Question 1

(a) (i) force acting normally per unit area --- [B1]
(ii) $kgm^{-1}s^{-2}$ --- [B1]
(iii) Rate of change of velocity --- [B1]

(b) (i) $[p] = kgm^{-1}s^{-2}$ $[\rho] = kgm^{-3}$ $[g] = ms^{-2}$ $[h] = m$
$[\rho][g][h] = (kgm^{-3})(ms^{-2})(m) = kgm^{-1}s^{-2}$ --- [M1]
LHS = RHS, so equation is homogeneous. --- [A1]

(c) $(\Delta p / p) \times 100\% = (\Delta\rho/\rho) \times 100\% + (\Delta h/h) \times 100\%$ --- [C1]
$= 4\ \% + 3\ \% = 7\ \%$ --- [A1]

Question 2

(a) (i) a projectile motion from P to Q --- [B1]
(ii) The gravitational force is acting vertically downwards, therefore giving a vertically downwards acceleration --- [B1]
This vertical acceleration will have no effect on the horizontal component of the velocity since it is perpendicular to it --- [B1]

(b) (i) $v^2 = u^2 + 2as$ --- [C1]
$32^2 = 0^2 + 2(9.81)(s)$ --- [C1]
$s = 52$ m
(b) (ii) $s = ut + \frac{1}{2} at^2$
$52 = \frac{1}{2} (9.81)(t^2)$ --- [C1]
$t = 3.26$ s --- [A1]
(b) (iii) $s = ut$
$s = (95)(3.26)$ --- [C1]
$s = 310$ m --- [A1]

(c) Air resistance reduces the resultant downward force, acceleration decreases --- [B1]
Max height increases (such that the landing speed is not more than 32 ms^{-1}) --- [B1]

Question 3

(a) (i) Resultant force acting in any direction must be zero. --- [B1]
Resultant moment about any point must be zero. --- [B1]

(a) (ii) taking pivot at point P
Anti C/W moment = C/W moment
$Q\,(0.1) = (0.12)(9.81)(0.25)$ --- [C1]
$Q = 2.94$ N--- [A1]

$Q = P + W$
$P = 1.77$ N --- [A1]

(b) Positioned at point Q --- [B1]
Moment due to force P is the same (taking moments about Q). Thus force P will be the same --- [B1]

Question 4

(a) $mgh = (70)(9.81)(150)$ --- [C1]
$= 1.03 \times 10^5$ J --- [A1]

(b) $\frac{1}{2}mv^2 = \frac{1}{2}(70)(45)^2$ --- [C1]
$= 7.09 \times 10^4$ J --- [A1]

(c) $1.03 \times 10^5 - 7.09 \times 10^4 = F_{air}\,(150)$ --- [C1]
$F_{air} = 214$ N --- [A1]

Question 5

(a) Diagram showing the centre of the rod is thinning. --- [B1]
The rod will become narrower / smaller in diameter at the centre / necking --- [B1]
It undergoes plastic deformation --- [B1]

(b) (i) $7.85 \times 10^{-7}\ m^2$ --- [A1]
(b) (ii) stress = F/A = $800/7.85 \times 10^{-7}$ --- [C1]
$= 1.02 \times 10^9$ Pa --- [A1]
(b) (iii) E = stress/strain = $1.02 \times 10^9/(0.1/20)$ --- [C1]
$= 2.04 \times 10^{11}$ Pa --- [A1]

Question 6

(a) Total R = 8 + 6 + 7 --- [C1]
Total R = 21 Ω --- [A1]

(b) (i) 0.35/2 = 0.175 A --- [A1]
(b) (ii) emf = 0.35(21) --- [C1]
= 7.35 V --- [A1]

Question 7

(a) $d \sin \theta = n\lambda$
$d = 1/6 \times 10^{5} = 1.67 \times 10^{-6}$ --- [C1]
$(1.67 \times 10^{-6}) \sin \theta = (1)(6.6 \times 10^{-7})$ --- [C1]
$\theta = 23.3°$ --- [A1]

(b) $(1.67 \times 10^{-6}) \sin (90) = n (6.6 \times 10^{-7})$ --- [C1]
n = 3 --- [A1]

(c) Longitudinal wave is a wave in which the direction of vibration of the particles is parallel to the direction of propagation of the wave. Longitudinal wave cannot be polarised.

Transverse wave is a wave in which the direction of vibration of the particles is perpendicular to the direction of propagation of the wave. Transverse wave can be polarised.

(d) (i) Unpolarised light – higher intensity , vibrates in all planes / orientations --- [B1]
Polarised light – lower intensity, vibrate in one plane / orientation only --- [B1]

(d) (ii) Sound wave --- [B1]
The vibration of particles is parallel to the direction of propagation of the wave --- [B1]

Question 8

(a) A process whereby an unstable nuclei become stable --- [B1]
by emission of α-particles, β-particles or gamma ray --- [B1]

(b) (i) the rate of decay is not affected by environment changes --- [B1]
such as pressure, temperature --- [B1]

(b)(ii) constant probability --- [B1]
of decay per unit time --- [B1]