Mechanics Level 2 Equation Test Answers

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?

$F = ma$
$F = -kx$

98 **Nm^{-1}**

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?

$p = mv$ **0.24** **ms^{-1}**

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.

$E_k = \frac{1}{2} mv^2$ **2.25×10^6** **J**

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?

$F = ma$ **2** **ms^{-2}**

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}?

$v_f^2 = v_i^2 + 2ad$ **1779** **m**

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.

$p = mv$ **1** **ms^{-1} to the left**

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?

$f = \frac{1}{T}$ **0.1** **s**

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?

$v_f^2 = v_i^2 + 2ad$ **2000** **ms^{-2}**

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?

$$d = v_i t + \tfrac{1}{2} a t^2$$ **160** **m**

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?

$$F_c = \frac{mv^2}{r}$$ **1.2** **N**

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

$$v_f = v_i + at$$ **5** **ms^{-1}**

12. A diving bell is lowered into the sea at a speed of 6.00 ms^{-1} and comes to rest with uniform retardation at a distance of 20.0 m below the surface. Calculate the time it takes to come to rest.

$$d = \frac{v_i + v_f}{2} t$$ **6.67** **s**

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})

$$v_f = v_i + at$$ **6** **s**

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.

$$\Delta E_p = mg\Delta h$$
$$E_k = \tfrac{1}{2} mv^2$$ **7.9** **ms^{-1}**

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?

$$p = mv$$ **330** **ms^{-1}**