

Solomon Practice Paper

Mechanics 2C

Time allowed: 90 minutes

Centre:

Name:

Teacher:

Question	Points	Score
1	7	
2	8	
3	9	
4	9	
5	13	
6	14	
7	15	
Total:	75	

How I can achieve better:

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1. A particle P of mass 2kg is subjected to a force F such that its displacement, r metres, from a fixed origin, O , at time t seconds is given by

$$r = (3t^2 - 4)\mathbf{i} + (3 - 4t^2)\mathbf{j}.$$

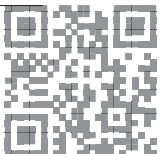
(a) Show that the acceleration of P is constant.

[4]

(b) Find the magnitude of F .

[3]

Total: 7

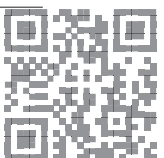


2. A pump raises water from a well 12 metres below the ground and ejects the water through a pipe of diameter 10 cm at a speed of 6 ms^{-1} .

Given that the mass of 1 m^3 of water is 1000kg,

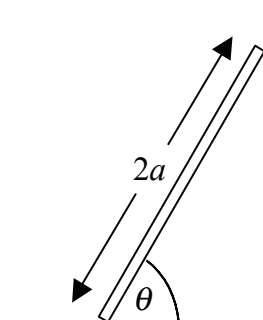
- (a) find, in terms of π , the mass of water discharged by the pipe every second, [4]
- (b) find in kJ, correct to 3 significant figures, the total mechanical energy gained by the water per second. [4]

Total: 8

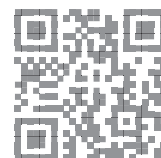


4. Figure shows a uniform ladder of mass m and length $2a$ resting against a rough vertical wall with its lower end on rough horizontal ground. The coefficient of friction between the ladder and the wall is $\frac{1}{2}$ and the coefficient of friction between the ladder and the ground is $\frac{1}{3}$.

[9]



Given that the ladder is in limiting equilibrium when it is inclined at an angle θ to the horizontal, show that $\tan \theta = \frac{5}{4}$.



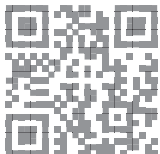
5. A firework company is testing its new brand of firework, the Sputnik Special. One of the company’s employees lights a Sputnik Special on a large area of horizontal ground and it takes off at a small angle to the vertical. After a flight lasting 8 seconds it lands at a distance of 24 metres from the point where it was launched.

The employee models the firework as a particle and ignores air resistance and any loss of mass which the Sputnik Special experiences.

Using this model, find for this flight of the Sputnik Special,

- (a) the horizontal and vertical components of the initial velocity, [5]
- (b) the initial speed, correct to 3 significant figures, [2]
- (c) the maximum height attained. [3]
- (d) Comment on the suitability of the modelling assumptions made by the employee. [3]

Total: 13



6. Three uniform spheres A , B and C of equal radius have masses $3m$, $2m$ and $2m$ respectively. Initially, the spheres are at rest on a smooth horizontal table with their centres in a straight line and with B between A and C . Sphere A is projected directly towards B with speed u .

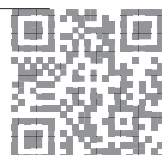
Given that the coefficient of restitution between A and B is $\frac{2}{3}$,

(a) show that the speeds of A and B after the collision are $\frac{1}{3}u$ and u respectively. [6]

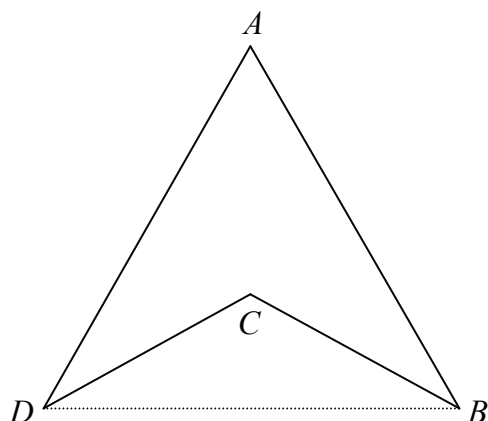
The coefficient of restitution between B and C is e . Given that A and B collide again,

(b) show that $e > \frac{1}{3}$. [8]

Total: 14



7. Figure shows a uniform lamina $ABCD$ formed by removing an isosceles triangle BCD from an equilateral triangle ABD of side $2d$.



The point C is the centroid of triangle ABD .

- (a) Find the area of triangle BCD in terms of d . [3]
- (b) Show that the distance of the centre of mass of the lamina from BD is $\frac{4}{9}\sqrt{3}d$. [8]

The lamina is freely suspended from the point B and hangs at rest.

- (c) Find in degrees, correct to 1 decimal place, the acute angle that the side AB makes with the vertical. [4]

Total: 15

