A Level H2 Physics Tutorial 3: Dynamics

Syllabus :
(a) state and apply each of Newton's laws of motion

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1. State Newton's laws of motion.

(b) show an understanding that mass is the property of a body which resists change in motion (inertia)

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2. There is a big iron ball and a wooden ball of the same size on the ground. A student pushes tham one at a time.

(i) If she uses the same force, which one moves faster?

(ii) The slower one apparently resists the push more than the faster one. How can we explain this?

(c) describe and use the concept of weight as the force experienced by a mass in a gravitational field

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3. Mass, the same property that resists movement, can somehow produce an attractive force on another mass.

(i) What is the name of this force?

(ii) When this force from Earth acts on a body, what is the common name of the force?

(d) define and use linear momentum as the product of mass and velocity

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4. Ball A is 0.2 kg. Ball B is 0.1 kg.

Ball A moves along a line to the right, with speed 3 m/s. Ball B moves along the same line to the left with speed 4 m/s, towards ball A.

Choosing the right side to be the positive direction, find the momenta of ball A and ball B.

(e) define and use impulse as the product of force and time of impact

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5. When ball A in the previous question hits ball B, a force F from A act on B for a short time t. An equal and opposite force from B acts on A for the same time – before they move apart.

The product Ft, called impulse, is equal to the change in momentum. Using the results from the previous question, find the impulse of ball A on ball B.

(f) relate resultant force to the rate of change of momentum

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6. The momentum of a box moving along the floor increases by 0.5 kg m/s every second.

What is the resultant force on the box?

(g) recall and solve problems using the relationship F = ma, appreciating that resultant force and acceleration are always in the same direction

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7. A force of 20 N from a rope pulls a box to the left, against a friction of 5 N. The mass of the box is 4 kg. Find its acceleration.

(h) state the principle of conservation of momentum

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8. State the principle of conservation of momentum.

(i) apply the principle of conservation of momentum to solve sim ple problems including inelastic and (perfectly) elastic interactions between two bodies in one dimension (knowledge of the concept of coefficient of restitution is not required)

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9. Ball A travels at 2 m/s along a straight line. It hits a ball B moving at 1 m/s in the opposite direction. Ball A has mass of 0.5 kg, ball B 1 kg. After colliding , A slows down to 1.2 m/s. Find the velocity of B after colliding.

(j) show an understanding that, for a (perfectly) elastic collision between two bodies, the relative speed of approach is equal to the relative speed of separation

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10. Prove the above syllabus statement.

(k) show an understanding that, whilst the momentum of a closed system is always conserved in interactions between bodies, some change in kinetic energy usually takes place. 4

11.
(i) For question 9, determine the total kinetic before and after collision.

(ii) Suggest why there is a change, if any.

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