USING EQUATIONS TEST 1

Some of these answers require you to remember Level 2 Physics and/or common sense.
(Take g = 10 ms^{-2}, h = 6.63 x 10^{34} Js, c = 3 x 10^{8} m s^{-1}, ε_o= 8.85 x 10^{-12} $N^{-1}m^{-2}C^{2}$)

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. $p = mv$ $0.42\ ms^{-1}$

2. X-rays of a frequency 1.05 x 10^{19} Hz can be used to form an image of a bone. What is the energy of an X-ray photon? $E = hf$ 6.96×10^{-15} J

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? $2.5 \sin 30 = 1.25$ $V_f^2 = V_i^2 + 2ad$ $5\ ms^{-1}$

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? $v = r\omega$ $3.6\ ms^{-1}$

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. $C = \frac{\varepsilon_o \varepsilon_r A}{d}$ 7.7×10^{-11} F

6. What is the resistance of a 240 V, 100 W light bulb? $P = VI$, $V = IR$ $576\ \Omega$

7. Americium-241 found in smoke detectors undergoes alpha decay;
Am -> Np + He + γ

Rest mass of Np = 3.9360161 x 10^{-25} kg, rest mass of Am = 4.0025778 x 10^{-25} kg, rest mass of He = 0.0664604 x 10^{-25} kg $E = mc^2$ 1.013×10^{-24} kg

Work out the mass deficit in this reaction and the energy released in joules. 9.2×10^{-13} J

8. A 5 kg mass extends a spring by 0.50 m. What is the spring constant of the spring? $F = ma$ $F = -Kx$ $100\ Nm^{-1}$

9. Calculate the wavelength of the light emitted when an electron falls from an energy level of - 6.06 x 10^{-20} J to an energy level of - 8.73 x 10^{-20} J. $\Delta E = |E_1 - E_2|$ $E = hf$ $v = f\lambda$ 7.45×10^{-6} m

10. How far apart are two parallel plates in air, area 0.50 m^2 and capacitance 1.5 μF ? $C = \frac{\varepsilon_o \varepsilon_r A}{d}$ 2.95×10^{-6} m

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? $\theta = \frac{(\omega_i + \omega_f)t}{2}$ 300 rad

12. Using c = 3.00 x 10^{8} m s^{-1}, calculate the energy associated with an electron which has a mass of 9.1 x 10^{-31} kg, if all its mass was converted to energy. $E = mc^2$ 8.2×10^{-14} J

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? $\tau = I\alpha$ $\alpha = \frac{\Delta\omega}{\Delta t}$ $\tau = 0.5$ Nm

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 x 10^{-26} kg, calculate its kinetic energy. $E_K = \frac{1}{2}mv^2$ $d = v_i t + \frac{1}{2}at^2$ 2×10^{-17} J