## RESOURCEFUL MOCK 2017

## Uganda Advanced Certificate of Education

## APPLIED MATHEMATICS

TIME: 3 HOURS

## INSTRUCTIONS TO CANDIDATES

- Attempt all the questions in section $\boldsymbol{A}$ and only five questions from section $\boldsymbol{B}$
- Any additional question(s) answered will not be marked
- In numerical work, take g to be $9.8 \mathrm{~ms}^{-2}$


## SECTION A

1. Two events $A$ and $B$ are such that $P\left(A^{\prime} \cap B^{\prime}\right)=x$, and $P(B)=4 / 7$. Using a Venn diagram, find the values of;
i) $\quad x$
ii) $\quad P(A \cap B)$
2. Particle $A$ of mass 2 kg moves under the action of three forces, $F_{1}, F_{2}$ and $F_{3}$ at a time $t$,
$F_{1}=(1 / 4 t-1) i+(t-3) j N$
$F_{2}=(1 / 2+2) i+(1 / 2 t-4) j N$
$F_{3}=(1 / 4 t-4) i+\left(\frac{3}{2} t+1\right) j N$, find the acceleration of the particle when $\mathrm{t}=2$ seconds.
3. A body of mass 8 kg rests on a rough plane inclined at $\theta$ to the horizontal. If the coefficient of friction is $\mu$, find the least horizontal force in terms of $\mu, \theta$ and $g$ which will hold the body in equilibrium.
4. The random variable X has a probability function
$f(x)= \begin{cases}K 2^{x} ; & x=0,1,2,3 \\ 0 & \text { elsewhere }\end{cases}$
Find;
a. The value of the constant $K$
b. E (x)
5. a) Show that the final velocity V of a body which starts with an initial velocity U and moves with uniform acceleration a consequently covering a distance x , is given by
$V=\left(u^{2}+2 a x\right)^{1 / 2}$
b) Find the value of X in each if $\mathrm{V}=30 \mathrm{~ms}^{-1}, \mathrm{U}=10 \mathrm{~ms}^{-1}$ and $\mathrm{a}=5 \mathrm{~ms}^{-2}$
6. Find the approximate value, to one decimal place of $\int_{0}^{1} \frac{d x}{1+x^{\prime}}$, using the trapezium rule with five strips.
7. The table below shows the values of a continuous function $f$ with respect to $t$

| t | 0 | 0.3 | 0.6 | 1.2 | 1.8 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{f}(\mathrm{t})$ | 2.72 | 3.00 | 3.32 | 4.06 | 4.98 |

Using linear interpolation find;
a. $f(t)$ when $t=0.9$
b. t when $\mathrm{f}(\mathrm{t})=4.48$
[2mks]
8. Show that the equation $f(x)=x^{3}+3 x-9$ has a root between $\mathrm{x}=1$ and $\mathrm{x}=2$. Using the Newton Raphson formula once, estimate the root of the equation rounded off to two significant figures.
[5mks]

## SECTION B

9. a) A block of wood of mass 0.52 kg , is at rest on a smooth horizontal table. A bullet of mass 0.08 kg is moving with horizontal speed of $30 \mathrm{~ms}^{-1}$. The bullet strikes the block and becomes embedded in it. Find the speed of the block after impact.
b) Two bodies A and B have masses of 3 kg and 4 kg respectively. When A is moving with a velocity of $(5 i-6 j) \mathrm{ms}^{-1}$, it collides with B whose velocity is $(2 i+3 j) m s^{-1}$. Immediately after collision the velocity of B is $5 i \mathrm{~ms}^{-1}$. Find the;
i) Velocity of A after the collision
ii) Loss in kinetic energy due to collision
10. a) A body of mass mkg lies on a rough plane inclined at $\theta^{0}$ to the horizontal, when a force of $\frac{m g}{2} \mathrm{~N}$ parallel to and up the plane is applied to the body, it is just about to move up the plane. When a force of $\frac{m g}{4} N$ parallel to and down the plane is applied to the body, it is just about to move down the plane. Calculate correct to two decimal places the value of;
i) $\theta$
ii) The coefficient of friction between the body and the plane.
11. a) A random variable $X$ has the probability density function.

$$
f(x)= \begin{cases}\frac{2}{3 a}(X+a) ; & -a \leq x \leq 0 \\ \frac{1}{3 a}(2 a-x) ; & 0 \leq x \leq 2 a \\ 0 & \text { elsewhere }\end{cases}
$$

Where a is a constant
Determine
i) The value of a
ii) The median of $X$
iii) $\quad P(x<1.5) /(x>0)$
iv) The cumulative distribution function $\mathrm{F}(\mathrm{x})$, sketch the graph of $\mathrm{F}(\mathrm{x})$.
12. a) Two particles are moving towards each other, along a straight line. The first particle has a mass of 0.2 kg and moving with a velocity of $4 \mathrm{~ms}^{-1}$, and the second has a mass of a 0.4 kg moving with a velocity of $3 \mathrm{~ms}^{-1}$. On collision, the first particle reverses its direction and moves with a velocity of $2.5 \mathrm{~ms}^{-1}$. Find the;
i. Velocity of the second particle after collision
ii. Percentage less in kinetic energy
b) The diagram shows particle A of mass 0.5 kg attached to one end of a light inextensible string passing over a fixed pulley and under a movable light pulley
B. The end of the string is fixed as shown below;

i. What mass should be attached at $B$ for the system to be in equilibrium?
ii. If $B$ is 0.8 kg , what are the accelerations of particle $A$ and pulley $B$ ?
13. Forces of magnitude $3 \mathrm{~N}, 4 \mathrm{~N}, 4 \mathrm{~N}, 3 \mathrm{~N}$ and 5 N act along the lines $\mathrm{AB}, \mathrm{BC}, \mathrm{CD}, \mathrm{DA}$ and $A C$ respectively, of the square $A B C D$ whose side has a length of a units. The direction of the forces are indicated by the order of the letters.
a. Find the magnitude and direction of the resultant force
b. If the line of action of the resultant force cuts $A B$ produced at $E$, find the length AE .
14. a) The numbers $X$ and $Y$ were estimated within maximum possible errors of $\Delta X$ and $\Delta \mathrm{Y}$ respectively. Show that the percentage relative error in XY is
$\left(\frac{\Delta X}{X}+\frac{\Delta Y}{Y}\right) \times 100$
[5mks]
b) Obtain the range of values within the exact value of $3.551 \times 2.71635$ lies. [04]
c) Locate each of the three roots of the equation $x^{3}-5 x^{2}+5=0 \quad[3 \mathrm{mks}]$
15. a) Use a graphical method to find a first approximation to the real root of $x^{3}-$ $3 x+4=0$
b) Use the Newton-Raphson method to find the root of the equation correct to 2 decimal places.
[12mks]
16. a) Bag A contains 2 green and 2 blue balls, while bag B contains 2 green and 3 blue balls. A bag is selected at random and two balls drawn from it without replacement. Find the probability that the balls drawn are of different colours.
b) A fair die is rolled 6 times. Calculate the probability that;
i. a 2 or 4 appears on the first throw,
ii. four 5 s will appear in the six throws

