**Applied Maths Higher Level Deferred paper 2022**

**2022 Deferred paper 1 (a)**

Two cars, A and B, travel along a straight level road in opposite directions.   
A passes point *P* with speed 4 m s−1 and uniform acceleration 2 m s−2.   
Three seconds later B passes point *Q* with speed 5 m s−1 and uniform acceleration 4 m s−2.

The distance from *P* to *Q* is 1143 m.

The cars meet *t* seconds after A passes *P*.

Find the value of *t*.

Find the distance from *P* to the meeting point.

Find the distance between the cars when A is 160 m from the meeting point, before the cars meet.

**2022 Deferred paper 1 (b)**

An object falls vertically, from rest, from a height *h* metres. It travels metres during its final second of motion before hitting the ground.

Find the time it takes to fall to the ground.

Find the value of *h*.

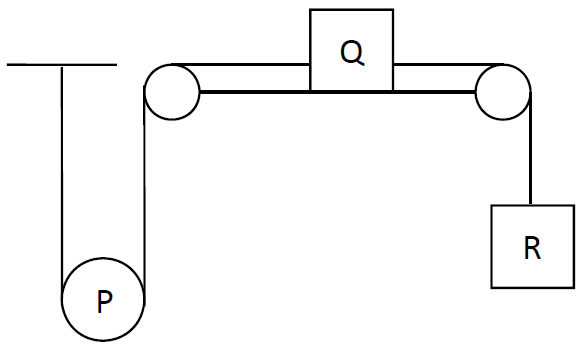
**2022 Deferred paper 3 (a)**

A particle is projected from a point on horizontal ground.

The speed of projection is 14 m s−1 at an angle 𝛼 to the horizontal.

Find the two values of 𝛼 that will give a range of 10 m.

**2022 Deferred paper 4 (a)**

A taut light inelastic string is fixed at one end and passes under a moveable pulley, P, of mass 4 kg which hangs vertically. The other end of the string is attached to Q, a mass of 4 kg which lies on a rough horizontal surface.

A second inelastic string connects Q to R, a mass of 10 kg which hangs vertically.

The fixed pulleys are smooth and light and the coefficient of friction between Q and the surface is ½.

The system is released from rest.

Find the accelerations of P, Q and R in terms of *g*.

**2022 Deferred paper 5 (a)**

A smooth sphere, P, of mass 3m collides directly with another smooth sphere, Q, of mass 5m.   
P and Q are moving in opposite directions before impact with speeds 4*u* and 2*u* respectively.   
The coefficient of restitution for the collision is *e*.

(i) Find the speed of P and the speed of Q after impact in terms of *u* and *e*.

(ii) If P and Q are moving in the same direction after impact, show that 0 ≤ *e* ˂ .

**2022 Deferred paper 5 (b)**

A smooth sphere, A, of mass m collides obliquely with

another smooth sphere, B, of mass m.

A circle with a line and a arrow

Description automatically generated with medium confidenceBefore impact, A is moving with speed u at an angle 𝛼 to the

line of centres of the spheres, where 0° ≤ 𝛼 ˂ 45°.

B is at rest before the impact.

The coefficient of restitution for the collision is e.

(i) Find the speed of A and the speed of B after impact in terms of u, e and 𝛼.

(ii) Given that A is deflected through angle 𝛼 because of the collision, show that tan2 𝛼 = e.

**2022 Deferred paper 6 (b)**

A particle of mass *m* is suspended vertically from a fixed point O by a light inelastic string of length *d* metres.

The particle is projected horizontally with speed *u*, where *u*2 = 4*gd*.

Show the string goes slack when it makes an angle with the upward vertical through O.

**2022 Deferred paper 10 (a)**

1. Solve the differential equation ) = 1 given that when .
2. If and when , find the value of *y* when .

**2022 Deferred paper 10 (b)**

A particle is projected horizontally along a smooth horizontal surface with initial speed 80 m s−1.   
The particle has a retardation of m s−2, where 𝑣 is the speed.

Find

(i) the speed of the particle after *t* seconds

(ii) the distance travelled in *t* seconds

(iii) the speed 𝑣 in terms of the distance travelled, *s*.