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QNO1.

The value of E at . . . . .

. . . .

(e) $G = 2a_x - 3a_y + 4a_z$.

Sol:

(a) In the direction of a_p = the incremental is given by $dW = -qE \cdot dL$.

Where in this case

$$dL = d\rho a_p = 6 \times 10^{-6} a_p.$$

thus,

$$dW = -(20 \times 10^{-6} C)(100 V/m)(6 \times 10^{-6} m)$$

$$= -12 \times 10^{-9} J$$

$$= \boxed{-12 nJ}$$

(b)

In the direction of a_ϕ . In this case dl

$= 2 d\phi\, a_\phi = 6\times10^{-6}$

So,

$dw = -(20\times10^{-6})(-200)(6\times10^{-6})$

2.4×10^{-8} J

$= 24$ nj

(c).

In the direction of a_z. Here $dl = dz\, a_z = 6\times10^{-6} a_z$

$dw = -(20\times10^{-6})(300)(6\times10^{-6})$

$= -3.6 \times 10^{-8}$ j

$= -36$ nJ

D)

In the direction of E.

$$a_E = \frac{100a_\rho - 200a_\phi + 300a_z}{[100^2 + 200^2 + 300^2]^{1/2}}$$

$$= 0.267a_\rho - 0.535a_\phi + 0.802a_z$$

thus.

$$dw = -(20\times10^{-6}) \cdot 200a_\phi + 300a_z] \cdot [$$

$$[0.267 - 535a_\phi + 0.802a_z] \times 6\times10^{-6}$$

$$= -44.9nJ$$

e)

In the direction of $G = 2a_x - 3a_y + 4a_z$.

$$a_G = \frac{2a_x - 3a_y + 4a_z}{[2^2 + 3^2 + 4^2]^{1/2}}$$

$$= 0.371a_x - 0.557a_y + 0.743a_z$$

Now

$dw = -(20\times10^{-6})[100a_\rho - 200a_\phi + 300a_z] \cdot [0.371a_x - 0.557a_y + 0.743a_z](6\times10^{-6})$

$= -(20\times10^{-6})[37.1(a_\rho \cdot a_x) - 55(a_\rho \cdot a_y)$

$- 74.2(a_\phi \cdot a_x) + 111.4$

$(a_\phi \cdot a_y) + 222.9](6\times10^{-6})$

wher

at P $(a_\rho \cdot a_x) = (a_\phi \cdot a_y) = \cos(40^\circ)$
$= 0.766$

$(a_\rho \cdot a_y) = \sin(40^\circ) = 0.643$

$(a_\phi \cdot a_x) = -\sin(40^\circ) = -0.643$

Now

$dw = -(20\times10^{-6})[28.4 - 35.8 + 47.7 + 85.3 + 222.9](6\times10^{-6})$

$= -41.8\,nJ$

Q2.

Let $E = 10 [\sin \pi/6] a_x + 5 \sin \pi/6 \, a_y + 10 \cos(\pi/6) a_z \}$

Sol:

(a) $E_p = -10 [\sin(\pi/6) a_x + 5 \sin(\pi/6) a_y + 10 \cos(\pi/6) a_z \}$

$= -[5 a_x + 25 a_y + 50 \sqrt{3} a_z]$.

(b) $dw_x = -q E \cdot dL_a$

$= -2 \times 10^{-9} (-5)(10^{-3})$

$= 10^{-11}$ J.

$= 10$ pJ

(c) a_y?

$dw_y = q E \cdot dL a_y$

$= -2 \times 10^{-9} (-25)(-10^{-3})$

$= 50^{-11}$ J

$= 150$ pJ

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(b) d) a_z

$$dw_z = -qE \cdot dL a_z$$

$$= \cdot 2 \times 10^{-9} (-50\sqrt{3}) (10^{-3})$$

$$= 100\sqrt{3} \text{ pJ}$$

e) of $(a_x + a_y + a_z)$?

$$dw_{xyz} = -qE \cdot dL \frac{(a_x + a_y + a_z)}{\sqrt{3}}$$

$$\frac{10 + 50 + 100\sqrt{3}}{\sqrt{3}}$$

$$= 135 \text{ pJ}$$

Q3.

Sol.

(a) P(1, 2, 3) toward Q(2, 1, 4)

The vector along this direction will be
Q - P = (1, -1, 1)
from which $a_{PQ} = [a_x - a_y + a_z]/\sqrt{3}$

$dW = -qE \cdot dL$

$-(50\times10^{-6})(120a_\rho \cdot \frac{(a_x - a_y + a_z)}{\sqrt{3}})$
(2×10^{-3})

At P $\phi = \tan^{-1}(2/1) = 63.4°$

thus $(a_\rho \cdot a_x) = \cos(63.4)$
$= 0.447$.

$a_\rho \cdot a_y = \sin(63.4°) = 0.894$

Substiting these we get

$dW = 3.1 \mu J$

b)

Q = (2,14) toward P(1,2,3) A little

thought is in order here. Note that

the field has only a radial component

and does not depends on ϕ or z.

And P and Q at the same radius.

rs from x axis. Thus the answer

is dW = 3.14 J. as in part a.

This also found by going through the

procedure as in part. but with the
direction

(Roles of P & Q) reversed.

Q4.

Compute the value $\int_A^P G \cdot dL$.

Sol:

(a) Straight line segments (A(1,-1,2) to P(2,1,2) in general we would have

$$\int_A^P G \cdot dL = \int_A^P 2y\,dx.$$

The change in x occurs when moving b/w B & P, during which y = 1

$$\int_A^P G \cdot dl = \int_B^P 2y\,dx.$$

$$\int_1^2 2(1)\,dx.$$

$$= 2$$

b) Straight line segment A(1,-1,2) to C(2,1,2) to P(2,1,2). In this case change in x occurs when moving form A to C during which y = 1

$$\int_1^2 2(-1)\, dx$$

$$= -2.$$

Q5.

Let $G = 3xy^3 a_x + 2z a_y$. Find.

Sol...

Let $G = 3xy^3 a_x + 2z a_y$

a) Straight line $y = x - 1$, $z = 1$

$$= \int G \cdot dL = \int_2^4 3xy^2 + \int_2^3 2z\, dy$$

$$= \int_3^4 3x(x-1)^2\, dx + \int_1^3 2(1)\, dy$$

$$= 90$$

(b) Parabola $6y = x^2+2$, $z = 1$

$$= \int G \cdot dl = \int_2^4 3xy^2 + \int_1^3 2z\,dy.$$

$$= \int_2^4 \frac{1}{2}\, x\,(x^2+2)^2 + \int_1^3 2(1)\,dy$$

$$= 82$$

//.