Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Practice Paper 1

(Time: 1 hour 30 minutes) | Paper Reference **9FM0/3C**

Further Mathematics

Advanced

Paper 3C: Further Mechanics 1

You must have:
Mathematical Formulae and Statistical Tables, calculator

Total Marks

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all questions and ensure that your answers to parts of questions are clearly labelled.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 75. There are 7 questions.
- The marks for each question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Answer ALL questions.

1. A particle P of mass 6 kg is travelling along rough horizontal ground when it collides with a particle Q of mass 4 kg. Immediately before the collision P is travelling with a speed of 2.5 m s^{-1}.

After the collision the two particles coalesce.

(a) State the coefficient of restitution between the two particles.

(1)

(b) Find the speed of the combined particles immediately after the collision.

(2)

(c) Calculate the kinetic energy lost in the collision.

(3)

(d) Given that combined particles come to rest after travelling 2 m, find the coefficient of friction between the particles and the ground.

(3)

(Total for Question 1 is 9 marks)

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2. A car of mass 1400 kg is moving along a straight horizontal road. When the car is travelling at a speed of v m s^{-1}, its total non-gravitational resistances to motion are modelled as a variable force of magnitude $(120 + 2v^2)$ N. The engine of the car is working at a constant rate of 20 kW.

(a) Find the acceleration of the car at the instant when $v = 16$.

(4)

The car now travels downhill on a straight road at an angle of 6° to the horizontal. The driver wishes to maintain a constant speed of 20 m s^{-1}.

(b) Show that the driver will need to brake to maintain this speed.

(3)

The driver places the car in neutral so that it freewheels with no driving force and no braking force.

(c) Find the maximum speed of the car.

(4)

(Total for Question 2 is 11 marks)

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3. A ball of mass m kg is dropped from a vertical height of h m above a smooth plane that is inclined at an angle θ to the horizontal, where $\tan\theta = \frac{3}{4}$. The coefficient of restitution between the ball and the plane is e.

Given that the ball loses half of its kinetic energy on impact with the plane, find the value of e.

(Total for Question 3 is 9 marks)

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4. A football of mass 0.2 kg is travelling with velocity $(5\mathbf{i} - 2\mathbf{j})$ m s^{-1} when it receives an impulse of **P** N. Immediately afterwards its velocity is $(8\mathbf{i} + 4\mathbf{j})$ m s^{-1}.

Find

(i) the magnitude of P,

(ii) the angle between P and i.

(Total for Question 3 is 5 marks)

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5. An elastic string has natural length 1.2 m and modulus of elasticity 15 N. One end is fixed at a point P on a horizontal ceiling. A ball of mass 0.25 kg is attached to the free end and hangs in equilibrium at the point Q, vertically below P.

(a) Find the distance PQ.

(3)

The string is then stretched to a length of 1.9 m.

(b) Calculate the work done in stretching the string from the equilibrium position.

(4)

The ball is released.

(c) Find the speed of the ball as it passes through Q.

(3)

(d) Show that in the subsequent motion the ball will not hit the ceiling.

(6)

(Total for Question 5 is 16 marks)

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6. Three balls, P, Q and R, of equal radius and with masses of 3 kg, 1 kg and 2 kg respectively, lie at rest in a straight line on a smooth horizontal table. Ball P is projected towards ball Q with speed 3 m s^{-1}. The coefficient of restitution between each pair of balls is e. After the initial collision Q has 3.645 J of kinetic energy.

(a) Work out:

(i) the velocities of P and Q after the collision,

(ii) the value of e.

(6)

Q then moves on to collide with R.

(b) Find the kinetic energy lost in the subsequent collision.

(8)

(c) State whether or not P and Q collide again. You must justify your answer.

(2)

(Total for Question 6 is 16 marks)

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7. A smooth sphere S is moving on a smooth horizontal plane with speed u when it collides with a smooth fixed vertical wall. At the instant of collision, the direction of motion of S makes an angle of 60° with the wall. Immediately after the collision S has a speed of $\frac{15}{16}u$ m s^{-1} and its direction of motion makes an angle of α with the wall.

(a) Find

(i) the value of α,

(ii) the coefficient of restitution between S and the wall.

(4)

S then moves on and collides obliquely with another smooth sphere T of equal mass and radius. Immediately before the impact T is stationary and the velocity of S makes an angle of α with the lines of centres of the two spheres, where α is the angle found in part (a)(i). The coefficient of restitution between the spheres is $\frac{3}{4}$.

(b) Find the speeds of S and T immediately after the collision in terms of u, and the angle the velocity of each sphere makes with the line of centres.

(5)

(Total for Question 7 is 9 marks)

TOTAL FOR FURTHER MECHANICS 1 IS 75 MARKS