IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper B

Difficulty Rating: 3.3300/0.7491

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 15 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 results of 100 people taking part in a wine tasting survey are shown below.

- 90 people liked wine A.
- 90 people liked wine B.
- 92 people liked wine C.
- 88 people liked wine A and B.
- 86 people liked wine B and C.
- 87 people liked wine A and C.
- 85 people liked wine A, B and C.

a) Draw a fully completed Venn diagram to represent this data. **(4)**

Find the probability that a randomly chosen person …

b) … likes only two out of the three wines. **(2)**

c) … likes wine B but not wine C. **(2)**

d) … does not like wine B. **(2)**

A person who likes at least two types of wine is selected.

e) Determine the probability that this person likes wines A and C. **(3)**

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Question 2

The following information about 5 observations of x is shown below.

$$\sum_{i=1}^{5}\left(\frac{x_i-255}{2}\right) = 50 \qquad \text{and} \qquad \sum_{i=1}^{5}\left(\frac{x_i-255}{2}\right)^2 = 1650 .$$

(6)

Calculate the mean and standard deviation of x.

Question 3

The manager of a cinema believes that the weights, X grams, of popcorn bags sold in his cinema are Normally distributed with mean of 340 and standard deviation of 10.

a) Taking $\mu = 340$ and $\sigma = 10$ ...

i. ... find, to the nearest gram, the weight x_0 exceeded by 5% of these popcorn bags. **(4)**

ii. ... $\mathrm{P}\left(X > \mu \middle| X < x_0\right)$. **(2)**

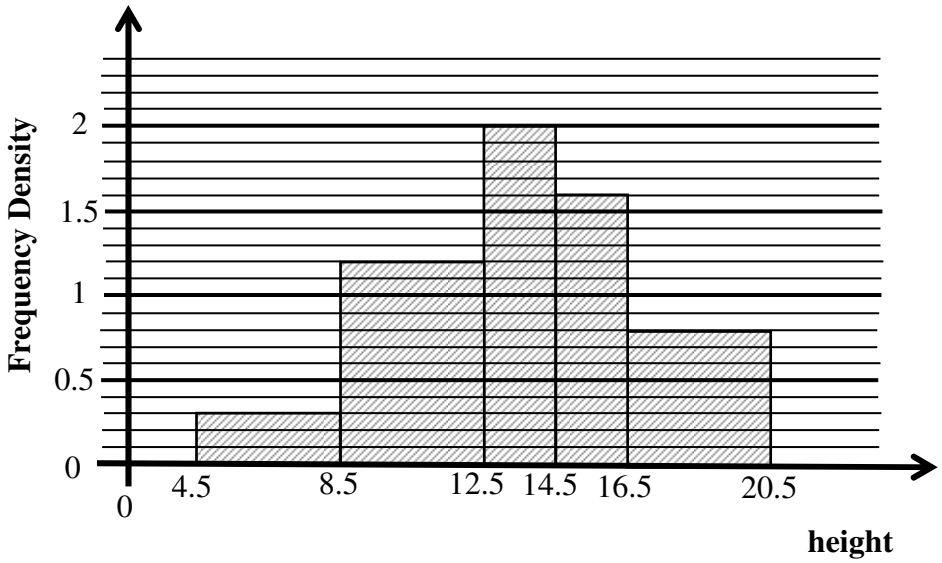
A new manager, which takes over the cinema, asks his staff to investigate the weights of these popcorn bags and is told that it was subsequently found that $\mu = 320$ and $\sigma = 10$.

The new manager claims that μ has to be higher than 320, as the mean of a random sample of 5 bags was found to be 327.

b) Using $\sigma = 10$, conduct a hypothesis test at the 5% level of significance to investigate the new manager's claim.

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

Question 4



The histogram above shows the distribution of the heights, to the nearest cm, of some plants in a garden centre. It is further given that there were 18 plants with a height between 5 cm and 8 cm, rounded to the nearest cm.

a) Use the histogram to estimate the median. **(6)**

b) Estimate, by calculation, the mean and the standard deviation of the heights of these plants. **(6)**

Question 5

A continuous random variable X is Normally distributed with mean μ and standard deviation σ.

It is further given that $\mathrm{P}(X > \mu + a) = 0.20$, where a is a positive constant.

Determine ...

a) ... $\mathrm{P}(X > \mu - a)$. **(1)**

b) ... $\mathrm{P}(|X - \mu| < a)$. **(2)**

c) ... $\mathrm{P}(X < \mu + a | X > \mu - a)$. **(2)**

Question 6

a) State four conditions for making a binomial distribution an appropriate model for statistical work. **(4)**

Roy and Ned are door to door salesmen.

The probability of Roy making a sale on a house visit is 0.05.

b) Showing a clear method, find the probability that Roy achieves …

i. … no sales in 15 visits. **(2)**

ii. … more than 3 sales in 20 visits. **(2)**

c) Calculate the least number of visits that Roy needs to make for the probability of at least 1 sale, to exceed 0.99. **(5)**

The probability of Ned making a sale on a house visit is 0.15.

d) If Roy and Ned make 20 house visits **each**, determine the probability that they will make …

i. … 2 sales each. **(2)**

ii. … a total of 5 sales between them. **(6)**

Ned makes 240 house visits in a given week.

e) Use a Normal approximation, to find the probability that Ned achieves more than 30 sales in these 240 visits. **(6)**

SECTION 2 - MECHANICS

Question 7

A car of mass 1500 kg is towing a trailer of mass 500 kg by means of a light rigid horizontal towbar. The car is experiencing a constant air resistance of 300 N, while the corresponding constant air resistance on the trailer is 100 N.

The car and trailer are modelled as particles.

a) Given the tension in the towbar is 200 N, calculate …

i. … the acceleration of the system. **(3)**

ii. … the driving force of the car. **(3)**

Later in the journey, the car's driving force is removed and the car's brakes are applied, providing a constant breaking force of 400 N, on the car only.

The air resistance on the car and trailer are unchanged.

b) Determine …

i. … the deceleration of the system. **(3)**

ii. … the thrust in the towbar. **(3)**

Question 8

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

Two helicopters, P and Q, are flying with constant velocities in the same horizontal plane. At noon, P is at the point with position vector $(20\mathbf{i}+35\mathbf{j})$ km. The position vector of P at time t hours after noon is $\mathbf{p}$.

a) Given that when $t=\frac{1}{2}$ hours, $\mathbf{p}=(65\mathbf{i}+59\mathbf{j})$ km, determine the velocity of P. **(3)**

b) Find an expression for $\mathbf{p}$, in terms of t. **(2)**

At noon, Q is at the point with position vector $200\mathbf{j}$ km.

The speed of Q is 125 km h^{-1}, in the direction $(24\mathbf{i}-7\mathbf{j})$.

The position vector of Q, at time t hours after noon, is $\mathbf{q}$.

c) Find an expression for $\mathbf{q}$, in terms of t. **(4)**

d) Calculate the distance between P and Q when $t=2$. **(4)**

Question 9

The points A, B and C lie on a straight horizontal road with B between A and C, so that $|AB|=300$ m and $|BC|=200$ m.

A car travelling with constant acceleration a ms^{-2} passes A with speed 5 ms^{-1} and travels directly to C in 20 seconds.

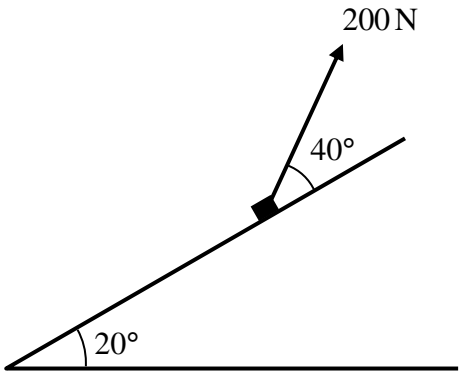
a) Find the value of a. **(2)**

b) Calculate …

i. … the speed of the car at B. **(2)**

ii. … the time it takes the car to travel from A to B. **(2)**

Question 10



The figure above shows a box of weight W N, resting on a plane inclined at an angle of $20°$ to the horizontal. The box is kept in **equilibrium** by a force of 200 N, acting up the plane, at an angle of $40°$ to the direction of the greatest slope of the plane.

The box is experiencing a frictional force of magnitude F N **down** the plane. The normal reaction between the box and the plane has magnitude 180 N.

By modelling the box as a particle, find the value of W and the value of F. **(6)**

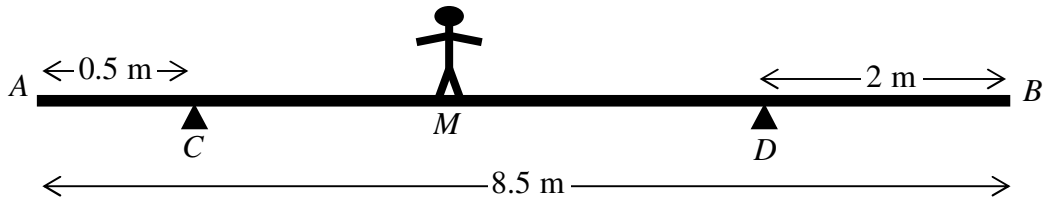
Question 11

A particle P, which is subject to no other external forces except its weight, is projected from a fixed point O with speed 42 ms^{-1} at an angle of elevation $\arctan\frac{4}{3}$.

3 s later another particle Q, which is also subject to no other external forces except its weight, is projected from O with speed U ms^{-1} at an angle of elevation ψ.

If the two particles collide 2 s after Q is projected, calculate the value of ψ and the value of U. **(10)**

Question 12



A non uniform plank of wood AB has length 8.5 m and mass 20 kg. The centre of mass of the plank is 3.75 m from B. The plank is smoothly supported at C and D, where $AC = 0.5$ m and $DB = 2$ m, as shown in the figure above.

A boy of mass 40 kg stands on the plank at the point M, where M is the midpoint of CD. The plank with the boy standing on the plank, remains in equilibrium with AB horizontal.

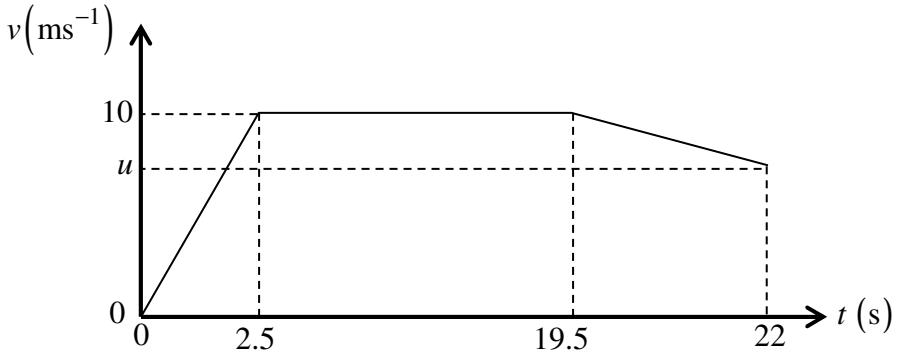
The plank is modelled as a non uniform rod and the boy as a particle.

a) Calculate the magnitude of each of the reaction forces acting on the rod at C and D. **(5)**

The boy next moves and stands at the point E on the plank, so that the plank is at the point of tilting about D.

b) Determine the distance DE. **(2)**

Question 13



The figure above shows the speed time graph (t,v) of a sprinter running a 200 m race in a straight horizontal track.

The sprinter starts from rest and accelerates uniformly until he reaches his top speed of $10\ \text{ms}^{-1}$ in $2.5\ \text{s}$. He maintains this speed for $17\ \text{s}$ when he experiences a cramp.

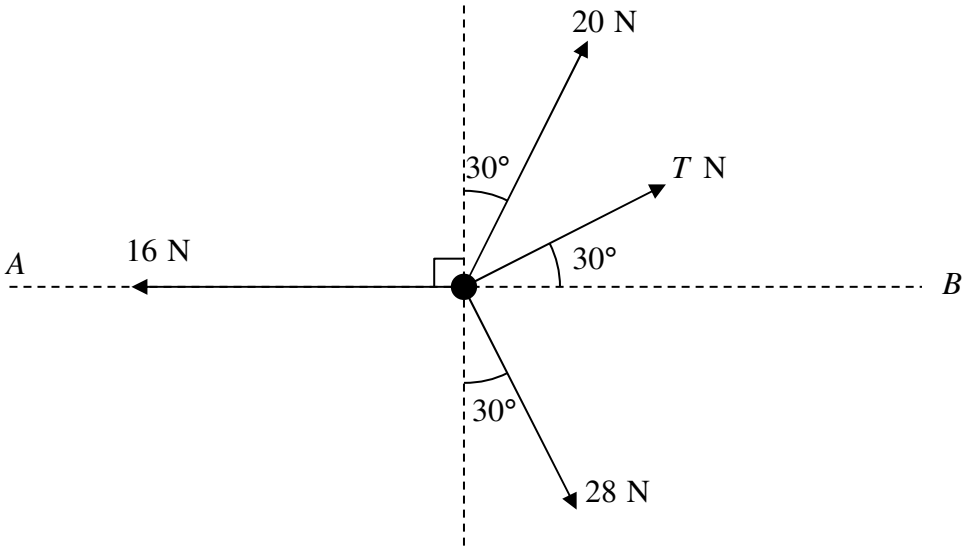
The sprinter then decelerates uniformly crossing the finishing line with speed $u\ \text{ms}^{-1}$, $22\ \text{s}$ after the start of the race.

a) Calculate the distance covered by the sprinter until the moment he experienced a cramp. **(2)**

b) Determine the value of u. **(3)**

c) Find the deceleration of the sprinter at the last part of the race. **(2)**

Question 14



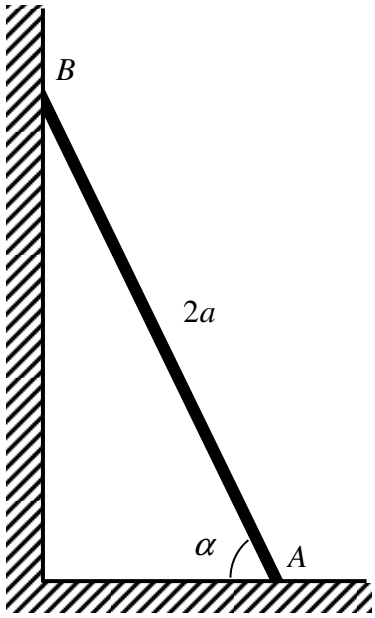
A particle of mass 80 kg is accelerating in the direction AB.

Four **horizontal** forces of different magnitudes are acting on the particle.

The magnitude and direction of these four forces, together with other important information is shown in the figure above.

Find the acceleration of the particle. **(7)**

Question 15



The figure above shows a ladder of length $2a$ and mass m, with one end A on rough horizontal ground and the other end B against a smooth vertical wall.

The ladder is inclined at an angle α to the horizontal, where $\tan\alpha = \frac{4}{3}$ and remains in equilibrium when a child of mass m stands at a point C on the ladder, where $AC = \frac{3}{2}a$.

By modelling the ladder as a uniform rod and the child as a particle, find the range of the possible values of the coefficient of friction between the ladder and the ground. **(7)**