MATHS

BOOKS - VK JAISWAL ENGLISH

DIFFERENTIAL EQUATIONS

Exercise Single Choice Problems

1. $\frac{dy}{dx}\left(\frac{1+\cos x}{y}\right) = -\sin x$ and $f\left(\frac{\pi}{2}\right) = -1$, then $f(0)$ is:

A. -2

B. 1

C. 3

D. 4

Answer: A

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2. The differential equation satisfied by family of curves $y = Ae^x + Be^{3x} + Ce^{5x}$ where A,B,C ar arbitrary constants is:

A. $\frac{d^3y}{dx^3} - 9\frac{d^2y}{dx^2} + 23\frac{dy}{dx} - 15y = 0$

B. $\frac{d^3y}{dx^3} - 9\frac{d^2y}{dx^2} - 23\frac{dy}{dx} + 15y = 0$

C. $\frac{d^3y}{dx^3} + 9\frac{d^2y}{dx^2} - 23\frac{dy}{dx} + 15y = 0$

D. $\frac{d^3y}{dx^3} + 9\frac{d^2y}{dx^2} + 23\frac{dy}{dx} - 15y = 0$

Answer: D

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3. If $y = y(x)$ and it follows the relation $e^{xy^2} + y\cos\left(x^2\right) = 5$ then $y'(0)$ is equal to

A. 4

B. -16

C. -4

D. 16

Answer: B

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4. The solution of the primitive integral equation $\left(x^2+y^2\right)dy=xydx$ is $y=y(x)\cdot$ If $y(1)=1$ and $y(x_0)=e,$ then x_0 is (a) $(b)(c)2\sqrt{(d)(e)\Big((f)(g)(h)e^{(i)2(j)}(k)-1(l)\Big)(m)(n)(o)}$ (p) (b) $(q)(r)2\sqrt{(s)(t)\Big((u)(v)(w)e^{(x)2(y)}(z)+1(aa)\Big)(bb)(cc)(dd)}$ (ee) (c) $(d)(e)\sqrt{(f)3(g)}(h)e(i)$ (j) (d) $(k)(l)\sqrt{(m)(n)(o)\dfrac{(p)(q)e^{(r)2(s)}(t)+1}{u}2(v)(w)(x)(y)(z)}$ (aa)

A. $\sqrt{3}e$

B. $\sqrt{e^2-\dfrac{1}{2}}$

C. $\sqrt{\dfrac{e^2-1}{2}}$

D. $\sqrt{e^2+\frac{1}{2}}$

Answer: A

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5. The differential equation $\frac{dy}{dx}=\frac{\sqrt{1-y^2}}{y}$ determinea a family of circles with :

A. Variable radil and fixed centre at $(0, 1)$

B. Variable radii and fixed centre at $(0, -1)$

C. Fixed radius 1 and variable centres along y-axis

D. Fixed radius 1 and variable centres along y-axis

Answer: C

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6. Interval contained in the domain of definition of non-zero solution of the differential equation $(x-3)^2 y' + y = 0$ is:

A. $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

B. $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$

C. $\left(\frac{\pi}{8}, \frac{5\pi}{4}\right)$

D. $(-\pi, \pi)$

Answer: A

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7. A function $y = f(x)$ satisfies $(x+1)f'(x) - 2(x^2+x)f(x) = \frac{e^{x^2}}{x+1}, Aax > -1.$ If $f(0) = 5,$ then f(x) is

A. $\left(\frac{3x+5}{x+1}\right).e^{x^2}$

B. $\left(\frac{6x+5}{x+1}\right).e^{x^2}$

C. $\left(\frac{6x+5}{(x+1)^2}\right).e^{x^2}$

D. $\left(\frac{5x+6x}{x+1}\right).e^{x^2}$

Answer: B

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8. The solution of the differential equation $2x^2y\frac{dy}{dx} = \tan\left(x^2y^2\right) - 2xy^2$, given $y(1) = \frac{\pi}{2}$, is (a) $(b)(c)s \in (d)x^{(e)2(f)}(g)(h)y^{(i)2(j)}(k) = (l)e^{(m)(n)x-1(o)}(p)(q)$ (r) (b) $(s)(t)\sin\left((u)(v)(w)x^{(x)2(y)}(z)(aa)y^{(bb)2(cc)}(dd)(ee)\right) = x(ff)$ (gg) (c) $(d)(e)\cos(f)x^{(g)2(h)}(i)(j)y^{(k)2(l)}(m) + x = 0(n)$ (o) (d) *[Math Processing Error]* (hh)

A. $\sin\left(x^2y^2\right) - 1 = 0$

B. $\cos\left(\frac{\pi}{2} + x^2y^2\right) + x = 0$

C. $\sin\left(x^2y^2\right) = e^{x-1}$

D. $\sin\left(x^2y^2\right) = e^{(x-1)}$

Answer: C

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9. The differential equation whose general solution is given by $y = \left(c_1 \cos(x + c_2) - \left(c_3 e^{(-x+c4)} + (c_5 \sin x),\right.\right.$ where c_1, c_2, c_3, c_4, c_5 are arbitrary constants, is (a) $(b)(c)(d)\frac{(e)(f)d^{(g)4(h)}(i)y}{j}\left((k)d(l)x^{(m)4(n)}(o)\right)(p)(q) - (r)\frac{(s)(t)d^{(u)}}{x}$

(gg) (hh)

$(ii)(jj)(kk)\frac{(ll)(mm)d^{(nn)3(oo)}(pp)y}{qq}\left((rr)d(ss)x^{(tt)3(uu)}(vv)\right)(ww)(\times$

$+ (mmm)\frac{(nnn)dy}{ooo}((ppp)dx)(qqq)(rrr) + y = 0(sss)$

(ttt) (uuu)

$(vvv)(www)(\times x)\frac{(yyy)(zzz)d^{(aaaa)5(bbbb)}(cccc)}{dddd}\left((eeee)d(ffff)x^{(gggg)5(}\right.$

(mmmm) (nnnn)

$(oooo)(pppp)(qqqq)\frac{(rrrr)(ssss)d^{(tttt)3(uuuu)}(vvvv)y}{wwww}\left((xxxx)d(yyyy)x^{(zzz}\right.$

$-(eeeee)\frac{(fffff)(ggggg)d^{(hhhhh)2(iiiii)}(jjjjj)y}{kkkkk}\left((lllll)d(mmmmm)x^{(nn}\right.$

$= 0(yyyyy)$

(zzzzz)

A. $\frac{d^4y}{dx^4} + \frac{d^2y}{dx^2} + y = 0$

B. $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + \frac{dy}{dx} - y = 0$

C. $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$

D. $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$

Answer: C

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10. If $y = e^{(\alpha+1)x}$ be solution of differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0,$ then α is:

A. 0

B. 1

C. -1

D. 2

Answer: B

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11. The order and degree of the differential equation $\left(\frac{dy}{dx}\right)^{1/3} - 4\frac{d^2y}{dx^2} - 7x = 0$ are α and β, then the value of $(\alpha + \beta)$ is:

A. 3

B. 4

C. 2

D. 5

Answer: D

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12. General solution of differential equation of $f(x)\frac{dy}{dx} = f^2(x) + yf(x) + f'(x)y$ is:

(c being arbitary constant.)

A. $y = f(x) + ce^x$

B. $y = -f(x) + ce^x$

C. $y = -f(x) + ce^x f(x)$

D. $y = cf(x) + e^x$

Answer: C

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13. The order and degree respectively of the differential equation of all tangent lines to parabola $x^2 = 2y$ is:

A. $1, 2$

B. $2, 1$

C. $1, 1$

D. $1, 3$

Answer: A

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14. The general solution of the differential equation $\frac{dy}{dx} + x(x+y) = x(x+y)^3 - 1$ is:

A. $\ln\left|\frac{(x+y+1)(x+y-1)}{(x+y)^4}\right| = x^2 + C$

B. $\ln\left|\frac{(x+y+1)(x+y-1)}{(x+y)^2}\right| = x^2 + C$

C. $2\ln\left|\frac{(x+y+1)(x+y-1)}{(x+y)^2}\right| = x^2 + C$

D. $\ln\left|\frac{(x+y+1)(x+y-1)}{(x+y)^2}\right| = x + C$

Answer: B

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15. The general solution of $\frac{dy}{dx} = 2y\tan x + \tan^2 x$ is:

A. $y\cos^2 x = \frac{x}{2} - \frac{\sin 2x}{4} + C$

B. $y\sec^2 x = \frac{x}{2} - \frac{\sin 2x}{4} + C$

C. $y\cos^2 x = \frac{x}{2} - \frac{\cos 2x}{4} + C$

D. $y\cos^2 x = \frac{x}{2} - \frac{\sin 2x}{4} + C$

Answer: A

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16. The solution of diferential equation $\frac{d^2y}{dx^2} = \frac{dy}{dx}, y(0) = 3$ and $y'(0) = 2$:

A. is a periodic function

B. approaches to zero as $x \to -\infty$

C. has an asymptote parallel to x-axis

D. has an asymptote parallel to y-axis

Answer: C

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17. The solution of the differential equation $\left(x^2+1\right)\frac{d^2y}{dx^2}=2x\frac{dy}{dx}$ under the conditions y(0)=1 and y '(0) =3,` is

A. $y=x^2+3x+1$

B. $y=x^3+3x+1$

C. $y-x^4+3x+1$

D. $y=3\tan^{-1}x+x^2+1$

Answer: B

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18. The differential equation of the family of curves $cy^2=2x+c$ (where c is an arbitrary constant.) is:

A. $\frac{xdy}{dx}=1$

B. $\left(\frac{dy}{dx}\right) = \frac{2xly}{dx} + 1$

C. $y^2 = 2xy\frac{dy}{dx} + 1$

D. $y^2 = \frac{2ydy}{dx} + 1$

Answer: C

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19. The solution of the equation $\frac{dy}{dx} + \frac{1}{x}\tan y = \frac{1}{x^2}\tan y \sin y$ is:

A. $2y = \sin y\left(1 - 2cx^2\right)$

B. $2x = \cot y\left(1 + 2cx^2\right)$

C. $2x = \sin y\left(1 - 2cx^2\right)$

D. $2x \sin y = 1 - 2cx^2$

Answer: C

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20. Solution of the differential equation $xdy - \sqrt{x^2 + y^2}dx = 0$ is :

A. $y - \sqrt{x^2 + y^2} = cx^2$

B. $y + \sqrt{x^2 + y^2} = cx$

C. $x = \sqrt{x^2 + y^2} = cx^2$

D. $y + \sqrt{x^2 + y^2} = cx^2$

Answer: D

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21. Let the $f(x)$ be differentiabe function on the interval $(0, \infty)$ such that $f(1) = 1$ and $\lim_{t \to x} \left(\frac{t^2 f(x) - x^2 f(t)}{t^2 - x^2} \right) = \frac{1}{2} \forall x > 0,$ then $f(x)$ is:

A. $\frac{1}{4x} + \frac{3x^2}{4}$

B. $\frac{3}{4x} + \frac{x^2}{4}$

C. $\frac{1}{4x} + \frac{x^3}{4}$

D. $\frac{1}{4x^3} + \frac{3x}{4}$

Answer: C

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22. The population p(t) at time t of a certain mouse species satisfies the differential equation $d\frac{p(t)}{dt} = 0.5p(t) - 450$ If $p(0) = 850$, then the time at which the population becomes zero is .....

(1) 2 ln 18 (2) ln 9 (3) $\frac{1}{2}$ ln 18 (4) ln 18

A. $\frac{1}{2}\ln 18$

B. $\ln 18$

C. $2\ln 18$

D. $\ln 9$

Answer: C

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23. The solution of the differential equation $\sin 2y\frac{dy}{dx} + 2\tan x \cos^2 y = 2\sec x \cos^3 y$ is: (where C is arbitary constant)

A. $\cos y \sec x = \tan x + C$

B. $\sec y \cos x = \tan x + C$

C. $\sec y \sec x = \tan x + C$

D. $\tan y \sec x = \sec x + C$

Answer: C

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24. The solution of the differential equation $\frac{dy}{dx} = (4x + y + 1)^2$ is: (where C is arbitary constant)

A. $4x + y + 1 = 2\tan(2x + y + C)$

B. $4x + y + 1 = 2\tan(x + 2y + C)$

C. $4x + y + 1 = 2\tan(2y + c)$

D. $4x + y + 1 = 2\tan(2x + c)$

Answer: D

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25. If a curve is such that line joining origin to any point $P(x, y)$ on the curve and the line parallel to y-axis through P are equally inclined to tangent to curve at P, then the differential equation of the curve is:

A. $x\left(\frac{dy}{dx}\right) - 2y\frac{dy}{dx} = x$

B. $x\left(\frac{dy}{dx}\right)^2 + 2y\frac{dy}{dx} = x$

C. $x\left(\frac{dy}{dx}\right)^2 - 2x\frac{dy}{dx} = x$

D. $x\left(\frac{dy}{dx}\right)^2 - 2y\frac{dy}{dx} = x$

Answer: A

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26. If $y = f(x)$ satisfy the differential equation $\frac{dy}{dx} + \frac{y}{x} = x^2, f(1) = 1,$ then value of $f(3)$ equals:

A. 7

B. 5

C. 9

D. 27

Answer: A

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27. Let $y = f(x)$ and $\frac{x}{y}\frac{dy}{dx} = \frac{3x^2 - y}{2y - x^2}, f(1) = 1$ then the possible value of $\frac{1}{3}f(3)$ equals :

A. 9

B. 4

C. 3

D. 2

Answer: C

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Exercise One Or More Than One Answer Is Are Correct

1. Let y=f(x) be a real valued function satisfying $x\frac{dy}{dx} = x^2 + y - 2$, f(1)=1 then f(3) equal

A. $f(x)$ is minimum at $x = 1$

B. $f(x)$ is maximum at $x = 1$

C. $f(3) = 5$

D. $f(2) = 3$

Answer: A::C

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2. about to only mathematics

A. $xy = \sin x + c\cos x$

B. $xy\sec x = \tan x + c$

C. $xy + \sin x + c\cos x = 0$

D. None of these

Answer: A::B

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3. If a function satisfies `(x-y)f(x+y)-(x+y)f(x-y)=2(x^2 y-y^3) AA x, y in R and f(1)=2, then a) f(x) must be polynomial function, b) f(3)=12, c) f(0)=0, d) f(x) may not be differentiable.

A. f (x) must be polynomial function

B. $f(3) = 12$

C. $f(0) = 0$

D. $f(3) = 13$

Answer: A::B::C

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4. A function $y - f(x)$ satisfies the differential equation $f(x)\sin 2x - \cos x + \left(1 + \sin^2 x\right) f'(x) = 0$ with $f(0) = 0$. The value of $f\left(\frac{\pi}{6}\right)$ equals to :

A. $\frac{2}{5}$

B. $\frac{3}{5}$

C. $\frac{1}{5}$

D. $\frac{4}{5}$

Answer: A

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5. Solution of the differential equation $\left(2+2x^2\sqrt{y}\right)ydx+\left(x^{21}\sqrt{y}+2\right)xdy=0$ is/are:

A. $xy\left(x^2\sqrt{y}+5\right)=c$

B. $xy\left(x^2\sqrt{y}+3\right)=c$

C. $xy\left(y^2\sqrt{x}+3\right)=c$

D. $xy\left(y^2\sqrt{x}+5\right)=c$

Answer: B

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6. If y (x) satisfies the differential equation $\frac{dy}{dx}=\sin 2x+3y\cot x$ and $y\left(\frac{\pi}{2}\right)=2$ then which of the following stattement (s) is/are correct ?

A. $y\left(\frac{\pi}{6}\right) = 0$

B. $y'\left(\frac{\pi}{3}\right) = \frac{9 - 3\sqrt{2}}{2}$

C. $y(x)$ increases in the interval

D. $\int_{-\pi/2}^{\pi/2} y(x)dx = x$

Answer: A::C

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Exercise Comprehension Type Problem

1. A differentiable function $y = g(x)$ satisfies $\int_0^x (x - t + 1)g(t)dt = x^4 + x^2, \forall x \geq 0$. y =g (x)` satisfies the differential equation :

A. $\frac{dy}{dx} - y = 12x^2 + 2$

B. $\frac{dy}{dx} + 2y = 12x^2 + 2$

C. $\frac{dy}{dx} + y = 12x^2 + 2$

D. $\frac{dy}{dx} + y = 12x + 2$

Answer: C

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2. A differentiable function $y = g(x)$ satisfies $\int_0^x (x - t + 1)g(t)dt = x^4 + x^2, \forall x \geq 0$. y =g (x)` satisfies the differential equation :

A. 0

B. 1

C. e^2

D. Data insufficient

Answer: A

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3. Suppose f and g are differentiabel functions such that $xg(f(x))f'(g(x))g'(x) = f(g(x))g'(f(x))f'(x)\,\forall x \in R$ and f is positive $\forall n \in R.$ Also $\int_0^x f(g(t))dt = \frac{1}{2}\left(1 - e^{-2x}\right)\,\forall x \in R, g(f(0)) = 1$ and $h(x) = \frac{g(f(x))}{f(g(x))}$ The graph of $y = h(x)$ is symmetric with respect to line:

A. $x = -1$

B. $x = 0$

C. $x = 1$

D. $x = 2$

Answer: C

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4. Suppose f and g are differentiabel functions such that $xg(f(x))f'(g(x))g'(x) = (g(x))g'(f(x))f'(x)\,\forall x \in R$ and f is positive $\forall n \in R.$ Also

$\int_0^x f(g(t))dt = \frac{1}{2}\left(1 - e^{-2x}\right) \forall x \in R, g(f(0)) = 1$ and $h(x) = \frac{g(f(x))}{f(g(x))}$

The value of $f(g(0)) + g(f(0))$ is equal to:

A. 1

B. 2

C. 3

D. 4

Answer: B

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5. Given a function ' g' which has a derivative $g'(x)$ for every real x and satisfies $g'(0) = 2$ and $g(x + y) = e^y g(x) + e^y g(y)$ for all x and y then:

Find g(x).

A. $x(2 + xe^x)$

B. $e(e^x + 1)$

C. $2xe^x$

D. $x + \ln(x + 1)$

Answer: C

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6. Given a function ' g' which has a derivative $g'(x)$ for every real x and satisfies $g'(0) = 2$ and $g(x + y) = e^y g(x) + e^y g(y)$ for all x and y then: Find g(x).

A. R

B. $\left[-\frac{2}{e}, \infty\right)$

C. $\left[-\frac{1}{e}, \infty\right)$

D. $[0, \infty)$

Answer: B

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7. Given a function ' g' which has a derivative $g'(x)$ for every real x and satisfies $g'(0) = 2$ and $g(x+y) = e^y g(x) + e^y g(y)$ for all x and y then: Find g(x).

A. 0

B. 1

C. 2

D. Does not exist

Answer: A

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Exercise Subjective Type Problems

1. Find the value of |a| for which the area of triangle included between the coordinate axes and any tangent to the curve $x^a y = \lambda^a$ is constant

(where λ is constnat.),

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2. Let $y = f(x)$ satisfies the differential equation $xy(1+y)dx = dy.\ If f(0) = 1$ and $f(2) = \dfrac{e^2}{k - e^2}$, then find the vlaue of k.

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3. If $y^2 = 3\cos^2 x + 2\sin^2 x$, then the value of $y^4 + y^3 \dfrac{d^2y}{dx^2}$ is

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4. Let $f(x)$ be a diffentiable function in $[-1, \infty)$ and $f(0) = 1$ such that $\lim\limits_{t \to x+1} \dfrac{t^2 f(x+1) - (x+1)^2 f(t)}{f(t) - f(x+1)} = 1$. Find the value of $\lim\limits_{x \to 1} \dfrac{\ln(f(x)) - \ln 2}{x - 1}$.

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5. Let y = $(a\sin x + (b+c)\cos x)e^{x+d}$, where a,b,c and d are parameters represent a family of curves, then differential equation for the given family of curves is given by $h'' - \alpha y' + \beta y = 0$, then $\alpha + \beta =$

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6. Let $y = f(x)$ satisfies the differential equation $xy(1+y)dx = dy.\ If f(0) = 1$ and $f(2) = \dfrac{e^2}{k - e^2}$, then find the vlaue of k.

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