IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper E

Difficulty Rating: 3.0667/0.6818

Time: 2 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 100.

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 table below shows the amount spent per month by a local radio on marketing M, in £1000, and the number of listeners L, in 1000, in that month.

M	6.5	8	11.5	14.25	15
L	87	139	119	127	147

a) Use a statistical calculator to find …

i. … the value of the product moment correlation coefficient between M and L. **(1)**

ii. … the equation of the regression line between M and L, giving the answer in the form

$$L = a + bM \ ,$$

where a and b are constants. **(2)**

b) Use the equation of the regression line to estimate the number of cars that are expected to be sold in a month where the amount spent on marketing and advertising is …

i. … £9,800.

ii. … £20,000.

Comment further on the reliability of each of these two estimates. **(4)**

c) Interpret in the context of this question the physical meaning of a and b. **(2)**

d) Calculate the residual of the month where £14,250 was spent. **(2)**

Question 2

A shop owner has established over a long period of time, that 12% of the people who buy crisps, prefer the "ready salted" variety.

On a certain day 65 customers bought crisps.

Using a distributional approximation, find the probability that more than 9 of these 65 customers bought crisps of the "ready salted" variety. **(6)**

Question 3

The number of hours spent on homework by 70 students, in a particular week, is summarized in the table below.

Hours (nearest hour)	Frequency
2 – 3	6
4 – 6	18
7 – 9	15
10 – 11	18
12	7
13 – 15	6

a) Draw an accurate histogram to represent this data. **(5)**

b) Use the histogram to estimate the number of students that spent between 7.75 and 13.5 hours during that week. **(3)**

c) Estimate the median of the data. **(2)**

Question 4

The monthly mileages of a sales rep are summarised in the table below.

Mileages (m)	Frequency
$3250 \le m < 3300$	19
$3300 \le m < 3350$	45
$3350 \le m < 3400$	16
$3400 \le m < 3450$	5
$3450 \le m < 3500$	2

By using the coding

$$y = \frac{x - 3325}{50},$$

where x represents the midpoint of each class, estimate the mean and the standard deviation of this data.

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

Question 5

A game is played by rolling simultaneously 15 standard fair six sided dice.

Showing a full method, find the probability that in a single roll of the 15 dice …

a) … no six will be obtained. **(2)**

b) … exactly three dice will show a six. **(2)**

c) … more than three dice will show a six. **(2)**

A game is won if **more than three dice** show a six.

d) If ten games are played determine the probability of winning exactly 5 games. **(3)**

Question 6

A bag contains blue, yellow and red discs and these discs show on their face a single digit whole number.

The probability of drawing a blue disc is $\frac{1}{2}$, the probability of drawing a yellow disc is $\frac{1}{3}$ and the probability of drawing a red disc is $\frac{1}{6}$.

$\frac{5}{12}$ of the blue discs show an even number, $\frac{5}{8}$ of the yellow discs show an even number and $\frac{1}{4}$ of the red discs show an even number.

A disc is drawn at random from the bag.

a) Determine the probability that the disc will show an even number. **(4)**

b) Given that the disc that was drawn was showing an even number, find the probability that the disc was not red. **(3)**

Question 7

A test statistic has distribution $\mathrm{B}(30, p)$.

Given that

$$\mathrm{H}_0 : p = 0.4, \quad \mathrm{H}_1 : p \neq 0.4,$$

find the critical region for the test statistic at the 5% significance level. **(5)**

Question 8

The events A and B satisfy

$$\mathrm{P}(A) = 0.5, \ \mathrm{P}(B) = 0.2 \ \text{ and } \ \mathrm{P}(A|B) = 0.3.$$

Determine …

a) … $\mathrm{P}(A \cap B)$. **(2)**

b) … $\mathrm{P}(A \cup B)$. **(2)**

c) … $\mathrm{P}(B|A)$. **(2)**

Question 9

The time, in minutes, taken by a large group of students to complete an Economics exam are thought to be Normally distributed with mean μ and standard deviation σ.

15% of the students finished the exam in under 74 minutes while 20% used in excess of 115 minutes.

a) Find, correct to the nearest minute, the value of μ and the value of σ. **(7)**

The school exam secretary believes that the value of μ is much higher than the one found in part **(a)**, based on a random sample of 10 students whose mean time to complete the exam was 108 minutes.

b) Using the value of σ found in part **(a)**, conduct a hypothesis test at the 5% level of significance to investigate the school exam secretary's belief.

State your hypotheses clearly. **(6)**

SECTION 2 - MECHANICS

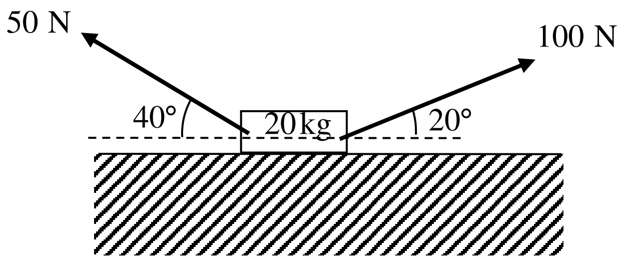
Question 10

A light rigid rod AB, where A is vertically above B, has a particle of mass 0.2 kg attached to it at A and a particle of mass 0.3 kg attached to it at B.

The loaded rod is accelerated vertically upwards by a vertical force of magnitude 6 N, applied to B.

Find the thrust in the rod. **(6)**

Question 11



The figure above shows a small box of mass 20 kg, pulled by two light inextensible strings along rough horizontal ground.

The tension in the rope inclined at $20°$ to the horizontal is 100 N.

The tension in the rope inclined at $40°$ to the horizontal is 50 N.

The box is modelled as a particle in equilibrium, experiencing a constant frictional force of F N and a normal reaction of R N.

Determine the value of R and the value of F. **(6)**

Question 12

A non uniform ladder of weight 180 N and length 6 metres, rests with its end A on smooth horizontal ground and its end B against a rough vertical wall.

The coefficient of friction between the ladder and the wall is $\frac{1}{4}$.

The centre of mass of the ladder is 1.5 metres from A.

The ladder lies in a vertical plane perpendicular to the wall and the ground, and is inclined at an angle θ to the horizontal, where $\tan\theta = 2$.

A man can just prevent the ladder from sliding down the wall by pushing the bottom of the ladder with a horizontal force F.

By modelling the ladder as a non uniform rod determine the value of F. **(6)**

Question 13

A car is travelling along a straight horizontal road. It starts from rest at point A and accelerates uniformly at a ms^{-2}, reaching a speed of 18 ms^{-1}.

The car then travels at constant speed for T s. Finally the car begins to decelerate uniformly at 0.75 ms^{-2} coming to rest at point B.

a) Sketch a speed time graph to show the motion of the car from A to B. **(2)**

b) Determine the time for which the car decelerates. **(2)**

It is further given that the car accelerates for $\frac{1}{4}T$ s and the distance AB is 1512 m.

c) Calculate …

- **i.** … the value of T. **(3)**
- **ii.** … the value of a. **(2)**

d) Sketch an acceleration time graph to show the motion of the car from A to B. **(2)**

Question 14

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

$$v = t^2 - 4t - 12, \; t \geq 0.$$

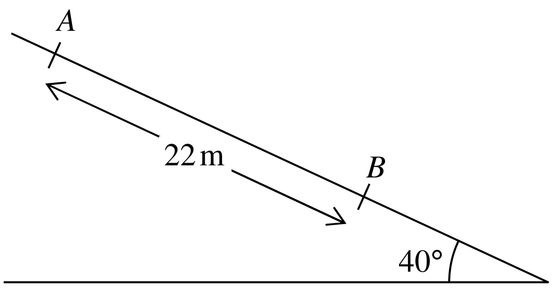
When $t = 0$, its displacement x from the origin O is 20 m.

a) Find the acceleration of P when $t = 3$. **(3)**

b) Find the acceleration of P, when P is instantaneously at rest. **(4)**

c) Determine the distance of P from O, when P is instantaneously at rest. **(5)**

Question 15



A particle P slides with constant acceleration down the line of greatest slope of a rough plane inclined at $40°$ to the horizontal.

The particle covers a distance AB, where $|AB| = 22$ m, in 4 s.

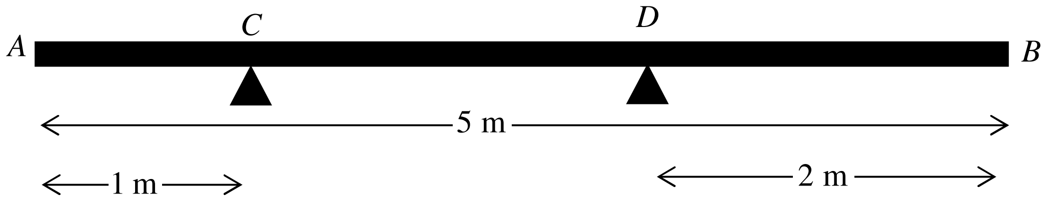
a) Given the speed of P at A is 3 ms^{-1}, calculate …

i. … the speed of P at B. **(2)**

ii. … the acceleration of P. **(2)**

b) Hence find the coefficient of friction between the particle and the plane. **(6)**

Question 16



A uniform rod AB has length 5 m and weight 300 N.

The rod rests in a horizontal position on two smooth supports at C and D, where $AC = 1$ m and $DB = 2$ m, as shown in the figure above.

A particle of weight W N is placed on the rod at the point E, where $AE = x$ m.

The magnitude of the reaction on the rod at C is twice the magnitude of the reaction on the rod at D.

a) Show clearly that

$$W = \frac{750}{5-3x}.$$ **(7)**

b) Determine the range of possible values of x. **(1)**

Question 17

A particle A is released from rest from a point h m above level horizontal ground.

One second later, another particle B is projected vertically downwards with speed 19.6 ms^{-1} from the same point, A was released.

Given that the particles reach the ground at the same time, determine the value of h.

(8)

Question 18

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

At time $t = 0$ s a footballer A kicks the ball from the point with position vector $(4\mathbf{i} + 2\mathbf{j})$ m giving it a constant speed of 10 ms^{-1} in the direction $(4\mathbf{i} + 3\mathbf{j})$.

The ball is modelled as a particle moving with constant velocity.

a) Show that the position vector of the ball, t s after it was kicked, is given by

$$(8t + 4)\mathbf{i} + (6t + 2)\mathbf{j}.$$ **(4)**

You may not use the answer to verify this part.

At time $t = 0$ s, another footballer B is observed to be running through the point with position vector $(11\mathbf{i} + 23\mathbf{j})$ m.

Footballer B is modelled as a particle running due East with constant speed U ms^{-1}.

b) Given that B intercepts the ball determine the value of U. **(4)**