Set A

Please check the examination details below before entering your candidate information

Candidate surname	Other names

MME Edexcel
Level 3 GCE

Centre Number | | | | | |

Candidate Number | | | | |

MME Edexcel Practice Papers

Morning (Time: 2 hours) | Paper Reference **3MME**

Mathematics
Advanced
Paper 3: Statistics and Mechanics

You must have:
Mathematical Formulae and Statistical Tables, Calculator

Total Marks

Candidates may use any approved calculator.
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.
- Values from statistical tables should be quoted in full. If a calculator is used instead of tables the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information
- The total mark for this paper is 100. Each section is worth 50 marks.
- 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.

Turn over ▶

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Paper 31: STATISTICS

Answer ALL questions. Write your answers in the spaces provided.

1. A meteorologist records the daily mean air temperature in degrees Celsius for Jacksonville over the course of six months.

A sample of this data taken from a spreadsheet is shown below.

Date	Temperature °C
15/05/2015	24.2
15/06/2015	27.2
15/07/2015	28.1
15/08/2015	25.9
15/09/2015	23.3
15/10/2015	19.1

(a) Suggest, with a reason, whether the sample is random or systematic. Give an advantage and disadvantage for each of these methods.

(3)

(b) Calculate the mean, variance and standard deviation of the data set.

(4)

(c) Based on this data, the meteorologist uses the values calculated in part (b) to model the temperature in Jacksonville in 2015 using a normal distribution.

Suggest, with a reason, whether his plan is suitable.

(1)

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2. The discrete random variable X has binomial distribution $B(n, p)$.

Given that, $n \times p = \sqrt{np(1-p)} = 0.9$

Find the value of n.

(4)

(Total for Question 2 is 4 marks)

3. In a survey of maths students, it was found that 75% use Instaphoto, 60% use Snaptalk and 10% use neither.

(a) Find the probability that a student uses both Instaphoto and Snaptalk.

(3)

(b) Draw a Venn diagram to show this information.

(2)

(c) Determine whether the probability of using Instaphoto is independent from the probability of using Snaptalk.

(3)

(d) Find $P([I' \cup S'] \cap [I \cup S])$.

(2)

Turn over ▶

4. Bruce grows championship pumpkins and is testing a new compost.

Over 5 years he has found that there is a 0.25 chance of a pumpkin weighing more than 20 kg.

He hopes that a new compost will increase pumpkin size and wants to test this.

He takes a sample of 10 pumpkins and measures their weight after 6 months growth in the new compost.

(a) State suitable hypotheses for testing the new composts affects.

(1)

(b) Using a 5% significance level find the critical region and write down the actual significance level of this test.

(5)

(c) Given that Bruce finds 4 out of 10 pumpkins sampled weigh more than 20 kg after 6 months of growth with the new compost, state your conclusions from the hypothesis test clearly.

(2)

Turn over ▶

5. A pump's lifetime, D, follows a normal distribution.

$\mu = 1500$
$\sigma^2 = 1500$

A pumping station needs 5 working pumps, without which it fails.

(a) Find the probability that a pump will fail before 1400 hours of use.

(2)

(b) 5 new pumps were installed at the same time. They have already run for 1400 hours.

Find the probability that the pumping station will fail before the pumps have worked for 1500 hours.

(5)

(c) After 1500 hours the 5 new pumps are all still working.
The engineers believe the mean lifetime is greater than 1500 hours.

A sample of 5 pumps are tested and have a mean lifetime of 1550 hours.
Clearly stating hypotheses, test the engineers' claim at the 5% significance level.

(5)

6. A discrete random variable X satisfies

$$X \sim B(n, p)$$

Given that $P(X = 4) = P(X = 5)$, show that the expected number of successes is $5 - p$

(8)

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Paper 32: MECHANICS

Unless otherwise stated, whenever a numerical value of g is required, take $g = 9.8\ \text{ms}^{-2}$ and give all your answers to 2 or 3 significant figures unless otherwise stated.

Answer ALL questions. Write your answers in the spaces provided.

1. At time t seconds, the acceleration of a particle in ms^{-2} is given by

$$\boldsymbol{a} = 6t^2\boldsymbol{i} + 8t^3\boldsymbol{j}$$

when $t = 0$, $\mathbf{u} = 400\boldsymbol{i}$ and the particle is at the origin.

(a) Find the particles distance from the origin after the first 10 seconds of its motion.

(5)

(b) At $t = 10$ the particle is at the point A.

Find the angle, in degrees, between the position vector of A and unit vector $\boldsymbol{i}$.

(3)

Turn over ▶

2. Boat A travels in a straight line at a constant velocity of 20 ms^{-1}, passing point P at time $t = 0$. Exactly 4 seconds later, a second boat, B, travelling at 15 ms^{-1}, moves in the same direction from point P. Boat B accelerates at a constant 2 ms^{-2}.

At time t seconds after Boat A's departure, the two boats collide.

Show that $t^2 - 13t - 44 = 0$

(5)

(Total for Question 2 is 5 marks)

3. A box of mass 15 kg is being pulled along a rough horizontal plane by a force of 25 N at 30° to the horizontal shown in **Figure 1**.

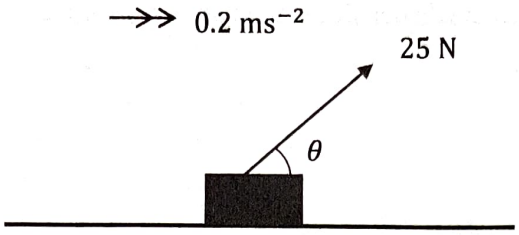

Figure 1

Given the the box is accelerating at 0.2 ms^{-2}, by modelling the box as a particle, find

(a) the magnitude of the normal reaction of the plane on the box.

(3)

(b) the coefficient of friction between the box and the plane.

(3)

(Total for Question 3 is 6 marks)

4. A ball is thrown upwards from a point A which is 9 m above the horizontal ground as shown in **Figure 2**.

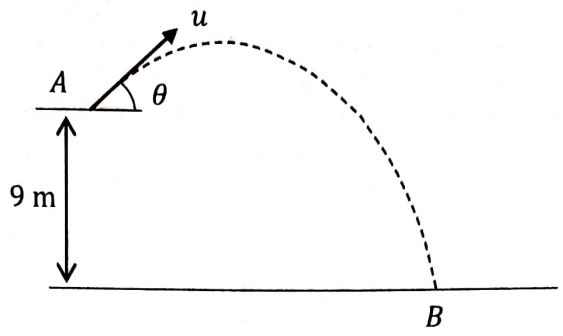

Figure 2

The ball is projected with an initial velocity of u ms^{-1} at an angle θ above the horizontal. The ball moves freely under gravity and hits the ground at the point B.

The magnitude of the velocity of the ball immediately before it hits the ground is $2u$ ms^{-1}

(a) Find the value of u.

(6)

(b) If the ball hits the ground after 2 seconds, find the value of θ.

(4)

Turn over ▶

5. Louise takes part in a parkrun where the first 1 km of the course is a long flat straight section.

She starts from rest and moves with constant acceleration until reaching a speed of $6.25\ \text{ms}^{-1}$ which she maintains for T seconds.

She then decelerates at a constant rate until she stops at the 1 km mark.

Louise has covered this distance in three minutes.

(a) In the space provided, sketch a speed-time graph to illustrate Louise's run.

(2)

(b) Calculate the value of T.

(2)

(Total for Question 5 is 4 marks)

6. A non-uniform plank AB, of mass 50 kg and length 15 m is supported on 2 smooth supports P and Q. As shown in **Figure 3**, the distance $AP = 1.8$ m, $QB = 2.4$ m and the centre of mass of the plank is at C.

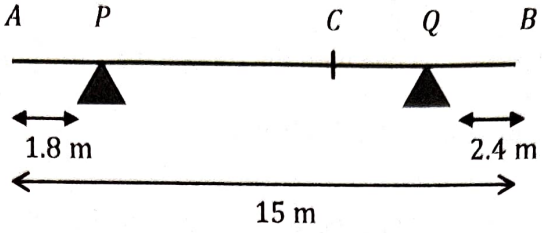

Figure 3

The magnitude of the reaction at support Q is three times that of the magnitude of the reaction at point P.

The system is in equilibrium.

(a) Find the magnitude of the reaction at P.

(3)

(b) Find the distance between C and A.

(5)