IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper A

Difficulty Rating: 3.0133/0.6742

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 18 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 concentration of lactic acid, in appropriate units, after a period of intense exercise was measured in the blood of 12 marathon runners.

Athlete	A	B	C	D	E	F	G	H	I	J	K	L
Lactic Acid Concentration	180	172	110	175	256	140	241	450	205	375	402	195

a) Find the mean and the standard deviation of the data. **(4)**

b) Determine the value of the median and the quartiles. **(3)**

The skewness of data can be determined by the formula

$$\frac{3(\text{mean}-\text{median})}{\text{standard deviation}}.$$

c) Evaluate this expression for this data and hence state its skew. **(2)**

d) Draw a suitably labelled box plot for this data.
You may assume that there are no outliers in this data. **(3)**

Question 2

A test statistic has distribution $\text{B}(25, p)$.

a) Given that

$$\text{H}_0 : p = 0.35, \quad \text{H}_1 : p \neq 0.35,$$

find the critical region for the test statistic such that the probability of rejecting in each tail is as close as possible to 2.5%. **(5)**

b) State the probability of incorrectly rejecting H_0 using this critical region. **(1)**

Question 3

The table below shows the times obtained by a group of students, in two separate runs of a lap of the school's stadium.

Student	A	B	C	D	E	F	G	H
Run 1 (sec)	65	76	71	73	76	69	60	66
Run 2 (sec)	71	78	68	68	74	75	64	66

Let x and y represent the times obtained in Run 1 and Run 2, respectively.

a) Use a statistical calculator to find the value of the product moment correlation coefficient between x and y. **(1)**

b) Explain how the value of the product moment correlation coefficient between x and y will be affected if the individual times were converted into minutes. **(1)**

c) Test, at the 1% level of significance, whether there is evidence of positive correlation between x and y. **(5)**

d) Repeat the test of part **(c)** at the 5% level of significance, **(2)**

A student was absent from Run 1 but he ran Run 2 in 80 seconds.

e) Use linear regression to estimate this student's time in Run 2. **(3)**

Question 4

In a histogram the commuting times of a group of individuals, correct to the nearest minute, are plotted on the x axis.

In this histogram the class $47-50$ has a frequency of 48 and is represented by a rectangle of base 6 cm and height 3.6 cm.

In the same histogram the class $51-55$ has a frequency of 30.

Determine the measurements, in cm, of the rectangle that represents the class $51-55$. **(4)**

Question 5

The events A and B are statistically independent and further satisfy

$$\mathrm{P}(A)=0.4 \quad \text{and} \quad \mathrm{P}(A\cap B)=0.12\,.$$

Determine …

a) … $\mathrm{P}(B)$. **(2)**

b) … $\mathrm{P}(A\cup B)$. **(2)**

c) … $\mathrm{P}(A\cap B')$. **(2)**

d) … $\mathrm{P}(B'|A')$. **(1)**

Question 6

A popular bag of confectionary contains 20 sweets, of which $\frac{1}{5}$ are expected to be orange in flavour.

a) Find the probability that once such bag selected at random will contain at least 3 but no more than 7 orange flavoured sweets. **(2)**

A family size bag of the same confectionary contains 90 sweets. The proportion of the orange flavoured sweets in these bags is also expected to be $\frac{1}{5}$.

b) Use a distributional approximation, to find the probability that a randomly selected family size bag, will contain less than 25 orange flavoured sweets. **(6)**

Question 7

A biased six sided die has the following probability distribution

x	1	2	3	4	5	6
$\mathrm{P}(X=x)$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{2}$

where the random variable X represents the number shown on its uppermost face when it comes to rest after it is rolled.

The die is rolled twice and the two independent observations of X, X_1 and X_2, produce the score Y defined as

$$Y=\begin{cases} 6 & \text{if } X_1=6 \\ X_1+X_2 & \text{if } X_1\neq 6 \end{cases}$$

a) Find the value of $\mathrm{P}(Y=6)$. **(3)**

b) Find the value of $\mathrm{P}(Y<7|Y>4)$. **(5)**

Question 8

The weights of marmalade jars are Normally distributed with a mean of 250 grams.

a) Calculate, correct to 1 decimal place, the standard deviation of these jars if 1% of the jars are heavier than 256 grams. **(4)**

b) Using the answer of part **(a)**, determine the probability that the weight of one such marmalade jar is between 249 and 253 grams. **(4)**

c) Given that the weight of a randomly picked marmalade jar is between 249 and 253 grams, find the probability that the jar weighs more than 250 grams. **(3)**

Question 9

Three boxes A, B and C contain coins.

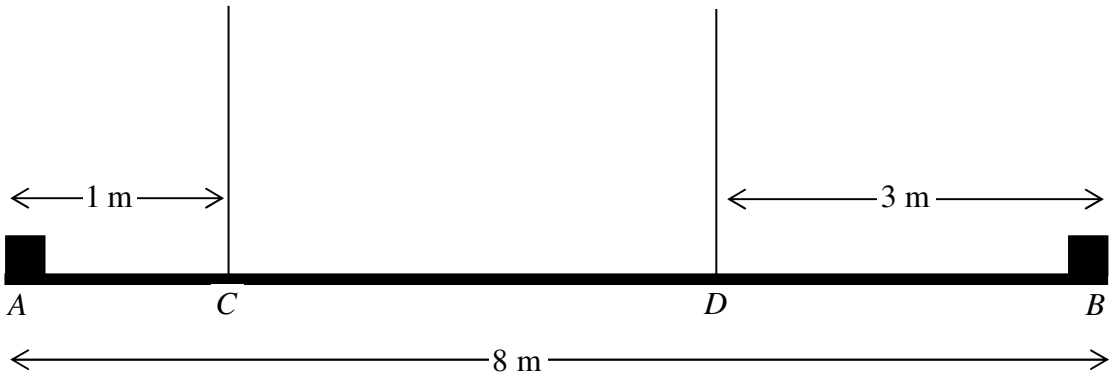
- Box A contains 3 gold coins.
- Box B contains 2 gold coins and 2 silver coins.
- Box C contains 4 gold coins and 1 silver coin.

A box is selected at random and 2 coins are selected.

Find the probability that box C was selected, if both coins selected were gold. **(7)**

SECTION 2 - MECHANICS

Question 10



A uniform iron girder AB has length 8 m and weight W N. A load of 250 N is attached to the girder at A and a load of 400 N is attached to the girder at B.

The loaded girder is suspended by two light vertical cables attached to the girder at points C and D, where $AC = 1$ m and $DB = 3$ m. When the loaded girder rests undisturbed in a horizontal position, the tension in the cable at D is four times the tension at the cable at C.

The girder is modelled as a uniform rod and the two loads as particles.

a) Determine magnitude of the tension on the girder at C. **(3)**

b) Find the value of W. **(2)**

Question 11

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, of mass 2 kg, is moving under the action of a single constant force $\mathbf{F}$ N. When $t = 0$ s, the velocity of P is $(3\mathbf{i} - 5\mathbf{j})$ ms^{-1} and when $t = 4$ the velocity of P is $(11\mathbf{i} + 7\mathbf{j})$ ms^{-1}.

a) Calculate the speed of the particle when $t = 0$. **(2)**

b) Determine the vector $\mathbf{F}$. **(3)**

c) Find the value of t when the particle is moving in an eastward direction. **(4)**

Question 12

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

The two particles are connected by a light inextensible string which passes over a smooth light fixed pulley. The two particles are held at rest with the string taut and the hanging parts of the string vertical.

The system is released from rest and A moves **upwards**.

a) Determine the acceleration of the system in terms of m and g. **(3)**

b) Show that the tension in the string, while A ascends, is $\dfrac{8mg}{m+4}$. **(4)**

At the instant when A is 0.7 m above its original position, it has not yet reached the pulley and is travelling at 1.4 ms^{-1}.

c) Find the value of m. **(5)**

Question 13

A particle is projected vertically downwards from a great height.

It hits the ground with speed $28\ \text{ms}^{-1}$.

Determine the time it took the particle to cover the last $15\ \text{m}$ of its motion. **(5)**

Question 14

A train is travelling at $20\ \text{ms}^{-1}$ on a straight horizontal track when the driver sees a red signal $315\ \text{m}$ ahead of the front of the train.

The driver immediately applies the brakes and the train decelerates uniformly for $15\ \text{s}$ to a speed of $6\ \text{ms}^{-1}$.

The train then maintains this speed for another $12\ \text{s}$.

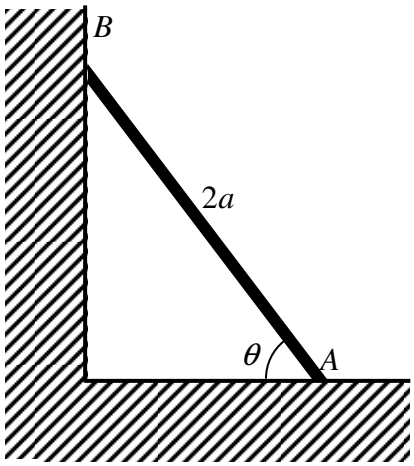
The driver then reapplies the brakes and the front of the train comes to a stop, level with the red signal.

a) Sketch a speed time graph which describes the above information. **(3)**

b) Find the distance travelled by the train from the moment the brakes were first applied to the moment its speed first reached $6\ \text{ms}^{-1}$. **(2)**

c) Calculate the total time from the moment the brakes were first applied to the moment the train came to rest. **(4)**

Question 15

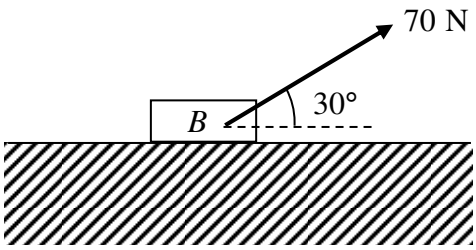


The figure above shows a uniform ladder AB of length $2a$ and of mass m resting with the end A on rough horizontal ground and the end B against a smooth vertical wall. The ladder is inclined at an angle θ to the ground.

When a child of mass $2m$ is standing on the ladder at B, the ladder is about to slip.

Given that the coefficient of friction between the ladder and the ground is $\frac{5}{12}$, find the value of θ. **(6)**

Question 16



A box B of weight 147 N is pulled at **constant** speed on rough horizontal ground by a pulling force of magnitude 70 N inclined at $30°$ to the horizontal, as shown in the figure above. The box is modelled as a particle moving on a rough horizontal plane where the coefficient of friction between the particle and the plane is μ.

a) Determine the value of μ. **(5)**

The pulling force is suddenly removed and the box decelerates uniformly coming to rest after covering a further 12.25 m.

b) Find the speed of the box at the instant when the pulling force was removed. **(7)**

Question 17

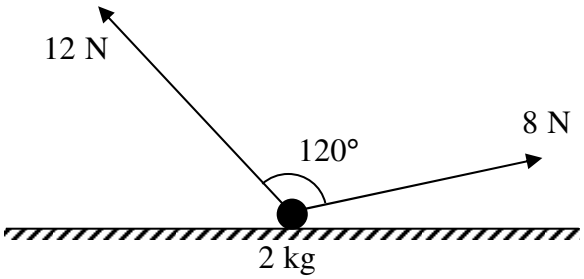
A particle is projected from a point O on level horizontal ground at an angle of elevation β, and continues to move freely under gravity without any air resistance.

The particle just clears a vertical wall of height 2 m, which is at a horizontal distance of 4 m away from O.

In the subsequent motion the particle just clears the top of a vertical transmitter of height 12 m, which is at a horizontal distance of 36 m away from O.

Calculate the value of β. **(10)**

Question 18



The figure above shows a particle, of mass 2 kg, resting in equilibrium on a smooth horizontal surface, under the action of two forces, of magnitudes of 8 N and 12 N.

The forces act in the same vertical plane and the angle between them is $120°$.

Calculate, in any order, the magnitude of the force exerted on the particle by the surface and the acute angle between the 8 N force and the surface. **(7)**