1.

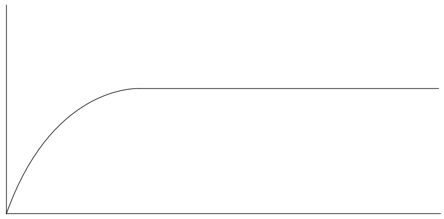
(a) Contact of ball on path.
Air resistance.

(b)

(1) Constant speed and direction. No net force is acting therefore no acceleration.

(2) Newton's 1st Law.

(3)



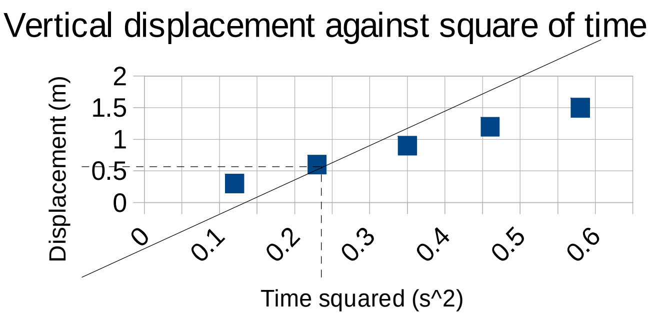
(c)

(1) Vertical displacement is the downwards distance from the starting point (the height change of the ball).

(2) Weight

(3) 0.46

(4)



(5) $t^2 = 0.28 \text{ s}^2$

$\therefore t = \sqrt{0.28} = 0.53 \text{ s}$

(6) $\frac{rise}{run} = \frac{1.55}{0.60} = 2.58 \text{ m/s}^2$

(7) $s = 2.58\ t^2$

(8) $s = \frac{1}{2} a \Delta t^2$

$\therefore slope = \frac{1}{2} a = \frac{1}{2} g$

$\therefore g = 2 \times slope = 2 \times 2.58 = 5.16 \text{ m/s/s}$

(9) The ball is rolling down a slope (not falling) so there is an upward force.
The ball experiences resistance forces, see 1(a).\

2.

(1) $a = \frac{F}{m} = \frac{16 \times 10^3}{12 \times 10^3} = 1.3 \text{ m/s/s}$

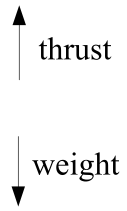
(2) $a = \frac{\Delta v}{\Delta t}$

$\therefore \Delta t = \frac{\Delta v}{a} = \frac{20 - 1000}{-1.3} = 7.5 \times 10^2 \text{s}$

(3) According to Newton's Third Law, the thrust the spacecraft experiences will be in the opposite direction to the force with which it pushes the gases from the rocket. So it must first the rocket to the right in order to accelerate to the left.

(b)

(1)



(2) $F = ma = 6.0\times10^3\times1.6 = 9.6\times10^3$ N upwards

(3) $v^2 = {v_0}^2 + 2as$

$\therefore v = \sqrt{v_0 + 2as}$

$= \sqrt{0.20^2 + 2\times1.6\times5.0}$

$= 4.0$ m/s

3.

(a)

(1) $\frac{700}{1100}\times100 = 64\%$

(2) $\Delta E = P\times\Delta t = 700\times30 = 2.1\times10^4$ J

(3) They vibrate more and move around faster (because they have more kinetic energy).

(4) $Q = mc\Delta T$

$\therefore \Delta T = \frac{Q}{mc} = \frac{2.1\times10^4}{0.300\times4180} = 17°\text{C}$

$T_f = T_i + \Delta T = 20.0 + 17 = 37°\text{C}$

(b) Heat transfers to (or from) the thermometer until thermal equilibrium is reached (thermometer same temeperature as water). During this time the thermometer is becoming more (or less) expanded and therefore showing a readable measurement.

(c) The change in volume will be proportional to change in temperature (if everything else is constant). Therefore as temperature increases, volume increases.

4.

(a) $I = \frac{P}{\Delta V} = \frac{480\times10^3}{240} = 2000$ A

(b) $P = I\Delta V \qquad \Delta V = IR$

$\therefore P = I\times IR = I^2R$

(c) $P = I^2R = \left(2\times10^3\right)^2\times0.50 = 2\times10^6$ W

(d) Increasing voltage allows the same power to transmitted at a lower current. This decreases power loss since it power loss is proportional to the square of the current. Less power loss means increased efficiency and therefore more profit.

(e) Metals conduct electricity well due the the free-moving delocalised electrons in their structure.

(f) Current is the flow rate of charges. Voltage is the change in the energy carried by the charges as they move through the circuit.

(g)

(1) $R = \frac{\rho L}{A} = \frac{1.7\times10^{-8}\times30}{3.1\times10^{-6}} = 0.16\ \Omega$

(2) Increasing temperature will increase resistance. Higher temperature means more vibration of the particles in the metal which resists the flow of charge through it.

(3) Resistance is inversely proportional to area (if resistivity and length are constant).

Therefore increasing A will decrease R. Power loss is proportional to resistance (if current is constant) therefore decreasing R decreases power loss.

(h)

(1) Parallel. The voltage across parallel components is equal.

(2) $P_T = 1200 + 2400 + 1440 = 5040$ W

$$I = \frac{P}{\Delta V} = \frac{5040}{240} = 21 \text{ A}$$

(3) The fuse is rated at 20 A and there is more current than this flowing through it. The flow will 'blow' and no longer conduct electricity.

(i) (some example points are summarised here but this is an extended response so should use full sentences and logical structure)

Conduction: from touching other fries or the walls of the frier (vibration is transferred)
Convection: from circulating air (heated air expands and rises, cooling air sinks)
Radiation: from the heating element (as electromagnetic waves)