

## Mechanics 5 – Forces

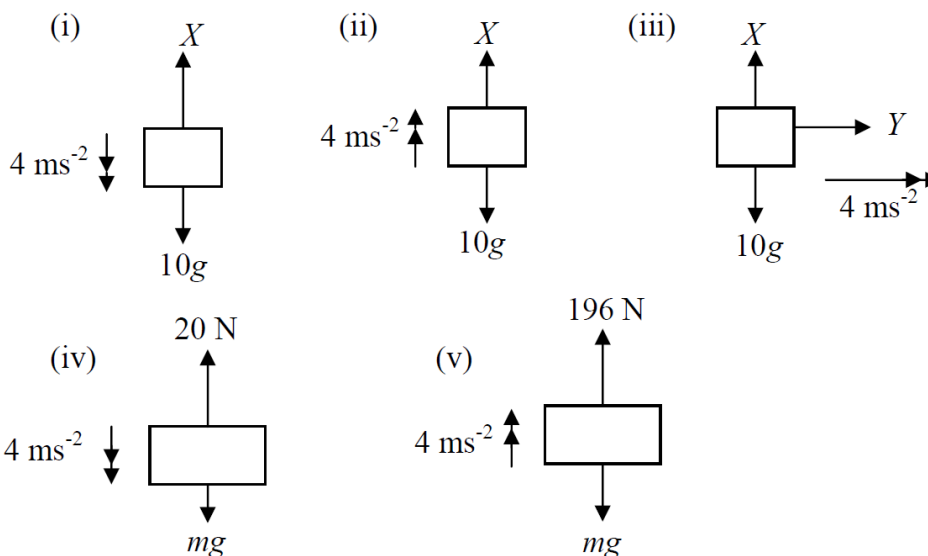
Please **complete** this homework by \_\_\_\_\_. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

### Section 1 – Review of previous topics. Please complete all questions.

- Find the missing values for  $s$ ,  $u$ ,  $v$ ,  $a$  or  $t$  in each case:
  - $s = 120$  m,  $u = 0$ ,  $v = 100$   $\text{ms}^{-1}$
  - $u = 0$ ,  $v = 12$   $\text{ms}^{-1}$ ,  $a = 2.4$   $\text{ms}^{-2}$
  - $s = 240$  m,  $v = 18$   $\text{ms}^{-1}$ ,  $t = 8$  s
  - $s = 130$  m,  $u = 12$   $\text{ms}^{-1}$ ,  $a = 0.2$   $\text{ms}^{-2}$
- A ball is rolling down a hill with a constant acceleration of  $0.25$   $\text{ms}^{-2}$ . It travels  $930$  m in one minute. What was the initial speed of the ball and what was its speed after one minute?
- A ball is thrown upwards at  $10$  m/s and strikes the ground at  $14.5$  m/s. How far above the ground was the ball thrown?
- A particle moves with constant acceleration along a straight line ABCD, passing B  $10$  seconds after A and passing C  $20$  seconds after B. AB is  $110$  m and BC is  $580$  m.
  - Find the acceleration of the particle
  - Find the velocity of the particle at B
  - Given that AD is  $1.75$  km, how long does it take the particle to travel from B to D?

### Section 2 – Consolidation of this week's topic. Please complete all questions.

- In each of the following scenarios, the forces acting on the body cause it to accelerate as shown. In each case, find the values of the given letter.



**(3+3+5+4+4 = 19 marks)**

2. A resultant force of 40 N which is acting on a particle of mass  $m$  kg produces an acceleration of  $2 \text{ ms}^{-2}$ . Find a value for  $m$ .  
**(2 marks)**
3. A package of mass 8 kg is lowered by means of a vertical cable with a downward acceleration of  $2 \text{ ms}^{-2}$ . Find the tension in the cable.  
**(3 marks)**
4. A bucket is lowered into a well. The bucket has a mass of 5 kg when empty and 15 kg when full. It is lowered into the well with a constant acceleration of  $4 \text{ ms}^{-2}$ . When full it is then raised at a constant speed of  $3 \text{ ms}^{-1}$ . Assuming that the rope is light, find the tension in the rope  
(a) when the bucket was being lowered  
(b) when the full bucket was being raised.  
**(3+3 = 6 marks)**
5. A lift descends with an acceleration of  $1.5 \text{ ms}^{-2}$ , then moves at a constant speed until it is retarded at  $1 \text{ ms}^{-2}$ . A package of mass 20 kg stands on the floor of the lift during the journey. Find the magnitude of the force it exerts on the floor during each stage.  
**(9 marks)**
6. A vehicle of mass 2000 kg is travelling along a straight horizontal road at  $90 \text{ kmh}^{-1}$ . It is brought to rest in a distance of 500 m by a force of magnitude  $P$  Newtons. Find  $P$  and the time taken to come to rest.  
**(9 marks)**
7. A particle of mass 5 kg is at rest 2 m from the edge of a horizontal table. The particle is subjected to a thrust of  $X$  N and the resistance to motion is 250 N. Find the value of  $X$  given that:  
(a) the particle does not accelerate  
(b) the particle accelerates at  $2 \text{ ms}^{-2}$   
(c) the particle falls off the edge of the table after 0.5 seconds.

**(3+3+6 = 12 marks)**

**(Total 60 marks)**

Section 3 – Extension questions. If you are aiming for a top grade, you should attempt these questions.

Past exam question (Jan 05)

A stone  $S$  is sliding on ice. The stone is moving along a straight line  $ABC$ , where  $AB = 24 \text{ m}$  and  $AC = 30 \text{ m}$ . The stone is subject to a constant resistance to motion of magnitude 0.3 N. At  $A$  the speed of  $S$  is  $20 \text{ m s}^{-1}$ , and at  $B$  the speed of  $S$  is  $16 \text{ m s}^{-1}$ . Calculate

- (a) the deceleration of  $S$ ,  
(b) the speed of  $S$  at  $C$ .  
(c) Show that the mass of  $S$  is 0.1 kg.