Solomon Practice Paper

Mechanics 1L

Time allowed: 90 **mintues**

Question	Points	Score
1	7	
2	9	
3	9	
4	10	
5	11	
6	12	
7	17	
Total:	75	

Centre:

Name:

Teacher:

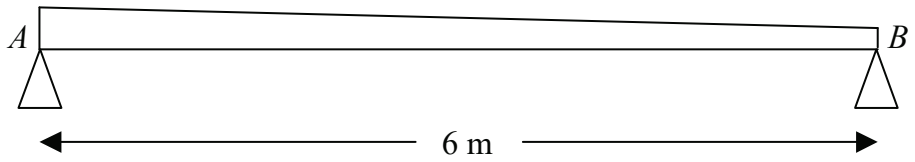
1. Two particles P and Q, of mass m and km respectively, are travelling in opposite directions on a straight horizontal path with speeds $3u$ and $2u$ respectively. P and Q collide and, as a result, the direction of motion of both particles is reversed and their speeds are halved.

   (a) Find the value of k. [4]

   (b) Write down an expression in terms of m and u for the magnitude of the impulse which P exerts on Q during the collision. [3]

Total: 7

2. Figure shows a plank AB of mass 40kg and length 6m, which rests on supports at each of its ends.



The plank is wedge-shaped, being thicker at end A than at end B.

A woman of mass 60kg stands on the plank at a distance of 2m from B.

(a) Suggest suitable modelling assumptions which can be made about [3]

i. the plank,

ii. the woman.

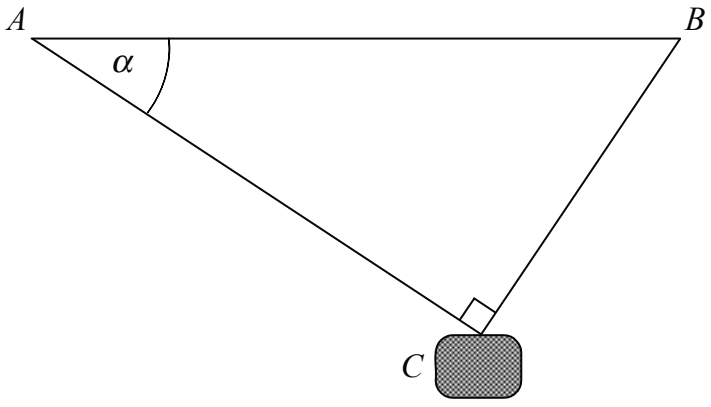
Given that the reactions at each support are of equal magnitude,

(b) find the magnitude of the reaction on the support at A, [2]

(c) calculate the distance of the centre of mass of the plank from A. [4]

Total: 9

3. Figure shows a cable car C of mass 1 tonne which has broken down.



The cable car is suspended in equilibrium by two perpendicular cables AC and BC which are attached to fixed points A and B, at the same horizontal level on either side of a valley. The cable AC is inclined at an angle α to the horizontal where $\tan(\alpha) = \frac{3}{4}$.

(a) Show that the tension in the cable AC is 5880N and find the tension in the cable BC. [7]

A gust of wind then blows along the valley.

(b) Explain the effect that this will have on the tension in the two cables. [2]

Total: 9

4. Andrew hits a tennis ball vertically upwards towards his sister Barbara who is leaning out of a window 7.5m above the ground to try to catch it. When the ball leaves Andrew's racket, it is 1.9m above the ground and travelling at 21ms^{-1}. Barbara fails to catch the ball on its way up but succeeds as the ball comes back down.

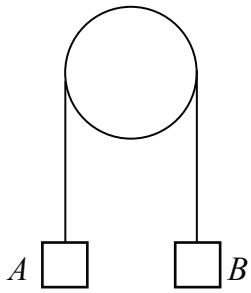
   Modelling the ball as a particle and assuming that air resistance can be neglected,

   (a) find the maximum height above the ground which the ball reaches. [4]

   (b) find how long Barbara has to wait from the moment that the ball first passes her until she catches it. [6]

Total: 10

5. Figure shows two particles A and B of masses m and km respectively, connected by a light inextensible string which passes over a smooth fixed pulley.



   When the system is released from rest with both particles 0.5m above the ground, particle A moves vertically upwards with acceleration $\frac{1}{4}g\text{ms}^{-2}$.

   (a) Write down, with a brief justification, the magnitude and direction of the acceleration of B. [2]

   (b) Find the value of k. [6]

   Given that A does not hit the pulley,

   (c) calculate, correct to 3 significant figures, the speed with which B hits the ground. [3]

Total: 11

6. Two trains A and B leave the same station, O, at 10 a.m. and travel along straight horizontal tracks. A travels with constant speed 80 kmh^{-1} due east and B travels with constant speed 52 kmh^{-1} in the direction $(5\mathbf{i} + 12\mathbf{j})$ where $\mathbf{i}$ and $\mathbf{j}$ are unit vectors due east and due north respectively.

(a) Show that the velocity of B is $(20\mathbf{i} + 48\mathbf{j})$ kmh^{-1}. [3]

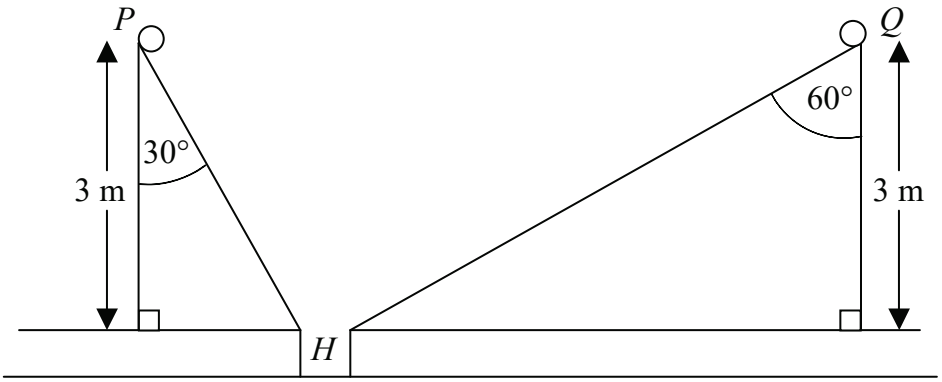
(b) Find the displacement vector of B from A at 10:15 a.m. [3]

Given that the trains are 23 km apart t minutes after 10 a.m.

(c) find the value of t correct to the nearest whole number. [6]

Total: 12

7. Figure shows two golf balls P and Q being held at the top of planes inclined at 30° and 60° to the vertical respectively.



Both planes slope down to a common hole at H, which is 3m vertically below P and Q.

P is released from rest and travels down the line of greatest slope of the plane it is on which is assumed to be smooth.

(a) Find the acceleration of P down the slope. [3]

(b) Show that the time taken for P to reach the hole is 0.904 seconds, correct to 3 significant figures. [5]

Q travels down the line of greatest slope of the plane it is on which is rough.

The coefficient of friction between Q and the plane is μ.

Given that the acceleration of Q down the slope is 3 ms^{-2},

(c) find, correct to 3 significant figures, the value of μ. [5]

In order for the two balls to arrive at the hole at the same time, Q must be released t seconds before P.

(d) Find the value of t correct to 2 decimal places. [4]

Total: 17