

FORM 5

CHAPTER 1

Paper 1

- 1 C 2 D 3 B 4 C
5 B 6 B 7 D 8 C

Paper 2

Structured Question

- 1 (a) Weight // Gravitational force.
 (b) (i) Resultant force, $F = ma$

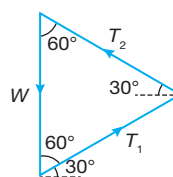
$$F = (14\,000 \text{ kg}) \times (0.4 \text{ m s}^{-1})$$

$$= 5\,600 \text{ N}$$
 (ii) $F = L - mg$, with the weight of the helicopter, $W = mg$
 $L = F + mg$
 $L = 5\,600 \text{ N} + (14\,000 \text{ kg})(9.81 \text{ N kg}^{-1})$
 $= 142\,940 \text{ N}$
 (c) At constant velocity, the acceleration, $a = 0$ and the resultant force of the horizontal force, $F = 0$. This shows $F =$ Forward thrust of the engine, $T -$ Drag force, $F_d = 0$ so T and F_d have the same magnitude but in the opposite direction.
- 2 (a) The elongation of a spring is directly proportional to the applied force if it does not exceed the elastic limit of the spring.
 (b) (i) Spring Q has a smaller spring coil diameter than spring P .
 (ii) Gradient of x - F graph $= \frac{(4.0 - 0) \text{ cm}}{(9.0 - 0) \text{ N}}$
 $= \frac{0.040 \text{ m}}{9.0 \text{ N}}$
 Spring constant, $k_p = \frac{F}{x} = \frac{1}{\text{Gradient of } x\text{-}F \text{ graph}}$
 $k_p = \frac{9.0 \text{ N}}{0.040 \text{ m}}$
 $= 225.0 \text{ N m}^{-1}$
 (c) Elastic potential energy, $E_p =$ Area under the F - x graph
 $E_p = \frac{1}{2} (0.040 \text{ m}) \times (9.0 \text{ N})$
 $= 0.18 \text{ J}$

Essay Questions

- 3 (a) Force balance means that the forces acting on an object are balanced and the resultant force is zero.

(b) (i)



K1: The equilateral triangle of the force triangle is drawn correctly.

K2: All angles are shown in the right triangle correctly.

K3: Powers W , T_1 and T_2 marked with an arrow in the right direction.

- (ii) Billboard weight, $W = mg$
 By using the sine tips,

$$\frac{T_1}{\sin 60^\circ} = \frac{W}{\sin 60^\circ}$$

$$T_1 = W = mg$$

$$T_1 = (120 \text{ kg})(9.81 \text{ N kg}^{-1})$$

$$= 1177.2 \text{ N}$$

$$T_2 = T_1 = 1177.2 \text{ N}$$

- (c) • The inclination angle, θ should be greater so that the vertical component of the cable tension is higher // the cable tension is lower.
 • The maximum tension should be higher so that it can support the extra weight // not break easily.
 • The cable material is steel because the tensile strength is higher // lasts longer // does not rust easily.
 • Oxidation rate is low so that it survives weather conditions // lasts longer // does not rust easily.
 • N cable is chosen because it has a greater angle, θ , higher maximum tension, steel cable with a low oxidation rate.
- (d) (i) At constant velocity, acceleration, $a = 0$ and resultant force $= 0$ then,
 Friction force, $F_R =$ Horizontal component of force, F_x
 $F_R = F \cos \theta$
 $= 68 \cos 40.0^\circ$
 $= 52.09 \text{ N}$
 (ii) Normal reaction, $R =$ Vertical component of force, F_y
 $R = F \sin \theta$
 $= 68 \sin 40.0^\circ$
 $= 43.71 \text{ N}$