



## Mathematics

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- (a) The sum of the infinite series  $1/1.4 + 1/4.7 + 1/7.10 + \dots \infty$  is ...

(b) The function  $y = e^{-x}$  is, at  $x=0$

  - Is continuous only
  - Continuous and differentiable
  - Differentiable with derivative equal to 1
  - Differentiable with derivative equal to -1
- (a) If the maximum value of  $y = a \cos x - \left(\frac{1}{3}\right) \cos 3x$  occurs when  $x = \frac{\pi}{6}$  then the value of  $a$  is ...

(b) The value of function  $y = \cos^2 x + \cos^2 \left(\frac{\pi}{3} + x\right) - \cos x \cdot \cos \left(\frac{\pi}{3} + x\right)$  is ...

(c) If  $\omega$  is the cube root of the unity, other than 1 the expression  $(1 - \omega)(1 - \omega^2)(1 - \omega^4)(1 - \omega^8)$  is equal to ...
- (a) The angle C of the triangle ABC in which  $(c + a + b)(a + b - c) = ba$  is ...

(b) The value of  $\int_0^x \frac{x \sin x}{(1 + \cos^2 x)} dx$  is ...

(c) In a single cast with two dice the odds against throwing 7 (that is against two number of which the sum is 7) is ...
- (a) In an argand plane the centroid of a triangle whose vertices are  $Z_1, Z_2, Z_3$  is ...

(b) A card is drawn from a pack, the card is replaced and the pack is reshuffled. If this is done six times, the chances that the cards drawn are two hearts, 2 diamonds and two black is ...
- (a) Find the latus rectum of the conic  $3x^2 + 4y^2 - 6x + 8y = 5$

(b) Determine the locus of the point of intersection of the normals at the end of a focal chord of the parabola  $y^2 = 4ax$
- (a) By expanding  $(1 - 2x - 3x^3)^{-1}$  prove that  $2^n + 3(n-1)2^{n-1} + [3^2(n-2)(n-3)/2!]2^{n-4} + [3^3(n-3)(n-4)(n-5)/3!]2^{n-6} + \dots = \frac{1}{4}[3^{n+1} + (-1)^n]$

(b) If the letters of 'ATTEMPT' are written down at random, find the chance that all the T's are together.
- (a) Given  $y = \sin(\sin^{-1}x)$  prove that  $(1-x^2)d^2y/dx^2 - xdy/dx + ky = 0$

(b) Evaluate  $\int_0^\pi \frac{dx}{a^2 \cos^2 x + b^2 \sin^2 x}$
- (a) Find the velocity and direction of projection of a particle which passes in a horizontal direction just over the top of a wall which is 32 mts distant and 12 mts high.

(b) A train is travelling along a horizontal rail at 45 mph, and rain falling vertically with a velocity of 22 ft/sec. Find the apparent direction and velocity of rain to a person travelling in the rain.



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9. ( a ) A particle of mass 50 lb, is suspended by two strings 3ft. and 4 ft. attached to two points at same level whose distance apart is 5 ft. Find the tension in the string.  
( b ) A plane is inclined at  $45^{\circ}$  to the horizontal, and a weight of 200 lbs, is to dragged up the coefficient of friction being 0.75. Determine the direction of the least force required for the purpose.
10. ( a ) Prove that  $|\vec{a} + \vec{b}|^2 - |\vec{a} - \vec{b}|^2 = 4|\vec{a} \cdot \vec{b}|$   
( b ) A man of height 6 ft observes the top of a tower and the foot of the tower at angles of  $45^{\circ}$  and  $30^{\circ}$  of elevation and depression respectively. Find the height of the tower.