This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 04

12FEB2024

Do NOT write in this box. Your MARK will be placed here.

Subject :	A Level Maths : M1Mech
Class :	11A and 12A
Teacher :	Dr Ruth Brett
Duration :	20 minutes

Answer on squared paper and staple it to the question paper. You may add to the diagrams on this paper, but no work written on this paper will be graded. Remember that you must include sufficient working, or you may get no credit for a correct answer. Whe

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Where necessary, use $g = 9.8\ ms^{-2}$

Q1.

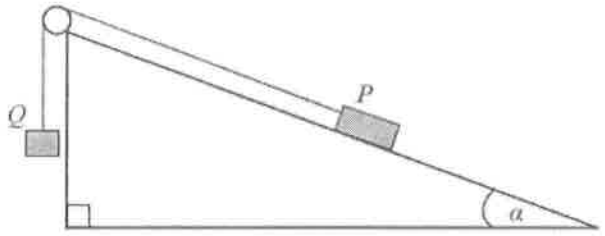


Figure 2

Two particles P and Q have masses 0.3 kg and m kg respectively. The particles are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed at the top of a fixed rough plane. The plane is inclined to the horizontal at an angle α, where $\tan \alpha = \frac{3}{4}$. The coefficient of friction between P and the plane is $\frac{1}{2}$.

The string lies in a vertical plane through a line of greatest slope of the inclined plane. The particle P is held at rest on the inclined plane and the particle Q hangs freely below the pulley with the string taut, as shown in Figure 2.

The system is released from rest and Q accelerates vertically downwards at $1.4\ m\ s^{-2}$.

Find

(*a*) the magnitude of the normal reaction of the inclined plane on P,

(2)

(*b*) the value of m.

(8)

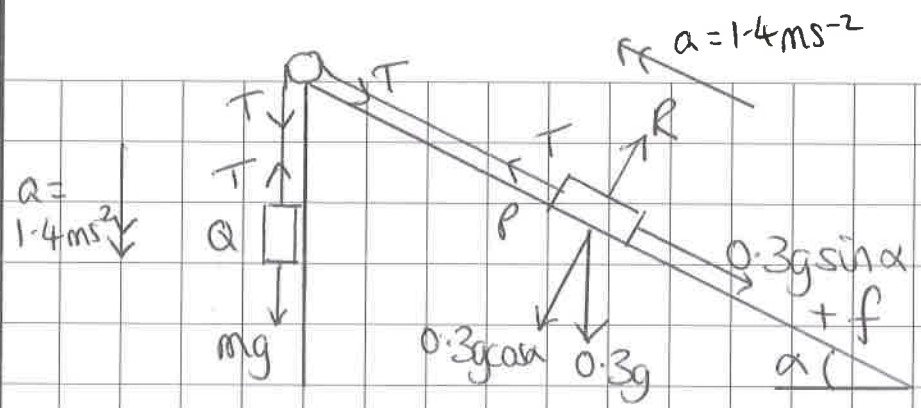
When the particles have been moving with this same acceleration for 0.5 s, the string breaks. Assuming that P does not reach the pulley,

(*c*) find the further time that elapses until P comes to instantaneous rest.

(6)

(Total 16 marks)

1.



$\tan\alpha = \frac{3}{4}$

$\cos\alpha = \frac{4}{5}$

$\sin\alpha = \frac{3}{5}$

a) $R\nearrow$ M① A①

$R = 0.3g\cos\alpha = 0.3g\left(\frac{4}{5}\right) = 2.35N$

b) For Q $\Sigma F = ma$

M① A①

$mg - T = m(1.4)$ ①

For P $\Sigma F = ma$ M① A① A①

$T - 0.3g\sin\alpha - f = 0.3(1.4)$

M①

$f = \mu R = \frac{1}{2}(2.35) = 1.18N$

$T = 0.3(9.8)\left(\frac{3}{5}\right) + 1.18 + 0.42 = 3.36N$

Subs for T in ①

$9.8m - 3.36 = 1.4m$ m①

$8.4m = 3.36$

$m = \frac{3.36}{8.4} = 0.4$ A①

c) P accelerates at $1.4\ ms^{-2}$ for 0.5s

find v at the end of this time

$v = ?$ $u = 0$ $t = 0.5$ $a = 1.4$

$v = u + at = 0.5(1.4) = 0.7\ ms^{-1}$ M①

New situation. Old v = new u.

New acceleration because T = 0

Now $\Sigma F = ma$

$-0.3g\sin\alpha - f = 0.3a$ M① A①

$-0.3(9.8)\left(\frac{3}{5}\right) - 1.18 = 0.3a$

$a = -9.81\ ms^{-2}$ A①

So now: $a = -9.81$ $u = 0.7$ $v = 0$ $t = ?$

$v = u + at$

$0 = 0.7 - 9.81t$ M①

$t = \frac{0.7}{9.81} = 0.071\ s$ A①