Two particles A and B have position vectors
$(2 \sin 2t\mathbf{i} + 2\cos 2t\mathbf{j})$ m and
$(2t\mathbf{i} + t^2\mathbf{j})$ m
respectively at time t seconds. Find

(a) the velocity of A relative to B when $t = 0$,

(b) the acceleration of each particle when $t = \frac{\pi}{4}$,

(c) the value of t for which the velocities of A and B have the same magnitude,

(d) the value of t for which the accelerations of A and B are parallel and in the same sense.

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2. A particle of mass 2 kg is acted on by forces $\mathbf{F}_1$, $\mathbf{F}_2$, and $\mathbf{F}_3$, where
$\mathbf{F}_1 = (4\mathbf{i} + 6\mathbf{j})$ N, $\mathbf{F}_2 = (6\mathbf{i} + 8\mathbf{k})$ N, $\mathbf{F}_3 = (2\mathbf{i} + 4\mathbf{k})$ N.
Initially the particle is at rest at the point with position vector $(2\mathbf{i} - 3\mathbf{j} + \mathbf{k})$ m. Find the position vector and the magnitude of the momentum of the particle after 4 seconds.

Find, also, the work done on the particle in this time.

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3. A particle P is projected from a point O of a horizontal plane π with velocity u at an angle α to the plane. Taking horizontal and vertical axes 0_x and 0_y respectively in the plane of the particle's path, show that the cartesian equation of the particle's path is

$$y = x\tan\alpha - \frac{gx^2 \sec^2\alpha}{2u^2}.$$

The particle passes through the points A (180, 30) and B (240, 20). Find

(a) the time of flight of P,

(b) the range of P on π,

(c) the greatest height of P above π.

(Take g as 10 m s^{-2}.)

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4. Two elastic spheres of masses 2m kg and 7m kg collide directly. Their velocities before impact are 6 m s^{-1} and 3 m s^{-1} respectively in the same direction and after impact they are $\frac{5}{2}$ m s^{-1} and u m s^{-1} respectively also in the same direction. Find the value of u and the coefficient of restitution between the spheres.

Find, also, the velocities of the spheres after impact if they collide directly when travelling in opposite directions, the velocity of the lighter sphere being 7 m s^{-1} and that of the heavier sphere 2 m s^{-1}.
In this case determine

(a) the loss in kinetic energy due to the impact,

(b) the magnitude of the impulse experienced by the lighter sphere.

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5. (i) A car moving along a straight level road accelerates uniformly from rest until it has travelled a distance x m. It then maintains a constant speed for 50 s and travels a further x m during this time. Finally it decelerates uniformly and comes to rest after travelling a further $\frac{x}{2}$ m. Find the total time for the journey.

(ii) A particle P moves in a straight line. The speed v m s^{-1} of the particle at time t seconds is given by

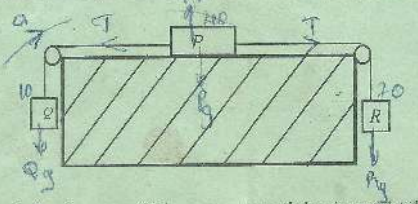
$$v = kt^2 - ct.$$

When $t = 0$, the particle is at the origin and when $t = 1$, the particle is again at the origin and travelling with an acceleration of 4 m s^{-2}. Find the values of the constants k and c. Hence find

(a) the distance covered during the first 4 seconds of motion,

(b) the acceleration of P during the third second of motion.

Two particles of masses 3m and 5m are attached to the ends of a light inextensible string of length a which passes through a smooth fixed ring at 0. The lighter particle describes a horizontal circle about the heavier particle, which remains at rest, as centre. Show that the heavier particle is at a depth $\frac{3a}{8}$ below 0, and that the time for a complete revolution is $\pi\sqrt{\frac{3a}{2g}}$.



The figure above shows a block P of a mass 40 kg on a smooth horizontal table. The block P is connected by two light inextensible strings passing over two smooth pulleys to blocks Q and R of masses 10 kg and 70 kg respectively. The blocks hang freely and the system is released from rest with both strings taut and the hanging parts vertical. Find

(a) the magnitude of the acceleration of the system,

(b) the tension in each string.

The block R falls a distance of 2 m and is brought to rest by the floor. Calculate the further distance that Q covers before momentarily coming to rest, given that it does not reach the pulley between it and block P.

(Take g as 10 m s^{-2}.)

(i) An urn contains 10 red balls, 12 green balls and 8 yellow balls. Balls are to be drawn from the urn at random, one after the other without replacement.

Calculate the probability that

(a) the first two balls drawn will both be red balls,

(b) the third ball drawn will be the first red ball,

(c) the first ball will be green and the second will be yellow,

(d) of the fist two balls drawn , one will be green and the other yellow,

(e) the last ball drawn will be red.

(ii) The events A and B are independent.

The probability of event A occurring is $\frac{1}{5}$ and the probability of event B occurring is $\frac{2}{5}$. Find the probability of

(f) either A or B occurring ,

(g) neither A nor B occurring ,

(h) one and only one of the two events occurring.

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2001

ADVANCED LEVEL

Subject Title	**Pure Mathematics with Mechanics**
Paper No.	**Paper 3**
Subject Code No.	**765**

Two and a half hours

Full marks may be obtained for answers to SIX questions.

(If you attempt more than six questions, only the best six answers will be taken into account.)

All questions carry equal marks.

You are reminded of the necessity for good English and orderly presentation in your answers.

Mathematical formulae and tables are provided.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

Electronic calculations are allowed.