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Q.50 Consider the unit sphere $S = \{(x, y, z) \in \mathbb{R}^3; x^2 + y^2 + z^2 = 1\}$ and the unit normal vector $\hat{n} = (x, y, z)$ at each point (x, y, z) on S . The value of the surface integral $\iint_S \left(\frac{2x}{\pi} + \sin(y^2) \right) x + \left(e^z - \frac{y}{\pi} \right) y + \left(\frac{2z}{\pi} + \sin^2 y \right) z \, dS$ is equal to _____.

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Gradient of function f is :

$$\nabla f = \frac{\partial f}{\partial x} \hat{i} + \frac{\partial f}{\partial y} \hat{j} + \frac{\partial f}{\partial z} \hat{k}$$

 Gradient at $(1,1)$, $\nabla f = \frac{3}{\sqrt{2}} \hat{i} + \frac{3}{\sqrt{2}} \hat{j}$
 \hat{e} = unit vector in the direction i.e., making an angle of $\frac{\pi}{4}$ with y -axis
 So representation of unit vector in cartesian is,

$$\left| \sin \frac{\pi}{4} \hat{i} + \cos \frac{\pi}{4} \hat{j} \right|$$

 \therefore directional derivative = $\hat{e} \cdot \nabla f = \frac{3}{\sqrt{2}} \left(\frac{3}{\sqrt{2}} \right) / \sqrt{2} = 3$

There is one obvious solution, $x_1 = 0$. Also, because $|\sin(x)| \leq 1$, there are no solutions for $|x| > 2$. And one more consideration, because $\sin(x)$ and $\frac{x}{2}$ are both odd functions, for each positive solution x there is one negative solution $-x$. So we can look only at $x \in [0, 2]$.

We know that $\sin(x)$ is strictly concave down on $(0, \frac{\pi}{2})$, and $\sin(0) = 0, \sin(\frac{\pi}{2}) = 1$. Therefore $\sin(x)$ is greater than the secant line through $(0, 0)$ and $(\frac{\pi}{2}, 1)$. The equation of this line is $y = x \frac{2}{\pi}$, so $\sin(x) > x \frac{2}{\pi} > \frac{x}{2}$ for $x \in (0, \frac{\pi}{2})$.

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TRICKY PROBLEM



(b) Using Stokes' theorem prove that :

$$\int_C (\sin z \, dx - \cos x \, dy + \sin y \, dz) = 2,$$

where C is the boundary of the rectangle $0 \leq x \leq \pi$,
 $0 \leq y \leq 1$, $z = 3$.

(B) Attempt any two of the following : [10]

(a) Find the directional derivative of the function :

$$\phi(x, y, z) = y^2 + z^2 + x^2$$

along the tangent to the curve $x = t$, $y = t^2$, $z = t^3$
 at the point $(1, 1, 1)$.

(b) Show that the vector field :

$$\vec{F} = (2xy + z^2) \vec{i} + (z^2) \vec{j} + (3xz^2) \vec{k}$$

is conservative and find the scalar potential associated with \vec{F} .

(c) Find the equation of the tangent line and normal plane to the curve :

$$\vec{r} = (2+t) \vec{i} - t^2 \vec{j} + (1+t^3) \vec{k}$$

at the point $t = 1$.

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nsecreuoser eht fo lla .erom dna tiderc elbaliava ,ecap ,tnemtimmoc emit eht gnidulcni noitamrofni lanoitidda ees llÂÂÄçuoY , ti no kCilc uoy nehw .esruoc taht rof secretuoser eht fo lla gniniatnoc elif piz a daolnwod ot knil Å € Ä Å ç SEGAP ESRUOC LA DAOLNWODÅœ € Ä ç EHT KCILC, EKAT OTUCOC NO DEED uoy ecno .egaugnal hsilgne eht nrael helpoep gniplexh ot detacounded etisbew a si snrael asu gro.snraelasu .srennigeb rof yoeht cisum DNA, sfig detamina: ngised n oitoM ,gnihctekS citsuocA dna dnuoS ot noitcudortnI erew gnitseretni dnuof I sesruoc derutaef eht fo wef a ,etisbew eht detisiv I nehW .wal/scitilop/yteicos dna ,ygolonhcet/htam/ecneics ,tnemnorivne/erutan ,ssenisub/yenom egaugnal ,tra/ retaeht ,tnempoleved/noitacude ,ygolohcysp/strops/htlaeh :saera tcejbus threfferid thgie ni sesruoc eerf 000,1 ylraen sedivorp nraeLnepO ytisrevinU nepO ehT Å .ecap nwo ruoy ta etelpmoc ot stnemele rehto dna sezziq ,stnemngissa ,serutcel oediv ,selcitra niatnoc yam sesruoc eht .Yalp elgoog no dna erots ppa eht ta elbaliava ppa na antiw og-eht-no gninrael rof noitpo taerg a si siht .emit yna ta earf rof hcctaw nac uy taht svitcele ediva dhena ™ ÄçuoY .eunitnoc ot tnuocca eerf a etaerc ot uoy eriuquer lliw taht)XdE sa hcus(etisbew rehtona ot detcerid eb yam uoy ,esruoc a dnuof evÅÂÄçuoY ecnO .nuf gninrael egaugnal ekam ot dengised si ognilouD ognilouD .ecap nwo ruoy ta krow uoy tel meht fo emos dna rep ilairetam odnacrec aits ut ehC ilanif ireisneP .inoizutitsi ertla da ottepsir etnemavititepmoc atatulav eresse otiderc id aro ingo noc ,etnemlarutan ,otiderc id ero 821 onos iC .essalc anu a itrevircsi id amirp ilgatted i ittut ereggel id itarucissA .etiutarg onos nraeL erutuF us issalc el ettut non ,aivattuT .ymedU e XdE aresruoC iuc art iralopop itis ius itnemogra id aiaiIgim eterevorT .itnemogra id Äteirav anu us ilibairav ezzehgnul id isroc onognetcoc ehc enigap 052 id ¹Äip eterevort ,âsesruoCâ adehcs al ottoS .21-K idarg ni itneduts ilg rep ivitargetni otnemidnerppa id ilairetam id arutinrof allus artnecnoc is ymedacA nahK ymedacA nahK .immargorp id ammag anu odnazzilitu e eugnil id Äteirav anu ni acifidoc allus esrosir onocsinrof knil itneuges I !opmet ortsov li eritsevni rep odom omitto nu eresse ²Äup eracifidoc a erarapmi ,ppa'nu erappulivs emoc o bew otis nu eriurtsoc emoc ,FIG nu eraf emoc otseihc iam eteva eS .augnil alled otnemidnerppa e elanosrep oppulivs ,enoizamrofni'lled aigoloncet acitamrofni ,enamu ezneics e itra onos ilibinopsid itnemogra ilged inucla oloS .ymedU otartnoci iah etnemlibaborp ,amirp sitarg enilno isroc ni otacrec iah eS ymedU .idecca e otutarg tnuocca nu aerc ,issergorp iout i erarotinom reP .israzzilaiceps onaredised aera iuc id atlecs anu itneduts ilga odnerffo ,aznatsid a otnemidnerppa id evitaizini ©Ähcnon ,inoizacinumocelet id e evitazzinagro iter id acifidom al e enoiznetunam al ,enoizatnemelpmi'l aenilottos osroc otseuQ .retupmoc led azneics alla ssenisub lad onnav ehc itnemogra eterevorT .enilno ilibinopsid onos etiutarg esrosir etnauq ad iserpros eresse ²Äup is ,augnil avoun anu erarapmi a itassereitni eteis eS ocitsiugn! this article can help connect you to the right materials. materials.