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1. A particle P of mass 2 kg is moving with speed 15 m s^{-1} in the direction of $3\mathbf{i}+4\mathbf{j}$ when it receives an impulse $\mathbf{J}\text{ N s}$. Immediately after receiving the impulse, P is moving with speed 17 m s^{-1} in the direction of $8\mathbf{i}+15\mathbf{j}$.

(a) Find the magnitude of \mathbf{J} [4]

The angle between the direction of the impulse and the direction of motion of P immediately before receiving the impulse is α° .

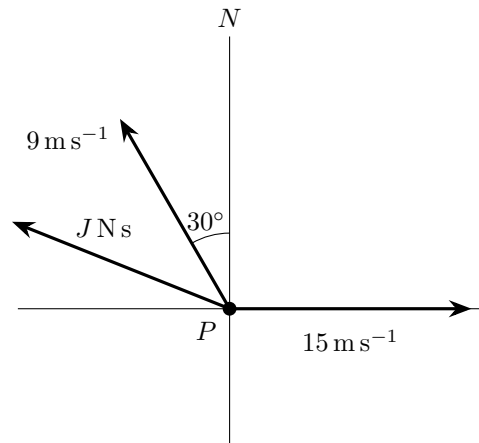
(b) Find the value of α [3]

2. A particle P of mass 0.8 kg is moving with velocity $\lambda(\mathbf{i} + 2\mathbf{j}) \text{ m s}^{-1}$ when P receives an impulse of magnitude $\frac{8\sqrt{2}}{5} \text{ N s}$

Immediately after receiving the impulse, P is moving at speed 5 m s^{-1} in the direction of $3\mathbf{i} + 4\mathbf{j}$.

Given that λ is a constant, find the two possible values of λ

[6]



3. A particle P of mass 0.4 kg is moving due east with speed 15 m s^{-1} on a smooth horizontal plane. The particle receives a horizontal impulse of magnitude $J \text{ N s}$.

Immediately afterwards, P is moving with speed 9 m s^{-1} on a bearing of 330° , as shown in the diagram.

Find the value of J

[6]

4. A particle Q of mass 0.5 kg is moving on a smooth horizontal surface with speed 10 m s^{-1} in the direction of the vector $4\mathbf{i} - 3\mathbf{j}$. The particle then receives an impulse of magnitude 5 N s in the direction of the vector $3\mathbf{i} + 4\mathbf{j}$.

(a) Find the speed of Q immediately after receiving the impulse [4]

As a result of receiving the impulse, the direction of motion of Q is turned through an angle θ° .

(b) Find the value of θ [2]

5. A particle P of mass 1 kg is moving with velocity $(3\mathbf{i} + \mathbf{j} + \mathbf{k}) \text{ m s}^{-1}$.

The particle receives an impulse $\lambda(2\mathbf{i} + \mathbf{j} + 2\mathbf{k}) \text{ N s}$, where λ is a constant.

Immediately after receiving the impulse, the kinetic energy of P is 19 J.

Find the possible values of λ

[7]

6. A particle P of mass 5 kg is moving with speed 13 m s^{-1} in the direction of the vector $5\mathbf{i} - 12\mathbf{j}$ when it receives an impulse $(45\mathbf{i} + 90\mathbf{j})\text{ N s}$.

(a) Find the speed of P immediately after receiving the impulse [4]

The direction of motion of P is then changed by α° .

(b) Find the value of α [2]

7. A particle of mass 1 kg is moving with velocity $(\mathbf{i} + 3\mathbf{j} - \mathbf{k}) \text{ m s}^{-1}$ when it receives an impulse $\mathbf{I} \text{ N s}$.

As a result, its kinetic energy increases by 6.5 J and the particle then moves in the direction $(\mathbf{i} + 2\mathbf{j} + \mathbf{k})$.

Find \mathbf{I}

[7]

8. A particle of mass 0.8 kg is moving with speed 5 m s^{-1} in the direction of the vector $3\mathbf{i} + 4\mathbf{j}$. It is then acted on by a constant force of $(8\mathbf{i} - 6\mathbf{j}) \text{ N}$ for 0.4 s .

(a) Find the speed of the particle at the end of the 0.4 s interval [5]

(b) Find the size of the angle between the direction of motion of the particle before the force acts and the direction of motion of the particle at the end of the 0.4 s interval [3]