |  |  |
| (b) |  V a  | Correct velocity OR acceleration vector. | BOTH vectors correct and labelled. |  |
| (c) | Acceleration is the change in velocity divided by the change in time $a=\frac{Δv}{Δt}$. The gannet’s speed is not changing, but since velocity is speed with direction, and the gannet is constantly changing its direction, its velocity is changing. Therefore the gannet is accelerating. | Correct definition of acceleration with words or equation.ORStatement that the gannet is accelerating because the direction is changing. | Statement that the gannet is accelerating because the direction is changingAND (Definition of accelerationORVelocity is speed + direction). | Statement that the gannet is accelerating because the direction is changingAND Definition of accelerationANDVelocity is speed + direction. |
| (d) | Force from the waterWeight/gravity | Weight down and an upwards force. | Correct diagram. |  |
| (e) | Before the gannet hits the water the only force on it is its weight. When it hits the water there is a resistance force from the water which acts upwards against the motion of the gannet. This force is initially larger than the weight as it decreases the downwards velocity so a net upwards force must be present (Newton 2nd Law).  | Idea that the water makes the forces unbalanced, causing the gannet to slow down.  | Idea that the water makes the forces unbalanced, causing the gannet to slow down.AND The water resistance force is greater than the gravity force. |  |

**Judgement Statement**

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| **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| 10 AME | 12AME incl 7ME | 13 AME incl 8ME of which 3E  |