

## USING EQUATIONS TEST 5

For the following questions you will be given credit for writing down the equation(s) used, the final answer and the correct S.I. units.

1. A mass A of 6 kg moving with a velocity of  $5 \text{ ms}^{-1}$  collides with a mass B of 8 kg moving in the opposite direction at  $3 \text{ ms}^{-1}$ . Calculate the final velocity if the masses stick together on impact.  $p = mv$   $0.43 \text{ ms}^{-1}$
2. A train travelling at  $10 \text{ ms}^{-1}$  increases its speed uniformly to  $25 \text{ ms}^{-1}$  in 3 s. Find its acceleration.  $v_f = v_i + at$   $5 \text{ ms}^{-1}$
3. A diving bell is lowered into the sea at a speed of  $6 \text{ ms}^{-1}$  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.  $v_f^2 = v_i^2 + 2ad$ ,  $v_f = v_i + at$   $6.67 \text{ s}$
4. A car travelling at  $5 \text{ ms}^{-1}$  is being accelerated uniformly and travels a distance of 300 m in 20 s. Calculate the speed of the car at the end of 20 s.  $d = v_i t + \frac{1}{2}at^2$   $v_f^2 = v_i^2 + 2ad$   $25 \text{ ms}^{-1}$
5. A ball is thrown upwards with an initial velocity of  $30 \text{ ms}^{-1}$ . Find the time taken for the ball to return to its starting point (take  $g = 10 \text{ ms}^{-2}$ ).  $v_f^2 = v_i^2 + 2ad$   
 $v_f = v_i + at$   $6 \text{ s}$
6. A small car of mass 800 kg travelling along a horizontal road at  $4.8 \text{ ms}^{-1}$  collides head on with an approaching car of mass 1200 kg. During the collision both cars come to rest. The time taken for the cars to come to rest is 0.12 s. Neglecting external friction forces and assuming that the conservation of momentum applies, calculate the average force exerted on the smaller car during collision.  $v_f = v_i + at$   $F = ma$   $32000 \text{ N}$
7. 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.  $E_p = mgh$ ,  $E_k = \frac{1}{2}mv^2$   $7.9 \text{ ms}^{-1}$
8. An electric motor has a rotor with a moment of inertia of  $3.9 \text{ kgm}^2$ . What is the torque required to give it an angular acceleration of  $0.40 \text{ rad s}^{-2}$ ?  $\tau = I\alpha$   $1.56 \text{ kgm}^2 \text{ s}^{-1}$
9. A wheel has a radius of 0.2 m. It rotates with an angular velocity of  $4 \text{ rad s}^{-1}$ . What is the linear velocity of a point on the rim of the wheel?  $v = r\omega$   $0.8 \text{ ms}^{-1}$
10. A friction brake acts on a flywheel of moment of inertia  $2.0 \text{ kg m}^2$  and slows it down from an angular velocity of  $500 \text{ rad s}^{-1}$  to an angular velocity of  $340 \text{ rad s}^{-1}$  in 4.0 s. What is the torque which the brake exerts on the flywheel?  $\omega_f = \omega_i + \alpha t$   
 $\tau = I\alpha$   $80 \text{ kgm}^2 \text{ s}^{-1}$
11. A car of mass 1200 kg takes a bend of radius 100 m at a speed of  $72 \text{ kmh}^{-1}$ . What is the acceleration that the car is undergoing?  $a = \frac{v^2}{r}$   $4 \text{ ms}^{-2}$
12. What torque is required to accelerate a  $0.5 \text{ kg m}^2$  wheel at  $5.3 \text{ rad s}^{-2}$ ?  $\tau = I\alpha$   $2.65 \text{ Nm}$
13. When a bullet with mass  $0.015 \text{ kg}$  travelling at  $650 \text{ ms}^{-1}$  passes clean through a wooden block of mass  $1.2 \text{ kg}$ , initially at rest, the block moves off at  $4 \text{ ms}^{-1}$  immediately after the bullet has passed through it. What is the bullet's final speed?  $p = mv$   $330 \text{ ms}^{-1}$