Solomon Practice Paper

Mechanics 1E

Time allowed: 90 **mintues**

Question	Points	Score
1	4	
2	7	
3	8	
4	8	
5	8	
6	10	
7	11	
8	19	
Total:	75	

Centre:

Name:

Teacher:

1. Three forces $(-5\mathbf{i}+4p\mathbf{j})$N, $(2q\mathbf{i}+3\mathbf{j})$N and $(\mathbf{i}+\mathbf{j})$N act on A particle A of mass 2kg. [4]

   Given that A is in equilibrium, find the values of p and q.

2. An underground train accelerates uniformly from rest at station A to A velocity of 24 ms^{-1}. It maintains this speed for 84 seconds, until it decelerates uniformly to rest at station B. The total journey time is 116 seconds and the magnitudes of the acceleration and deceleration are equal.

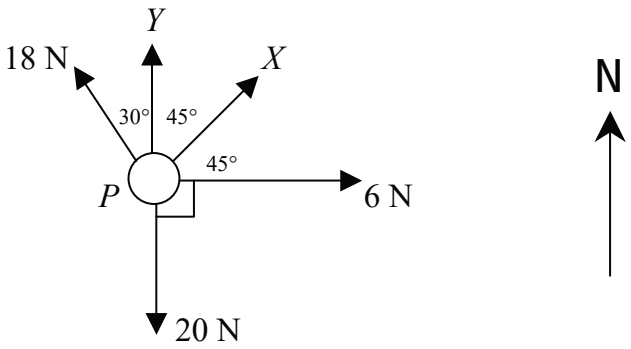
   (a) Find the time it takes the train to accelerate from rest to 24 ms^{-1}. [2]

   (b) Illustrate this information on A velocity-time graph. [2]

   (c) Using your graph, or otherwise, find the distance between the two stations. [3]

   Total: 7

3. Figure shows the forces acting on A particle, P.



   These consist of A 20N force to the South, a 6N force to the East, an 18N force 30° West of North and two unknown forces X and Y which act to the North-East and North respectively.

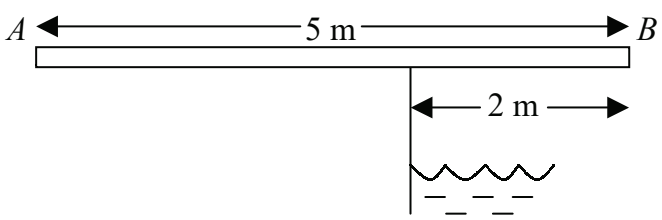
   Given that P is in equilibrium,

   (a) show that X has magnitude $3\sqrt{2}$N, [4]

   (b) find the exact value of Y. [4]

   Total: 8

4. Figure shows A uniform plank AB of mass 50kg and length 5m which overhangs A river by 2m.



   When A boy of mass 20kg stands at A, his sister can walk to within 0.3m of B, at which point the plank is in limiting equilibrium.

   (a) What is the mass of the girl? [4]

(b) Find the smallest extra weight which must be placed at A to enable the girl to walk right to the end B. [3]

(c) How have you used the fact that the plank is uniform? [1]

Total: 8

5. A cricket ball of mass 0.3kg is approaching A batsman at $-30\mathbf{i}$ ms^{-1}. The batsman hits the ball with A 1.5kg bat moving with velocity $15\mathbf{i}$ ms^{-1}. Contact between bat and ball lasts for 0.2 seconds. Immediately after this, bat and ball move with velocities $5\mathbf{i}$ ms^{-1} and $v\mathbf{i}$ ms^{-1} respectively.

(a) Suggest A suitable model for the cricket ball. [1]

(b) Calculate the value of v. [4]

(c) Find the magnitude of the force with which the batsman hits the ball. [3]

Total: 8

6. A boy kicks A football vertically upwards from A height of 0.6m above the ground with A speed of 10.5 ms^{-1}. The ball is modelled as A particle and air resistance is ignored.

(a) Find the greatest height above the ground reached by the ball. [4]

(b) Calculate the length of time for which the ball is more than 2m above the ground. [6]

Total: 10

7. A particle has an initial velocity of $(\mathbf{i} - 5\mathbf{j})$ ms^{-1} and is accelerating uniformly in the direction $(2\mathbf{i} + \mathbf{j})$ where $\mathbf{i}$ and $\mathbf{j}$ are perpendicular unit vectors.

Given that the magnitude of the acceleration is $3\sqrt{5}$ ms^{-2},

(a) show that, after t seconds, the velocity vector of the particle is $[(6t+1)\mathbf{i} + (3t-5)\mathbf{j}]$ ms^{-1} . [6]

(b) Using your answer to part (a), or otherwise, find the value of t for which the speed of the particle is at its minimum. [5]

Total: 11

8. Figure shows two particles A and B, of mass $5M$ and $3M$ respectively, attached to the ends of A light inextensible string of length 4m.

The string passes over A smooth pulley which is fixed to the edge of A rough horizontal table 2m high. Particle A lies on the table at A distance of 3m from the pulley, whilst particle B hangs freely over the edge of the table 1 m above the ground. The coefficient of friction between A and the table is $\frac{3}{20}$.

The system is released from rest with the string taut.

(a) Show that the initial acceleration of the system is $\frac{9}{32}g$ ms^{-2}. [8]

(b) Find, in terms of g, the speed of A immediately before B hits the ground. [4]

When B hits the ground, it comes to rest and the string becomes slack.

(c) Calculate how far particle A is from the pulley when it comes to rest. [7]

Total: 19