Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

MME Edexcel
Level 3 GCE

MME Edexcel Practice Papers

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

Mathematics (A-A*)

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 ▶

MME

MME

Paper 31: STATISTICS

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

1. The events A and B are such that,

$$P(A) = \frac{1}{4}, P(B) = \frac{11}{48}, P[(A \cap B') \cup (A' \cap B)] = \frac{15}{48}$$

Find the value of $P(A \cap B)$

(6)

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2. A list of six numbers is given below:

$$x + 1, \quad x, \quad 2x - 3, \quad 6 - x, \quad 3x + 5, \quad 3$$

(a) Find the mean of the numbers.

Give your answer in terms of x.

(2)

(b) The standard deviation of the numbers is $\frac{4\sqrt{6}}{3}$

Given that x is positive, find the value of x.

(5)

3. The probability distribution of a discrete random variable X is given by,

$$P(X = r + 1) = \begin{cases} \frac{5}{6}P(X = r) & r = 1,2,3,4,\ldots \\ 0 & \text{otherwise} \end{cases}$$

Determine $P(9 \leq X \leq 28)$.

(7)

(Total for Question 3 is 7 marks)

4. Buses arrive on Cranmer high street every half an hour. They are either late or on time.

If a bus is on time, the probability of the next bus being on time is 0.8

If a bus is late, the probability of the next bus being late is 0.5

On a certain day the 07:32 bus arrived on time.

Given that the 09:02 bus arrived on time, find the probability that the 08:02 bus was late.

(6)

5. A random sample of 20 students is taken from a group who sat an exam.

The probability that they get the 4^{th} question correct is found to be 0.25

Students get 6 marks for getting the 4^{th} question correct but lose 2 if they answer incorrectly.

Find the probability that the total number of marks scored by all 20 students is greater than 24 for the 4^{th} question.

(6)

(Total for Question 5 is 6 marks)

6. A computer program takes on average 17 minutes to complete its task.

(a) Assume the time taken is normally distributed with $\sigma = 1.5$, find the time the program takes to complete in 5% of the runs.

(2)

A new company begins using this software.

(b) Given that on the first run it took less than 22 minutes to complete, determine the probability it took more than 13 minutes.

(4)

(c) Given instead that the program took more than 13 minutes, find the probability it took less than 17 minutes.

(1)

(Total for Question 6 is 7 marks)

7. The amount of mayonnaise dispensed into a jar by a machine is normally distributed with a mean of 252 ml and a standard deviation of σ ml.

Given that,

$$P(X < a) = 0.82\% \text{ and } P(X > a + 10) = 5.48\%$$

Where a is a positive constant.

Find the value of σ.

(6)

8. A sample of size 28 is used to test the null hypothesis $H_0: p = 0.85$ against the alternative hypothesis $H_1: p > 0.85$ using a $k\%$ level of significance.

(a) Given that there is at least one value that leads to the rejection of the null hypothesis, find the range of values for k.

(2)

A sample of size n is used to test the null hypothesis $H_0: p = 0.3$ against the alternative hypothesis $H_1: p \neq 0.3$ using a 1% level of significance.

(b) Given that there is exactly one critical region for this test, find the range of values for n.

(3)

(Total for Question 8 is 5 marks)

TOTAL FOR PAPER 31 IS 50 MARKS

Paper 32: MECHANICS

Unless otherwise stated, whenever a numerical value of g is required, take $g = 9.8\ ms^{-2}$ 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. Two forces of magnitude 10 N have a resultant magnitude of 16 N.

The two forces act on a particle, of mass m kg, which remains at rest.

The particle lies on a smooth horizontal surface which makes an acute angle θ with one of the two 10 N forces.

The surface exerts a force of 8 N on the particle.

Determine the exact value of m and the exact value of $\cos\theta$.

(8)

2. For a particle projected with initial velocity u ms^{-1} at an angle of $\alpha°$ above the horizontal, show that the equation of the trajectory of the particle is given by

$$y = x\tan\alpha - \frac{(1+\tan^2\alpha)\,gx^2}{2u^2}$$

(6)

(Total for Question 2 is 6 marks)

3.

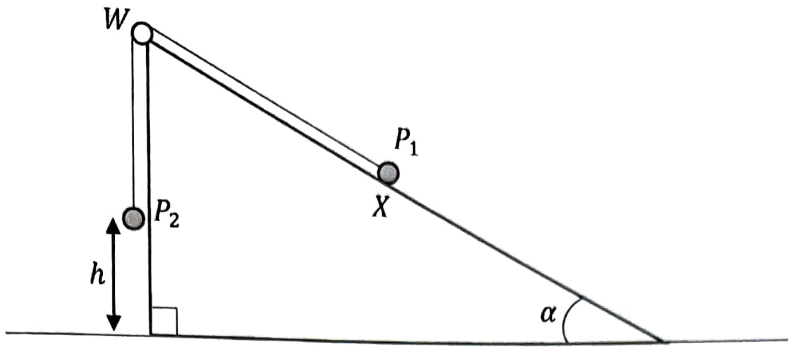

Figure 1

Two particles P_1 and P_2 have masses m and $3m$ respectively. Each end of a light inextensible string is attached to A and B. Initially P_1 is held at rest on a rough inclined plane, which is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{3}{4}$. The coefficient of friction between P_1 and the plane is $\frac{1}{3}$. The string passes over a small smooth pulley W, fixed at the top of the plane. The string from W to P_1 is parallel to the line of greatest slope of the plane. P_2 hangs vertically below W. When released from rest the string is taut, P_1 is at the point X on the plane and P_2 is at height h above the ground.

(a) For the motion until P_2 hits the ground, find the acceleration of each particle.

(7)

When P_2 strikes the ground, it does not rebound and P_1 continues moving up the plane until the point Y where it comes to instantaneous rest without reaching W.

(b) Find the distance XY in terms of h.

(6)

4.

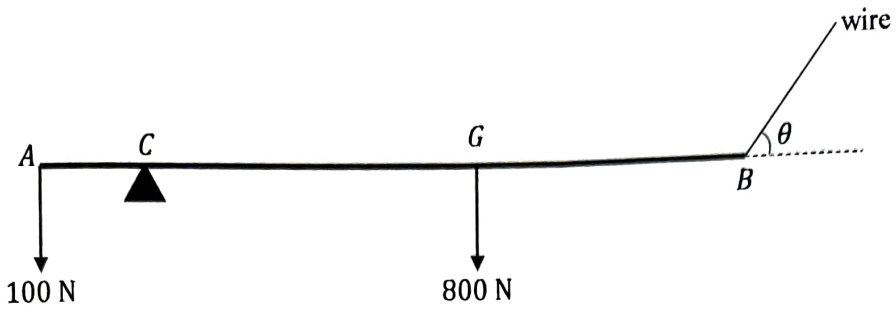

Figure 2

A thin rigid non-uniform beam AB of length 6 m and weight 800 N has its centre of mass at G, where $AG = 4$ m. An additional weight of 100 N is fixed at A.

The beam lies in a horizontal position supported by a rough peg at C, where $AC = 1$ m, and a light inextensible wire attached at B.

When the wire is inclined at θ to the horizontal, where $\sin\theta = 0.8$, the beam remains horizontal, in limiting equilibrium.

Calculate the tension in the wire and the value of the coefficient of friction between the peg and the beam.

(9)

5. *The unit vectors* $\mathbf{i}$ *and* $\mathbf{j}$ *are oriented due east and due north, respectively.*

Two planes, A and B, are flying with constant velocities $(7\boldsymbol{i} + 3\boldsymbol{j})$ kmh^{-1} and $(-3\boldsymbol{i} + 9\boldsymbol{j})$ kmh^{-1}, respectively.

At midnight, B is on a bearing of 120° from A, 12 km away.

(a) Find, correct to the nearest metre, the distance between A and B when B is due east of A.

(8)

(b) Find the time when the two planes are the closest to each other.

(6)