Assessment Schedule – 2017

Science: Demonstrate understanding of aspects of mechanics (90940)

Evidence Statement

<table>
<tr><th>Q</th><th>Evidence</th><th>Achievement</th><th>Merit</th><th>Excellence</th></tr>
<tr>
<td>ONE
(a)</td>
<td>Sam accelerates at $0.8\ \text{m s}^{-2}$ for 10 seconds, reaching a speed of $8\ \text{m s}^{-1}$. Stays at constant speed of $8\ \text{m s}^{-1}$ for next 50 seconds.
Dani accelerates at $0.35\ \text{m s}^{-2}$ for 20 seconds, reaching a constant speed of $7\ \text{m s}^{-1}$. Stays at constant speed of $7\ \text{m s}^{-1}$ for next 40 seconds.
Comparison: Sam has a greater acceleration during first 10 seconds, but does not accelerate for as long as Dani. Between 20 and 60 seconds, neither accelerated; they both had a constant speed. Sam had a higher constant speed during this time.
<table>
<tr><th></th><th>Speed</th><th>Acceleration</th></tr>
<tr><td>Sam</td><td>First 10 s: increasing speed / accelerating to
$\bar{v} = 8\ \text{m s}^{-1}$

10–60 s:
Constant speed of
$v = 8\ \text{m s}^{-1}$</td><td>First 10 s:
$a = 0.8\ \text{m s}^{-2}$

10–60 s:
$a = 0\ \text{m s}^{-2}$</td></tr>
<tr><td>Dani</td><td>First 20 s:
increasing speed / accelerating to
$\bar{v} = 7\ \text{m s}^{-1}$

20–60 s:
Constant speed of
$v = 7\ \text{m s}^{-1}$</td><td>First 20 s:
$a = \frac{7}{20} = 0.35\ \text{m s}^{-2}$

20–60 s:
$a = 0\ \text{m s}^{-2}$</td></tr>
</table>
</td>
<td>• Correct statement / calculation for Sam and Dani.
ie
Correct statement about speed.
OR
Correct working and answer for average speed.
OR
Correct statement about acceleration.

NB No Justification</td>
<td>• Correct statement comparing speed with justification from graph for Sam and Dani
OR
Correct statement comparing acceleration with justification from graph for Sam and Dani
OR
Two cells correct either horizontally or vertically.
(see evidence)

NB Justification means words, values from graph, or calculations</td>
<td></td>
</tr>
</table>

(b)	$a = \frac{\Delta v}{\Delta t} = \frac{8-0}{10} = 0.8 \text{ m s}^{-2}$ $F = ma = 308 \times 0.8 = 246.4 \text{ N}$ $W = Fd = 246.4 \times 40 = 9\,856 \text{ J}$	• One calculation step,	• Two steps, i.e. correct calculation of force OR work calculated with an incorrect value of acceleration *(Working required but ignore unit.)*	
(c)	Work is proportional to the force applied (weight force) and the distance travelled. OR $W = F \times d$ (formula or words) OR work is needed to transfer energy, as new jockey has more mass and weight, more energy transferred therefore more work done. Power is the work completed over the time taken. OR $P = \frac{W}{t}$ Therefore, the new jockey with an increased weight / force makes the horse do more work, and if the horse completes the race in the same time it would have more power because power is measured by dividing work by time.	• States with new heavier jockey the horse does more work .	• **Links** relationship between mass / weight force, and work. *(ie all increase)*	• **Explains** relationship between mass / weight (force), work, and power since time and distance stay the same.
(d)	Distance = area under graph. $d \text{ (Dani)} = \left(\frac{1}{2} \times 7 \times 20\right) + (7 \times 40) + \left(\frac{1}{2} \times 5 \times 30\right) + (30 \times 7) = 635 \text{ m}$ Difference = 710 – 635 = 75 m Therefore, Sam and his horse are 75 m ahead of Dani and her horse.	• Calculates a correct distance under the graph for any part of Dani's journey (usually on graph).	• Correct calculation of distance for Dani in 90 s. OR Makes a correct comparison after an error in calculation *(Correct comparison from their calculation.)*	• Shows Sam is 75 m ahead of Dani after 90 s using calculations. (Area under graph at 90 s; Sam = 710 m, Dani = 635 m calculated.) *(Minor error can occur but have to end up with correct conclusion.* *E.g. Sam is 75 m ahead of Dani.)* ***OMI*: One Minor error ignored***.

Not Achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	1 correct idea. E.g. correct use of formula.	1 point	2 points.	3 points.	3 points.	4 points.	2 points with minor error in one point.	2 points.

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO (a)	Weight is the downward force due to gravity that an object experiences due to its mass, while mass is a measure of the amount of matter that an object has. OR mass is the amount of matter / stuff / molecules in an object, while weight is the force due to gravity. Mass does not change when location changes while weight does; (explaining) $F_w = m \times g$ $= 9.90 \text{ kg} \times 10$ $= 99 \text{ N}$	• Defines mass. OR Defines weight. • Calculates weight.	• Uses the waka ama as an example to explain the difference between mass and weight, including the calculation of weight. *(The calculation uses the waka ama as an example)*	
(b)	Surface area of large hull = $6.55 \times 0.40 = 2.62 \text{ m}^2$ Surface area of small hull = $4.00 \times 0.15 = 0.60 \text{ m}^2$ Total surface area of BOTH hulls = $2.62 + 0.60 = 3.22 \text{ m}^2$ Weight of waka ama: $F = m \times g = 9.90 \times 10 = 99$ N $P = \frac{F}{A} = \frac{99}{3.22} = 30.7$ Pa (N / m or N m^{-2})	• Calculates the area of one of the hulls correctly. OR Substitutes into pressure formula correctly.	• Calculates the pressure for the waka ama correctly, but uses one hull instead of two.	• Correctly calculates area and then pressure. *(Unit minor error)*
(c)	Weight of waka ama and paddler: $F = m \times g = 76.9 \times 10 = 769$ N $P = \frac{F}{A} = \frac{769}{3.22} = 238.8$ Pa (N / m or N m^{-2}) Sinking into the water depends on pressure – the greater the pressure, the further the waka ama sinks. $P = \frac{F}{A}$ A 'lighter' waka ama will have less weight force than a 'heavier' waka ama. In this example, the waka ama has the same area but a greater weight when the paddler is in the canoe, so the waka ama sinks deeper into the water because the pressure has increased.	• States that there is an increase in pressure. OR Calculates weight. • States that the waka ama with paddler has more weight force.	• Explains that the waka ama with paddler on has more mass, therefore more weight force, therefore more pressure (or vice versa for the one without).	• Compares the calculated weight of the waka ama with calculated weight of waka ama and paddler, to explain why the paddler with a **greater weight** (force) and therefore **more pressure**, **sinks further** into the water since the **area stays the same.**

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	1 correct idea. E.g. correct use of formula.	2 points	3 points	4 points	2 points.	3 points.	2 points with minor error in one point (e.g. unit).	2 points.

Q	**Evidence**	**Achievement**	**Merit**	**Excellence**
THREE (a)(i)	$W = F \times d = 60\ 000 \times 30 = 1\ 800\ 000$ J	• Calculates work. OR Calculates power with incorrect work. (*No unit required.*)	• Calculates power correctly. (*Unit required for Power.* *Working required)*	
(ii)	$P = \frac{W}{t} = \frac{1800000}{15} = 120000$ W or 120kW			
(b)	Work is done when a force causes a load to move in a direction of the force. The force is not causing the object to move, so no work is being done. (No distance travelled in the direction of the force.)	• Identifies that there is no work being done.	• Explains that there is no motion (distance), and as $W = Fd$, there is no work being done.	
(c)	A net force is the resultant (overall / total / sum of) force on an object (when multiple forces interact). Net forces determine whether the container is accelerating, decelerating, or maintaining constant speed. If the net force is pointing in the same direction as the direction of motion, the object accelerates. If the net force is pointing in the opposite direction to the direction of motion, the container decelerates. If there is no net force, the container has constant speed or is stationary. The container is speeding up, so is accelerating. An unbalanced force is required to make an object's speed change, therefore, as there is an unbalanced force, the speed will increase, and the net (vertical) force is in the same direction as the motion of the container.	• Describes net force. OR That forces are balanced (the net force is zero) when moving at a constant speed. OR Forces are unbalanced (the net force is not zero) (or there is a negative net force) when slowing down. OR Container accelerates / speeds up OR Downward force is larger	• Explains that **unbalanced** forces lead to a **change in speed.**	• In the diagram the forces are **unbalanced**, with the net force being **downward** which causes an increase in speed / **acceleration**.

(d)	Explanation of energy difference: At the top, the container has a certain amount of gravitational potential energy and no kinetic energy. Just before the container hits the ground, the gravitational potential energy has been converted into kinetic energy. E_P calculation: $E_P = mgh = 6500 \times 10 \times 15 = 975\,000$ J Difference between E_P and E_K: $= 975\,000 - 970\,000 = 5\,000$ J Energy loss: Some kinetic energy is lost as heat energy, due to the frictional force of air resistance.	• Calculates E_P. • Identifies gravitational potential energy being present when the container is hanging. • Recognises that the Potential energy is converted to kinetic energy • Identifies energy lost as heat or sound.	• Calculates E_P and the difference in energy (unit not required). • Shows understanding of concepts and principles of energy conservation, explaining the "missing" energy is loss due to friction with the air / air resistance OR lost as heat (sound).	• Calculates E_P and the difference in energy correctly (no unit OMI). AND Connects the justification for the difference in energy between the top and bottom positions with the relevant physics principles, discussing **frictional forces** due to air resistance causing energy loss as heat.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or no relevant evidence.	1 correct idea. E.g. correct use of formula.	2 points	3 points	4 points	3points.	4points	2 points with minor error in one point.	2 points.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 18	19 – 24