Science Mastery

P3.1 Mastery Quiz: Acceleration

Mark Scheme

Section A

Qu	Answer	Marks	Supporting information for fix-it tasks
1	B	1	Answering A or C shows a gap in knowledge about examples of vector and scalar quantities. *To fix it, reteach the difference between vectors and scalars and then give lots of quantities for students to sort into those two columns.*
2	A	1	Answering B shows a misconception that acceleration is an increase in speed. *To fix it, recap the definition of acceleration and then ask students to explain why acceleration is not just a change in speed.* Answering C shows that they have understood that acceleration is a vector quantity so involves a direction but that it does not necessarily have to be a change in direction to be acceleration. *Ask students to write their own definition for acceleration using the terms: speed and direction.*
3	B	1	Answering A shows a confusion with Newton's first law. *To fix it, reteach Newton's first and third laws and then ask students to write their own descriptions for each.* Answering C is shows a common misconception that stationary objects have no forces acting on them. *To fix it, ask students to describe the forces acting on a water bottle that is stationary on a table.*
4a	B	1	Answering A shows that students have correctly identified the direction of the resultant force but have not applied Newton's first law correctly – if an unbalanced force acts on an object, the object will accelerate in the direction of the resultant force. *To fix it, students may need further support to understand the difference between constant speed and acceleration.* Answering C shows that pupils have not understood that there is a resultant force and therefore have not applied Newton's first law. *To fix it, reteach Newton's first law and then ask students to explain why this object will not remain stationary in this example.*
4b	B	1	Answering A shows that students have understood that objects at constant speed will continue at that constant speed in the same direction but have not identified that this is an example of an unbalanced/non-zero resultant force.

			Answering C shows that pupils have identified the resultant force and its direction but not taken into account the original direction of the object. *To fix it, show students different scenarios, some stationary and some with constant speed in different directions and balanced or unbalanced forces to practice determining the resulting motion.*
5a	B	1	Answering A suggests that students have incorrectly applied the gradient rule from distance-time graphs and assumed that a lower gradient means a slower speed. *To fix it, ask students to explain why the acceleration is greater at 10-20 seconds as compared to 30-40 seconds.* Answering C suggests that students have confused velocity-time graphs with distance-time graphs and incorrectly identified a horizontal line as stationary. *To fix it, ask students to describe what a horizontal line represents in a D-T and a V-T graphs.*
5b	A	1	Answering B shows that pupils have confused the graph with a distance-time graph where it would be returning to its original position. It could not be travelling in the opposite direction unless it had a negative velocity (in the negative Y-axis), which pupils may need a reminder of. Answering C shows that pupils have identified relative gradients but misinterpreted this as speed rather than acceleration. *Pupils may find it useful to annotate a velocity time graph with the motion at each stage and calculate any possible values.*
5c	B	1	Answering A shows that students have just done the calculation of 10 x 30, which is the maximum velocity and the total time period, rather than the area under the graph. *To fix it, practice calculating area under the graph, particularly with different shapes (triangles/rectangles), although they are not expected to calculate area under a curve (i.e. where there is changing acceleration).* Answering C shows that pupils have calculated the total area under the graph, rather than just the first 30 seconds. This could be a case of pupils scanning questions too quickly. *To fix it, model how to underline/highlight the key information in a question and then ask students to underline the key information in all the questions.*
5d	A	1	Answering B shows that pupils have correctly used the gradient to calculate the acceleration but have given the SI unit for speed/velocity rather than acceleration. *To*

			fix it, ask students to write out the SI units for: speed, acceleration, distance, time, mass, weight. Answering C shows that pupils have used the correct unit for acceleration but have incorrectly calculated gradient as change in x/change in y. *To fix it, model how to calculate the acceleration for this question and then ask students to calculate the acceleration from 10-20 seconds showing their workings.* Answering D shows they have incorrectly calculated the gradient and chosen the incorrect unit. *To fix it model how to calculate the acceleration for this question and then ask students to write out how to calculate acceleration and to state the units.*
6	A	1	Answering B or C suggests a gap in knowledge about what the quantities in this equation are. *Reteach this equation and ask students to copy it in books, annotating what each part is.*
7	B	1	Answering A shows some understanding of the importance of using the correct equipment for accuracy, but it is not the cause of the anomaly. *To fix it, ask students to explain why option B could cause an anomaly. Then ask students to suggest an explanation if the anomaly was a much higher number.* Answering C suggests a gap in knowledge about what an anomaly is. *To fix it, model why the circled reading is indeed anomalous. Then ask students to explain why the circled anomaly should be excluded from the mean calculation.*
8	C	1	Answering A or B suggests a gap in knowledge about how to calculate acceleration. *To fix it, reteach how to calculate acceleration using a worked example and then ask students to answer other practice questions.*
9	B	1	Answering A shows that pupils know gradient is the change in x and y but have got these the wrong way round. Answering C or D shows that pupils do not understand how to work out the gradient of a specific part of a line rather than an average value for the whole graph. *To fix it, ask students to calculate the gradient of practice graphs, explicitly including the step change in y/change in x each time.*
10	C	1	Answering A suggests that students have understood that forces at right angles (or less) will produce a larger resultant force, but not that it will be smaller than if the forces were acting in the same direction. Answering B shows that students have not applied their knowledge to see that 180° means that forces would be acting in opposite directions and therefore would be

			subtracted from each other, making the minimum resultant force. *To fix it, students may find it useful to be given 2 forces and calculate the resultant in each case to show mathematically that forces acting in the same direction would cause the greatest resultant force because they would be added together.*
11	D	1	Answering A suggests that students have used the correct final velocity and the correct time but have not understood that 'rest' indicates an initial velocity of 0. Answering B suggests that students have incorrectly substituted the values for time and final velocity but have noticed that the initial velocity is 0. Answering C suggests that students have identified that rest is 0 m/s but incorrectly used this as final velocity rather than initial velocity. *To fix it, students may find it useful to be given calculation questions and highlight initial/final velocities, times and accelerations in different colours or underlined/circled etc to ensure that they substitute values into the correct place.*

Section B

Qu	Model answer	Supporting information ***Suggestions for fix-it tasks***
1	distance, speed, mass or energy	Students may confuse scalars and vectors. *To fix it, reteach the difference between vectors and scalars and then give lots of quantities for students to sort into those two columns.*
2	Displacement is how far an object is from its original position or from a point of reference in a given direction.	A common error here is to not include the 'given direction' part of the definition. *To fix it, reteach the difference between displacement and direction and ask students why 2.4 km North is a measure of displacement and not distance.*
3	An object moving in a circle at constant speed is accelerating because acceleration is the change in speed or direction. This means that the object is accelerating because it is constantly changing direction.	A common misconception about acceleration is that it just refers to increasing speed, however it also includes changes in direction. *Using the information from this question, ask students to write their own definition for acceleration.*

4	See the graph below	This is a useful activity to identify which parts of a V-T graph students cannot deduce information about speed/acceleration. The most common error is to confuse the conventions of straight lines, gradients, and curves with that of D-T graphs. *To fix it, recap in a table what straight lines, gradients, and curves represent in D-T and V-T graphs and then ask students to annotate what is happening at each part of the graph in Q5.*