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| **Pearson Edexcel Level 3** | |
| **GCE Mathematics**  **Advanced Subsidiary**  **Paper 2: Mechanics** | |
| **Specimen paper**  **Time: 35 minutes** | **Paper Reference(s)** |
| **8MA0/02** |
| **You must have:**  **Mathematical Formulae and Statistical Tables, calculator** | |

**Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic 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** the questions in Section B.

• 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.

• Inexact answers should be given to three significant figures unless otherwise stated.

**Information**

• A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.

• There are 4 questions in this section. The total mark for Part B of this paper is 30.

• 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.

• If you change your mind about an answer, cross it out and put your new answer and any working underneath.

**SECTION B: MECHANICS**

**Answer ALL questions.**

**1.** A small ball is projected vertically upwards from a point *A* which is 19.6 m above the ground. The ball strikes the ground, for the first time, 4 s later.

The motion of the ball is modelled as that of a particle moving freely under gravity.

(a) Use the model to find the speed of the ball as it hits the ground for the first time.

**(3)**

The ball rebounds from the ground with a vertical speed of 14.7 m s–1 and next comes to instantaneous rest at the point *B*.

(b) Use the model to find the height of *B* above the ground.

**(2)**

In a refined model of the motion of the ball, the effect of air resistance is included and this refined model is now used to find the speed of the ball as it hits the ground for the first time

(c) How would this new value of the speed of the ball as it hits the ground for the first time compare with the value found using the initial model in part (a)?

**(1)**

**(Total 6 marks)**

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**2.** A cartravels along a straight horizontal road between two sets of traffic lights. The distance between the two sets of traffic lights is 1500 m.

In a model of the journey, the car leaves the first set of traffic lights, accelerating uniformly from rest until it reaches a speed of *V*m s–1, then immediately decelerates uniformly until it comes to rest at the second set of traffic lights. The car completes the journey between the two sets of lights in 120 s.

(a) Sketch a velocity-time graph which represents the above model of the journey of the car between the two sets of traffic lights.

**(2)**

(b) Using the model, find the value of *V*.

**(2)**

It is given that the car accelerates uniformly for *T* seconds.

(c) Explain why there is a range of possible values for *T* which satisfy the requirements of the model.

**(2)**

(d) Suggest one improvement to the model that would make it more realistic.

**(1)**

**(Total 7 marks)**

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**3.**

*P* (0.4 kg)

*Q* (*M* kg)

2 m

**Figure 1**

A ball, *P,* of mass 0.4 kg rests on a rough horizontal table and is attached to one end of a thin rope. The rope passes over a pulley which is fixed at the edge of the table. The other end of the rope is attached to another ball, *Q*, of mass *M* kg which hangs freely below the pulley, as shown in Figure 1.

The system is released from rest with the rope taut and with *Q* at a height of 2 m above the ground and *Q* moves downwards with acceleration 2.5 m s–2. In the subsequent motion *P*does not reach the pulley before *Q* reaches the ground.

The balls are modelled as particles, the rope as a light and inextensible string and the pulley as being small and smooth. The total resistance to the motion of *P* is modelled as having constant magnitude 1.5 N. The acceleration due to gravity is modelled as being 10 m s–2.

Using this model, find, to 2 significant figures,

(a) (i) the tension in the rope,

(ii) the value of *M*,

**(6)**

(b) the time, after release, for *Q* to hit the ground.

**(2)**

(c) State one limitation of the model which will affect the accuracy of your answer to part (a).  **(1)**

**(Total 9 marks)**

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**4.** A particle *P* moves along a straight line such that at time *t* seconds, *t*  0, its velocity, *v*m s–1, is given by

*v* = 16 – 3*t*2

Given that the velocity *v* is the rate of change of position *s*, i.e. ,

find

(a) the distance *s* travelled by *P* in the first second,

**(3)**

(b) the value of *t* at the instant when *P* changes its direction of motion,

**(2)**

(c) the value of *t* at the instant when *P* returns to its starting point.

**(3)**

**(Total 8 marks)**

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**TOTAL FOR SECTION B: 30 MARKS**