ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MATHEMATICS 9164/4

PAPER 4

JUNE 2014 SESSION 3 hours

Additional materials:
Answer paper
Graph paper
List of Formulae

TIME 3 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

There is no restriction on the number of questions which you may attempt.

If a numerical answer cannot be given exactly, and the accuracy required is not specified in the question, then in the case of an angle it should be given to the nearest degree, and in other cases it should be given correct to 2 significant figures.

If a numerical value for g is necessary, take $g = 9.81\ \text{ms}^{-2}$.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 120.

Within each section of the paper, questions are printed in the order of their mark allocations and candidates are advised, within each section, to attempt questions sequentially.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

This question paper consists of 7 printed pages and 1 blank page.

[Turn over

Section (a): Statistics

1 A bag contains 24 counters of which 6 are red, 8 are green and 10 are yellow. Three counters are taken from the bag at random without replacement.

(i) Show that the probability that 2 of the counters taken are green is $\frac{56}{253}$. [2]

(ii) Given that 2 of the counters are green, find the probability that the first counter taken is red. [3]

2 The probability that a boy hits a target is 0.8. Assuming that shots are independent of each other and suppose that during each practice period, the boy fires shots until he hits the target.

(i) Find the mean and standard deviation of the number of shots fired per practice period. [3]

(ii) Find the probability that the boy will need to take at least five shots to hit the target. [2]

3 A coin is tossed 5 times. Use a binomial test, at 5% level of significance, to test whether the coin is biased towards heads if at least 4 heads are obtained. [5]

4 The following are television prices in dollars taken in 40 different shops.

40	130	170	240	360	520	170	130
240	360	520	120	220	170	330	480
160	290	200	120	480	160	210	330
70	140	180	260	370	90	150	200
280	450	80	420	190	140	270	120

(i) Construct a stem and leaf diagram for the data. [3]

(ii) Find

1. the median,
2. the quartiles.

[2]

(iii) Draw a box and whisker plot. [2]

5 The probability that a seed grown under specified conditions will germinate and produce a plant is 0.8. The minimum number of seeds, n, are to be planted under these conditions to ensure a probability of at least 0.9 that 60 or more seeds will germinate and produce a plant.

(i) Using a suitable approximation show that $n^2 - 149.2n + 5531.6 \geq 0$. [4]

(ii) 1. Solve the inequality in part **(i)**.

2. Hence or otherwise find the minimum value of n, the number of seeds to be planted.

[3]

6 A random sample of eight observations of a normal variable gave $\overline{X} = 4.65$ and $\sum(x - \bar{x})^2 = 0.74$. Test at the 5% level of significance, whether the mean is 4.32. [7]

7 The switchboard of a small company handles both incoming and outgoing telephone calls. During lunch hour on any day, the numbers of incoming and outgoing calls are independent and have Poisson distributions with parameters 5 and 3 respectively.

Find the probability that during lunch hour of a randomly chosen day, there will be

(i) exactly 3 outgoing calls, [2]

(ii) at least 6 incoming calls, [2]

(iii) a combined number of 3 calls through the switchboard. [3]

8 A random variable X is normally distributed with mean 15 and standard deviation 6.

If a random sample of 40 is chosen and found to have a mean $\overline{X}$, find

(i) $P(\overline{X} > 16)$, [4]

(ii) the sample size n such that $P(\overline{X} > 15.5) = 0.05$. [5]

9 The data below summarises the altitude x (in metres) above sea level, and the mean air temperature y (in °C) for 10 weather stations.

$\sum x = 1076$ $\quad\quad$ $\sum x^2 = 211642$

$\sum y = 94.2$ $\quad\quad$ $\sum xy = 9383.1$

$\sum y^2 = 894.58$

(i) Calculate the product moment correlation coefficient and comment on the relationship between x and y. [3]

(ii) Calculate the equation of the regression line of y on x giving your answer in the form $y = a + bx$, [4]

(iii) Use your result in part **(ii)** to estimate the mean air temperature at a place 250 m above sea level. [2]

10 A manufacturer of vehicles sells two types of vehicles, heavy and light vehicles. The cost of each type of vehicle in thousands of dollars are shown in the table below.

	mean cost	**standard deviation**
Light	252	2
Heavy	1 012	5

(i) A vehicle of each type is selected at random. Find the probability that the heavy vehicle costs less than 4 times the light vehicle. [5]

(ii) One heavy and four light vehicles are selected at random. Find the probability that the cost of a heavy vehicle is less than the total cost of four light vehicles. [5]

11 A policeman attending to accidents claims that the type of an accident he attends depends on the colour of car involved. The table below shows the results of 200 accidents he attended to.

	minor	**serious**	**fatal**	**total**
black	15	23	22	60
white	35	24	11	70
red	20	23	27	70
Total	70	70	60	200

Test at the 10% level of significance whether the data supports the policeman's claim. [11]

12 One hundred electrical components are tested to see how many defects each has. The results are shown in the table.

number of defects	0	1	2	3	4	5	6	≥7
number of components	11	22	26	24	9	5	3	0

(i) Calculate the mean of the distribution. [2]

(ii) Calculate the expected frequencies (correct to 1 d.p.) of the associated Poisson distribution having the same mean. [3]

(iii) Perform a χ^2 goodness of fit test to determine whether or not the above data come from Poisson distribution using 5% level of significance. [9]

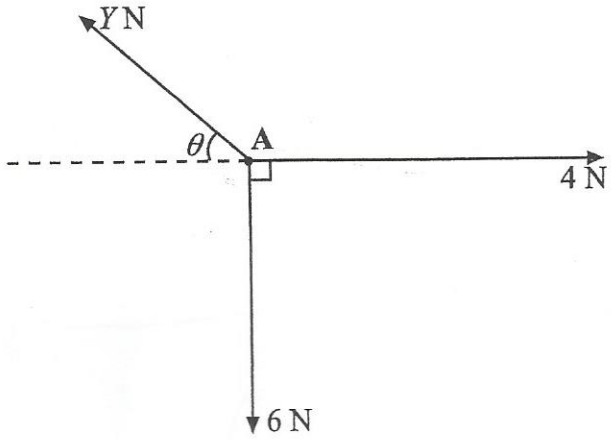
Section (b): Mechanics

13 Particles A and B of masses 5 kg and 8 kg respectively are connected by means of a light inextensible string which passes over a smooth pulley. Particle A lies on a smooth plane inclined at an angle $\tan^{-1}\left(\frac{4}{3}\right)$ to the horizontal and particle B is hanging freely. When the system is released from rest, calculate

(i) the tension in the string, [3]

(ii) the acceleration of the particles for the part of the motion before B hits the ground. [2]

14



A particle A rests in equilibrium on a smooth horizontal table.

Forces of magnitude 4 N, 6 N and Y newtons act on A (see diagram).

(i) Find the values of

1. Y,
2. θ. [4]

(ii) State **one** assumption made in answering the question. [1]

15 A particle decelerates uniformly from a velocity of 25 ms^{-1} to 15 ms^{-1} in 2 seconds. It maintains a velocity of 15 ms^{-1} for t_1 seconds and then accelerates uniformly to a velocity of 27 ms^{-1} in 3 seconds.

(i) Sketch a (t, v) graph for the whole journey. [3]

(ii) Given that it travels a total distance of 193 m, find the value of t_1. [3]

16 A particle is projected from a point O on a level ground with initial velocity of 10 ms^{-1} at an angle of elevation θ.

(i) Given that the particle passes through a point which is 3 m horizontally away from O and 2 m above the level of O, calculate the value of θ. [4]

(ii) Calculate the distance from the point of projection to the point where the particle is 8 m below the ground. [4]