Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Paper reference **8MA0/22**

Mathematics

Advanced Subsidiary
PAPER 22: Mechanics

October 2021 Shadow Set 1

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed by Pearson regulations. 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.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Unless otherwise indicated, wherever a value of g is required, take $g = 9.8\ \text{m s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 30. There are 3 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.
- Good luck with your examination.

Turn over ▶

1. At time $t = 0$, a ball is thrown vertically upwards with speed 24.5 m s^{-1} from a point A, above the ground.

At time $t = T$ seconds, the ball passes through A, moving downwards.

The stone is modelled as a particle moving freely under gravity throughout its motion.

Using the model,

(a) find the value of T,

(2)

(b) find the total distance travelled by the ball in the first 6 seconds of its motion.

(4)

(c) State one assumption that you have made, apart from ignoring air resistance, to create this simple model.

(1)

(Total for Question 1 is 7 marks)

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2. A particle is moving on the x-axis.

At time t seconds, the velocity v m s^{-1} of the particle is modelled as

$$v = 8t - t^2 - k \qquad t \leq 0$$

where k is a constant.

(a) Find the acceleration of the particle at time t seconds.

(2)

The particle P is instantaneously at rest when $t = 5$

(b) Find the other value of t when the particle is instantaneously at rest.

(4)

(c) Find the total distance travelled by the particle in the interval $0 \leqslant t \leqslant 5$

(4)

(Total for Question 2 is 10 marks)

3.

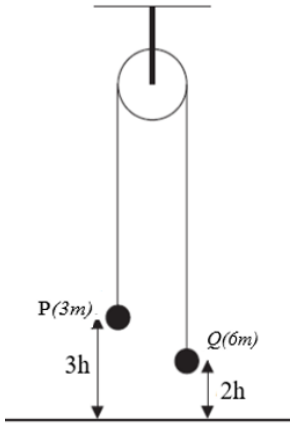

Figure 1

Two particles P and Q of masses $6m$ and $3m$ respectively are attached with a light inextensible string.

The string passes over a fixed pulley. The pulley is modelled as being small and smooth.

The system is held at rest with the balls hanging freely and the string taut.

The hanging parts of the string are vertical with P at a height $3h$ above horizontal ground and with Q at a height $2h$ above the ground, as shown in Figure 1.

The system is released from rest.

In the subsequent motion, Q does not rebound when it hits the ground and P does not hit the pulley.

Air resistance is ignored.

Using this model,

(a) (i) write down an equation of motion for P,

(ii) write down an equation of motion for Q,

(4)

(b) find, in terms of h only, the height above the ground at which P first comes to instantaneous rest.

(7)

(c) State how taking into account air resistance would (or could) affect your answer to part (b).

(1)

In reality, the string will not be inextensible.

(d) State how this would affect the accelerations of the particles.

(1)

(Total for Question 3 is 13 marks)

TOTAL FOR MECHANICS IS 30 MARKS