Mechanics Level 2 Equation Test

The formulae listed in the explanatory notes to the achievement standard will be provided, plus any other required formulae ($g = 9.8\ ms^{-2}\ (Nkg^{-1})$).

1. A 5 kg mass hangs from a spring extending the spring by 0.50 m. What is the spring constant of the spring?

2. If a rifle of mass 7 kg fires a bullet of mass 8 g at a speed 210 m s^{-1}, what is the rifle's initial recoil velocity?

3. A train of mass 5000 kg moves at a speed of 30 ms^{-1} on a horizontal surface. Calculate the kinetic energy of the train.

4. A resultant force of 4 N is applied to a body of mass 2 kg for 1 second. What is the acceleration of the body?

5. An airplane has a maximum acceleration on the ground of 3.4 ms^{-2}. What is the minimum length of runway needed if it is to reach its take-off speed of 110 ms^{-1}?

6. A 4 kg mass travels at 5 ms^{-1} to the right. It collides with a 3 kg mass travelling at 6 ms^{-1} to the left. After the collision, the 3 kg mass moves off to the right at 2 ms^{-1}. Use the law of conservation of momentum to work out the final speed of the 4 kg mass.

7. A student whirls a stone around on the end of a string in a horizontal circle. The stone rotates round at 10 times each second. What is the time period of the stone's rotation?

8. An arrow, in being fired from a bow, is accelerated over a distance of 0.40 m and leaves the bow with a velocity of 40 ms^{-1}. What is the acceleration of the arrow while being fired?

9. A bullet is fired horizontally from a gun held 1.4 m above the ground on the Canterbury plains. If the bullet leaves the gun with a velocity of 300 ms^{-1} at what distance from the gun will the bullet strike the ground?

10. A stone of mass 0.20 kg on the end of a piece of string is whirled in a horizontal circle of radius 1.0 m with a constant speed of 2.4 ms^{-1}. What is the tension in the string?

11. A train travelling at 10 ms^{-1} increases its speed uniformly to 25 ms^{-1} in 3 s. Find its acceleration.

12. A diving bell is lowered into the sea at a speed of 6 ms^{-1} and comes to rest with uniform retardation at a distance of 20 m below the surface. Calculate the time it takes to come to rest.

13. A ball is thrown upwards with an initial velocity of 30 ms^{-1}. Find the time taken for the ball to return to its starting point (take $g = 10\ ms^{-2}$)

14. A heavy rubber ball of mass 0.2 kg, initially at rest, falls vertically through a height of 3.2 m on to a flat, heavy, steel plate. Assuming negligible air resistance, calculate the speed of the ball just before impact.

15. When a bullet with mass 0.015 kg travelling at 650 ms^{-1} passes clean through a wooden block of mass 1.2 kg, initially at rest, the block moves off at 4 ms^{-1} immediately after the bullet has passed through it. What is the bullet's final speed?