CHUKA   **UNIVERSITY**

COLLEGE

INSTRUCTIONS:

Answer question One and any other Two questions.

1. (a)   Show that the expression $V = V_o + at^2$ is dimensionally incorrect, where V and Vo represent velocities, a is acceleration and t is a time interval.   [3 marks]

   (b)   One gallon of paint (Volume = 3.78×10^{-5} m^3) covers an area of 25m^2. What is the thickness of the paint on the wall?   [2 marks]

   (c)   A student at the top of a building of height h throws one ball upward with a speed of Vo and then throws a second ball downward with the same initial speed Vo. How do the final velocities of the ball compare when they reach the ground?
                                                        [3 marks]

   (d)   Can an object accelerate when its velocity is constant? Explain.   [2 marks]

   (e)   Two vectors are $\vec{A} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$
                      $\vec{B} = 3\mathbf{i} - 4\mathbf{j} + 3\mathbf{k}$

        Find   (i) $\vec{A} \cdot \vec{B}$

             (ii) $\vec{A} \times \vec{B}$

             (iii)   The angle between them.   [8 marks]

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(f)   If two particles have equal kinetic energies, are their momentum necessarily
        equal? Explain.   [2 marks]

(g)   Consider a perfectly inelastic collision between a car and large truck. Which
        vehicle loses more kinetic energy as a result of the collision? Explain.
                                                                              [2 marks]

(h)   A bicycle wheel rotates with a constant angular acceleration of 3.5 rads^{-2}. If
        The initial angular speed of the wheel is 2 rad s^{-1} at t = 0, through what angle
        does the wheel in 2s and what is its angular speed at this time?   [5 marks]

(i)   Describe the path of a moving body in the event that the acceleration is constant
        in magnitude at all time and

        (i) Perpendicular to the velocity
        (ii) Parallel to the velocity   [3 marks]

2. (a)   After falling from rest from a height of 30m a 0.5 kg ball rebounds upward
            reaching a height of 20m. If the contact between ball and ground lasted 2ms,
            what average force was exerted on the ball?   [6 marks]

    (b)   A 50kg student climbs a 5m long rope and stops at the top.

            (i)   What must her average speed be in order to match the power output of a
                    200 W bulb?
            (ii)   How much work does she do?   [6 marks]

    (c)   A 5g object moving to the right at 20cms^{-1} makes an elastic head on collision with
            a 10g object that is initially at rest. Find

            (i)   The velocities of each object after collision.
            (ii)   The fraction of the initial kinetic energy transferred to the 10g object.
                                                                            [8 marks]

3. (a)   A car starts from rest and travels for 5s with a uniform acceleration of 1.5 ms^{-2}.
            The driver then applies the brakes causing a uniform acceleration of -2ms^{-2}. If the
            brakes are applied for 3s, how fast is the car going at the end of the braking period
            and how far has it gone?   [8 marks]

    (b)   A ball thrown vertically upward is caught by the thrower after 2s. Find

            (i)   The initial velocity of the ball.
            (ii)   The maximum height it reaches.   [4 marks]

(c)   One swimmer in a relay race has a 0.5 s lead and is swimming at a constant speed of $4ms^{-1}$. He has 50m to swim before reaching the end of the pool. A second swimmer moves in the same direction as the lead swimmer. What constant speed must the second swimmer have in order to catch up to the leader at the end of pool?   [8 marks]

4. (a)   A man pushing a mop across a floor causes it to undergo two displacements. The first has a magnitude of 150 cm and makes an angle of $120°$ with the positive x - axis. The resultant displacement has a magnitude of 140cm and is directed at an angle of $35°$ to the positive x-axis. Find the magnitude and direction of the second displacement.

         (i)   Analytically
         (ii)   Geometrically

         Compare your answers in (i) and (ii).   [10 marks]

    (b)   A projectile is launched with an initial speed of $60ms^{-1}$ at an initial speed of $60ms^{-1}$ at an angle of $30°$ above the horizontal. The projectile lands on a hillside 4 s later. Neglecting air friction

         (i)   What is the projectiles velocity at the highest point of its trajectory?

         (ii)   What is the straight line distance from where the projectile was launched to where it lands?   [10 marks]

5. (a)   A car travelling at a constant speed of $30ms^{-1}$ passes a trooper hidden behind a billboard one second after the speeding car passes the billboard, the trooper sets off in chase with a constant acceleration of $5 ms^{-2}$.

         (i)   How long does it take the trooper to overtake the speeding car?
         (ii)   How far does it move in this time?

    (b)   On the same graph, plot the position versus time for each vehicle in (a) above and from the intersection of the two curves, determine the time at which the trooper overtakes the speeding car. Compare your answer with that obtained in (a) above.
                                                                                  [20 marks]