

USING EQUATIONS TEST 1

Some of these answers require you to remember Level 2 Physics and/or common sense.

(Take $g = 10 \text{ ms}^{-2}$, $h = 6.63 \times 10^{34} \text{ Js}$, $c = 3 \times 10^8 \text{ m s}^{-1}$, $\epsilon_0 = 8.85 \times 10^{-12} \text{ N}^{-1} \text{ m}^{-2} \text{ C}^2$)

1. A mass A of 6 kg moving with a velocity of 5 ms^{-1} collides with a mass B of 8 kg moving in the opposite direction at 3 ms^{-1} . Calculate the final velocity if the masses stick together on impact.
2. X-rays of a frequency $1.05 \times 10^{19} \text{ Hz}$ can be used to form an image of a bone. What is the energy of an X-ray photon?
3. An object of mass 2.0 kg starts from rest and slides down a frictionless incline at an angle of 30° to the horizontal. If it slides 2.5 m down the plane, what will be its velocity?
4. A wheel has a radius of 0.3 m. It rotates with an angular velocity of 12 s^{-1} . What is the linear velocity of a point on the rim of the wheel?
5. Calculate the capacitance of a pair of parallel plates of area 0.025 m^2 if they are separated by a piece of perspex 0.1 mm thick. Take the relative permittivity of perspex to be 3.5.
6. What is the resistance of a 240 V, 100 W light bulb?
7. Americium-241 found in smoke detectors undergoes alpha decay;
 $\text{Am} \rightarrow \text{Np} + \text{He} + \gamma$

Rest mass of Np = $3.9360161 \times 10^{-25} \text{ kg}$, rest mass of Am = $4.0025778 \times 10^{-25} \text{ kg}$, rest mass of He = $0.0664604 \times 10^{-25} \text{ kg}$

Work out the mass deficit in this reaction and the energy released in joules.
8. A 5 kg mass extends a spring by 0.50 m. What is the spring constant of the spring?
9. Calculate the wavelength of the light emitted when an electron falls from an energy level of $-6.06 \times 10^{-20} \text{ J}$ to an energy level of $-8.73 \times 10^{-20} \text{ J}$.
10. How far apart are two parallel plates in air, area 0.50 m^2 and capacitance $1.5 \mu\text{F}$?
11. A yo-yo, initially at rest, is allowed to fall from a finger. The yo-yo drops with constant linear acceleration. After 1.40 seconds it has fallen 1.20 m and reached an angular velocity of 4090 revolutions per minute. What angle (in radians) does the yo-yo turn through during the fall of 1.20 m?
12. Using $c = 3.00 \times 10^8 \text{ m s}^{-1}$, calculate the energy associated with an electron which has a mass of $9.1 \times 10^{-31} \text{ kg}$, if all its mass was converted to energy.
13. How much torque is needed to bring a flywheel with moment of inertia 0.2 kg m^2 rotating at 50 rad s^{-1} to rest in 20 seconds?
14. The time taken for a neutron to travel 6 m in a straight line is 0.3 ms. If a neutron has a mass of $5 \times 10^{-26} \text{ kg}$, calculate its kinetic energy.