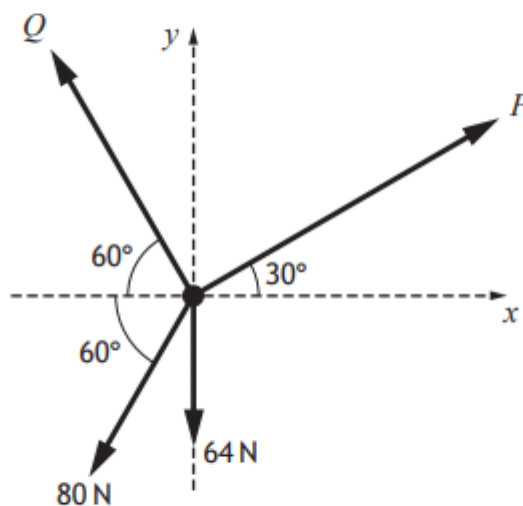| Grade Booster 1	
A skier starts from rest and skis straight down a slope inclined at an angle θ to the horizontal, where $\sin\theta = \dfrac{1}{4}$. The coefficient of friction between the skis and the snow is 0·125. Find the speed of the skier after she has travelled 75 metres.	4
A bicycle and rider have a total mass of 70 kg. They are travelling at 12 m s^{-1}. The cyclist applies the brakes for 1·5 seconds, resulting in a total resistive force of 180 newtons. What is the speed of the bicycle after 1·5 seconds?	3
In a children's playground game, four light inextensible ropes are attached at one end to a small toy ring. Four children each take the other end of a rope and pull it taut. The ring is in equilibrium and the whole system is in a horizontal plane with appropriate axes as shown in the diagram. The tensions in the four ropes are P, Q, 80 and 64 newtons respectively, and their directions relative to the axes are shown. Calculate the magnitude of the tensions P and Q.	4

A shell of mass 20 kg is travelling in a horizontal plane along the line NP at 100 m s⁻¹. At P it breaks into 3 pieces A, B and C of masses 12 kg, 6 kg and 2 kg respectively. These pieces instantaneously travel as shown in the diagram.

A shell of mass $20\,\text{kg}$ is travelling in a horizontal plane along the line NP at $100\,\text{m s}^{-1}$. At P it breaks into 3 pieces A, B and C of masses $12\,\text{kg}$, $6\,\text{kg}$ and $2\,\text{kg}$ respectively. These pieces instantaneously travel as shown in the diagram.
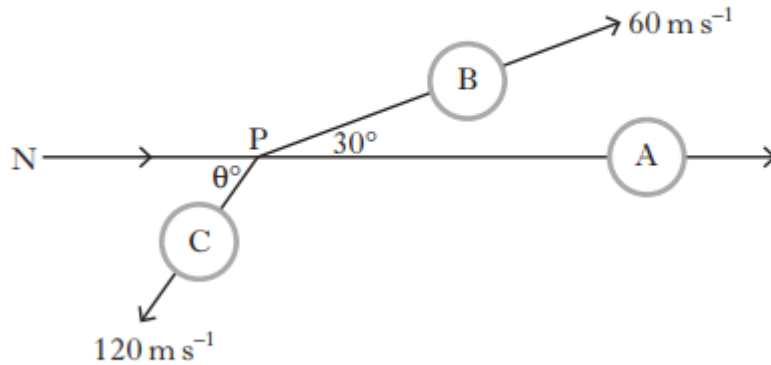
Find the speed of A, and the size of angle $\theta°$.

4

An automated train is programmed to move from rest under constant acceleration to a maximum speed of $20\,\text{m s}^{-1}$ in a distance of 300 m. It is brought to rest under uniform deceleration in 15 seconds. Two stations are 5 kilometres apart and the train is programmed to stop at each station.

Find the time taken to travel between the two stations.

5

A catapult consists of an elastic string of natural length 40 cm and modulus of elasticity 25 N. One end of the string is fixed to A and the other to B, with AB of length 20 centimetres.

A particle of mass 20 g is held in the middle of the string and the string pulled back to P.

It is held at rest with PC of length 24 centimetres. A, B, P and C all lie on the same horizontal plane. The particle is then released.

Find the speed with which it passes through C.
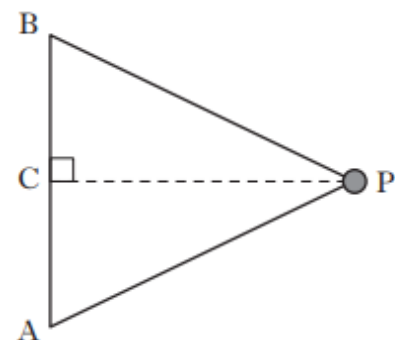
5

Two particles, P and Q, of masses 2 kg and m kg respectively, initially lie at rest in a straight line on a smooth horizontal surface. Particle P is acted on by a constant force of 3 N for 4 seconds, causing it to accelerate towards Q. When P collides with Q the particles coalesce and begin to move with speed $3\cdot75\,\text{m s}^{-1}$.

Find the value of m, the mass of particle Q.

4

An object oscillates on the x-axis about the origin, O, with simple harmonic motion. The period of the oscillation is $\frac{14\pi}{5}$ seconds, and when the object is at point K, 1·2 metres from the origin, it is moving away from the origin with a velocity of 2·5 m s^{-1}.

Find the amplitude of the motion and the time it takes for the particle to travel from O to K.

4

A particle is moving in a plane such that t seconds after the start of its motion, the velocity is given by $(3t\boldsymbol{i} + 5t^2\boldsymbol{j})$ m s^{-1}.

The particle is initially at the point $\left(\frac{1}{2}\boldsymbol{i} - 7\boldsymbol{j}\right)$ metres relative to a fixed origin O.

Find the distance of the particle from O when $t = 3$.

3

A ball of mass 0·5 kg is released from rest at a height of 10 metres above the ground.

If the ball reaches 2·5 metres after its first bounce, calculate the size of the impulse exerted by the ground on the ball.

4

| Ans: v=13.8ms^{-1}, v=8.143ms^{-1}, P=101N, Q=95.4N, v=154ms^{-1}, θ=48.6°, t=272.5s,v=6.71ms^{-1}, m=1.2kg, t=0.46s, s=40.5m, I=10.5Ns. |
| There are 40 marks available at C level. |
| Grade Booster 2 will focus on the pure maths. |