IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper S

Difficulty Rating: 4.8067/1.6760

Time: 3 hours

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 16 questions in this question paper.
The total mark for this paper is 150.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

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SECTION 1 - STATISTICS

Question 1

The discrete random variable X has binomial distribution $\mathrm{B}(n, p)$.

Given further that $n \times p = \sqrt{np(1-p)} = 0.95$ determine the value of n. **(4)**

Question 2

It is given that for a sample of data $x_1,\ x_2,\ x_3, x_4, x_5, \ldots x_n$ the mean $\overline{x}$ and standard deviation σ are

$$\overline{x} = \frac{1}{n}\sum_{r=1}^{n} x_r = 2 \qquad \text{and} \qquad \sigma = \sqrt{\frac{1}{n}\sum_{r=1}^{n}(x_r)^2 - \frac{1}{n^2}\left(\sum_{r=1}^{n} x_r\right)^2} = 3.$$

Determine, in terms of n, the value of

$$\sum_{r=1}^{n}(x_r + 1)^2. \qquad \textbf{(8)}$$

Question 3

The continuous random variables X and Y are independent of one another and have Normal distributions

$$X \sim \mathrm{N}\left(300, 25^2\right) \quad \text{and} \quad Y \sim \mathrm{N}\left(210, 50^2\right).$$

Given further that $P(X < k) = P(Y > k)$, determine the value of k.

Detailed workings must be presented in this question. **(8)**

Question 4

Two candidates, A and B, are about to be interviewed by a company.

The probability that **both** candidates will be **unsuccessful** is the same as the probability that candidate B will be **unsuccessful**.

Show that the probability that **both** candidates will be **successful** is the same as the probability that candidate A will be **successful**.

You may not assume independence in this question. **(4)**

Question 5

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

$$\mathrm{P}(X=x)=\begin{cases}\frac{1}{7} & x=1,\ 2,\ 3,\ \ldots\ 7\\ 0 & \text{otherwise}\end{cases}$$

The probability distribution of another discrete random variable Y is given by

$$\mathrm{P}(Y=y)=\begin{cases}\frac{1}{y} & x=2,\ 3,\ 6\\ 0 & \text{otherwise}\end{cases}$$

Two observations of X are made, denoted by X_1 and X_2, and one observation of Y, denoted by Y_1 are considered.

Assuming these three observations are independent, calculate $P(X_1+X_2\geq 9+Y_1)$. **(10)**

Question 6

It is given that the discrete random variable X satisfies

$$X \sim \mathrm{B}(n, p).$$

Given further that $\mathrm{P}(X = 2) = \mathrm{P}(X = 3)$, show that

$$\mathrm{E}(X) = 3 - p.$$

You may assume that $\mathrm{E}(X) =$ mean of the distribution , defined as $n \times p$. **(8)**

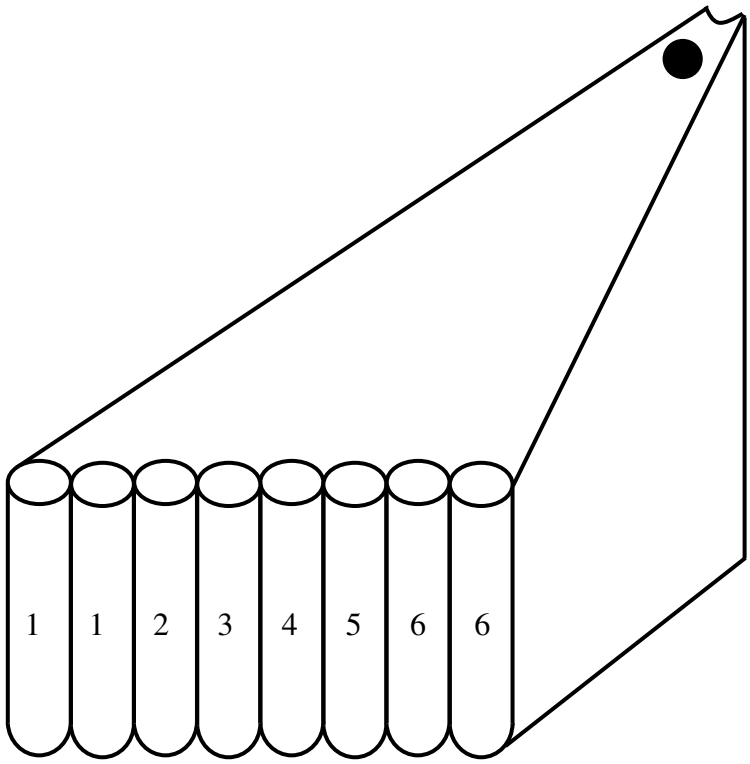
Question 7

The events A and B are such so that

$$\mathrm{P}(A \cup B') = 0.92, \quad \mathrm{P}(A' \cup B) = 0.5 \quad \text{and} \quad \mathrm{P}(A' \cup B') = 0.88.$$

Determine the value of $\mathrm{P}(A' \cap B')$. **(10)**

Question 8



The figure below shows a contraption where balls are rolling down a slope and fall into one of 8 vertical tubes. There is **equal chance** of a ball falling into any of these 8 vertical tubes. The ball scores according to which tube it falls in, and these scores are marked clearly in the figure below.

Two balls are rolled in succession.

Determine the probability that …

a) … their sum is even. **(3)**

b) … the second ball will score higher than the first. **(4)**

c) … their sum is even and the second ball will score higher than the first. **(5)**

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[continued from overleaf]

Three balls are rolled in succession.

Determine the probability that …

d) … they will fall into different tubes. **(3)**

e) … their scores will be different. **(8)**

SECTION 2 - MECHANICS

Question 9

A particle P is moving on the x axis and its velocity v ms^{-1} in the positive x direction, t seconds after a given instant, is given by

$$v = \frac{1}{2}t^2 - 3t + 4, \ t \geq 0.$$

The particle is passing through the origin when $t = 0$

Determine the displacement of the particle from the origin, when it has covered a **total distance** of 13 m. **(9)**

Question 10

Relative to a fixed origin O, the horizontal unit vectors $\mathbf{i}$ and $\mathbf{j}$ are pointing due east and due north, respectively.

A particle P is moving from point A to point B, with constant acceleration of $(p\mathbf{i} + q\mathbf{j})$ ms^{-2}, where p and q are constants. The velocity of P at A is $(10\mathbf{i} - 13\mathbf{j})$ ms^{-1} and the velocity of P at B is $(22\mathbf{i} + 22\mathbf{j})$ ms^{-1}.

Given that the magnitude of the acceleration is 3.7 ms^{-2}, find the value of p and the value of q. **(9)**

Question 11

A child is sitting over the shoulders of his father whose mass is 100 kg.

The father, with the child over his shoulders, is standing in a lift of mass 900 kg.

When the tension in the cable of the lift is 10200 N, the lift and its occupants is accelerating, with the child exerting a force of 200 N on the shoulders of his father.

Find the magnitude of the force exerted by floor of the lift to the feet of the father. **(9)**

Question 12

Two particles A and B have masses 4 kg and 1 kg, respectively.

A small, smooth light fixed pulley P, is located 1.6 m above a horizontal floor.

The two particles are connected by a light inextensible string, of length L m, which passes over P.

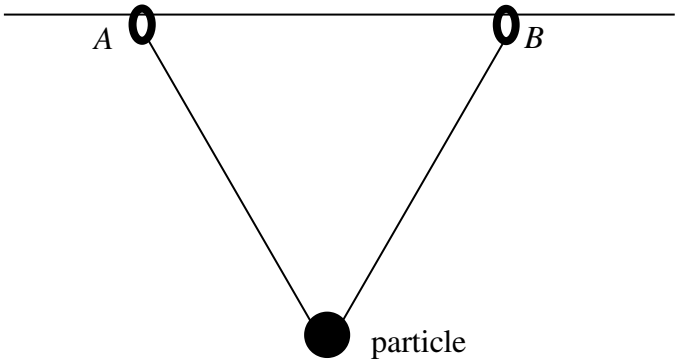
The particles are held at rest, with B level with the floor and A hanging above the floor, with the string taut and the hanging parts of the string vertical.

The system is released from rest and A hits the floor, from which it does not rebound.

B continues moving upwards and comes to instantaneous rest as it reaches P.

Determine the value of L. **(10)**

Question 13



Two identical small rings, A and B, are threaded on a fixed, rough horizontal wire. A light inextensible string of length 78 cm connects the two rings and a particle is attached to the midpoint of the string. The particle is hanging in equilibrium as shown in the figure above.

It is further given that the mass of each ring is $\frac{1}{3}$ of the mass of the particle, and the coefficient of friction between each ring and the wire is $\frac{1}{4}$.

Show that the length of AB is **at most** 30 cm. **(10)**

Question 14

Two cars, A and B, are travelling on a straight horizontal road.

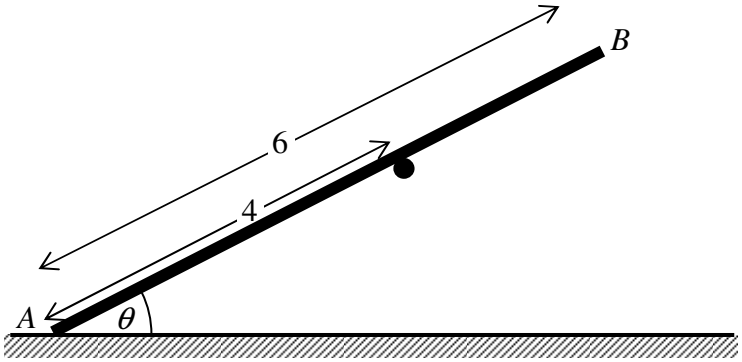
At time $t = 0$, A drives past a fixed point O on the road with speed 4.95 ms^{-1}, accelerating uniformly at 2 ms^{-2}.

After passing through O, A continues accelerating for 4 s, reaching a speed which it maintains thereafter.

At time $t = 2$, B starts from rest from O, accelerating uniformly at 1.5 ms^{-2}, until it reaches the point P, where it draws level with A.

Determine the distance OP. **(10)**

Question 15



The figure above shows a uniform rigid rod AB resting on a rough peg. The rod has weight W N and length 6 m and rests on the peg at the point C, where AC is 4 m. The coefficient of friction between the rod and the peg is 0.5.

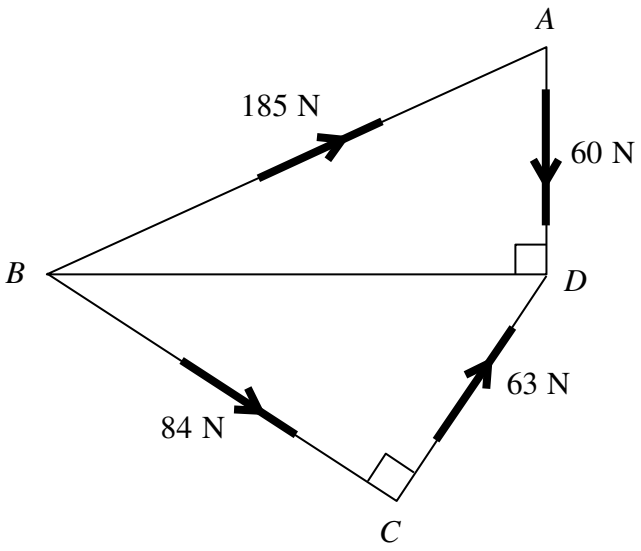
The end A of the rod rests in on rough ground, where the coefficient of friction between the rod and the ground is μ.

The rod is inclined at angle θ to the horizontal and the points A, B and C lie in a vertical plane which is perpendicular to the ground.

Given the equilibrium is limiting both at A and at C, show clearly that

$$\mu = \frac{6\tan\theta - 3}{8\tan^2\theta - 3\tan\theta + 2}. \qquad \textbf{(10)}$$

Question 16



The figure above shows a light rigid framework $ABCD$, where $\angle BDA = 90°$ and $\angle BCD = 90°$.

It is also given that $|AB| = 0.37$ m, $|BC| = 0.28$ m, $|CD| = 0.21$ m and $|AD| = 0.12$ m.

Forces of magnitude 185 N, 84 N, 63 N and 60 N are acting along AB, BC, CD and AD, in the directions indicated by the arrows in the figure.

The 4 forces reduce to a single force acting at some point P on AD, and at right angles to AD.

Determine the distance AP. **(8)**