A particle is moving along the x-axis under the action of a variable force $\vec{F}(x) = (Cx - 3x^2)\hat{i}$ N, where x is in meters and C is a constant. There is no friction.

8. What is the *dimension* of the constant C?
(a) $[M/T^3]$ (b) $[ML/T^3]$ (c) $[ML/T^2]$ (d) $[M/T^2]$ (e) $[ML^2/T^2]$

Question 11

11. Find the unit vectors orthogonal to the plane through the points P (0,0,0), Q(1,-1,1), R(4,3,7) in Oxyz cartesian coordinate system.
(a) $\pm(-\frac{10}{\sqrt{158}}\hat{i} - \frac{1}{\sqrt{158}}\hat{j} + \frac{7}{\sqrt{158}}\hat{k})$ (b) $\pm(\frac{3}{\sqrt{74}}\hat{i} - \frac{4}{\sqrt{74}}\hat{j} + \frac{7}{\sqrt{74}}\hat{k})$ (c) $\pm(\frac{4}{\sqrt{74}}\hat{i} - \frac{3}{\sqrt{74}}\hat{j} + \frac{7}{\sqrt{74}}\hat{k})$ (d) $\pm(\frac{1}{\sqrt{3}}\hat{i} - \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k})$
(e) $\pm(-\frac{1}{\sqrt{68}}\hat{i} - \frac{3}{\sqrt{68}}\hat{j} + \frac{7}{\sqrt{68}}\hat{k})$

6. Which of following is a scalar?
(a) power (b) displacement (c) momentum (d) velocity (e) acceleration

7. The dimension of power is
(a) $[M][L]^2/[T]^3$ (b) $[M][L]^2/[T]^2$ (c) $[M][L]^3/[T]^2$ (d) $[M][L]/[T]$ (e) none of them.

1. Which of the following is the unit of Power in MKS unit system?
(a) kg m/s (b) none of them (c) kg m^2/s (d) kg m^2/s^2 (e) kg m^2/s^3

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2. Two vectors, $\vec{a} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} + \hat{j} - 2\hat{k}$ are given. What is the magnitude of $\vec{c} \cdot (\vec{a} \times \vec{b})$ if $\vec{c} = 2\vec{a} - 3\vec{b}$ is given as a new vector?
(a) $\sqrt{35}$ (b) 0 (c) $\sqrt{29}$ (d) 5 (e) 6

3. The two non-zero vectors $\vec{a}$ and $\vec{b}$ satisfy the equation $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$. What is the angle between $\vec{a}$ and $\vec{b}$?
(a) 0° (b) 45° (c) 90° (d) 30° (e) 180°

4. What is the unit vector $\hat{e}_d$ in the direction of vector $\vec{d} = -2\hat{i} + \hat{j} - 2\hat{k}$?
(a) $\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} - \frac{2}{3}\hat{k}$ (b) $-\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} - \frac{2}{3}\hat{k}$ (c) $-\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}$ (d) $\frac{2}{3}\hat{i} - \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}$ (e) $\frac{2}{3}\hat{i} + \frac{1}{3}\hat{j} + \frac{2}{3}\hat{k}$

6. Which step of the following derivation is wrong or includes an invalid operation for the time independent expression of motion with constant acceleration?
I. $\vec{s} = \vec{v}t$
II. $\vec{s} = \left[\frac{\vec{v}+\vec{v_0}}{2}\right] \cdot \left[\frac{\vec{v}-\vec{v_0}}{\vec{a}}\right]$
III. $2\vec{a} \cdot \vec{s} = (\vec{v} + \vec{v_0}) \cdot (\vec{v} - \vec{v_0})$
IV. $2\vec{a} \cdot \vec{s} = \vec{v} \cdot \vec{v} - \vec{v_0} \cdot \vec{v_0}$
V. $2\vec{a} \cdot \vec{s} = v^2 - v_0^2$
(a) III (b) IV (c) V (d) II (e) I

8. Which one of these mathematical operations is not permissible?
(a) $\vec{A} \times (\vec{B} \bullet \vec{C})$ (b) $(\vec{A} - \vec{B}) \times \vec{C}$ (c) $\vec{A} \bullet (\vec{B} \times \vec{C})$ (d) $\vec{A} \bullet (\vec{B} - \vec{C})$ (e) $\vec{A} \times (\vec{B} \times \vec{C})$

9. Brunt-Vassala frequency for internal wave is given by (z is depth [m], ρ is density proceed to dimensional analysis)
(a) $\sqrt{g\frac{d\rho/dz}{\rho}}$ (b) $g\frac{d\rho/dz}{\rho}$ (c) $\sqrt{g\frac{\rho}{d\rho/dz}}$ (d) g/z (e) $\sqrt{gz}$

10. If three vectors add up to a zero resultant it is correct to say that:
(a) The three vectors must be in a plane.
(b) The three vectors cannot have the same magnitude.
(c) The three vectors must be co-linear (parallel).
(d) The three vectors must have the same magnitude.
(e) It is impossible to find three vectors that add up to a zero resultant.

Questions 11-15

Assume that there are three vectors with the following form: $\vec{A} = \hat{i} + \hat{j} + k$, $\vec{B} = x\hat{i} - 2\hat{j} + 2\hat{k}$, $\vec{C} = -\hat{i} + 2\hat{j} + 2\hat{k}$
If the angle between $\vec{A}$ and $\vec{B}$ is arccos(1/3)

11. Find x ?
(a) 2 (b) 1 (c) -1 (d) -2 (e) 1.5

12. Find $\left|\vec{A}\right|$?
(a) $\sqrt{3}$ (b) $\sqrt{2}$ (c) 2 (d) $\sqrt{5}$ (e) $2\sqrt{3}$

13. Find $\vec{A} \times \vec{C}$?
(a) $-3\hat{j} + 3\hat{k}$ (b) $-2\hat{i} + 2\hat{j} + 2\hat{k}$ (c) $2\hat{i} + 2\hat{k}$ (d) $-\hat{i} + 3\hat{j} + 2\hat{k}$ (e) $-\hat{i} - 3\hat{j} + 2\hat{k}$

14. Find $\left|\vec{A} \times \vec{B}\right|$?
(a) $3\sqrt{2}$ (b) $2\sqrt{3}$ (c) $2\sqrt{2}$ (d) 6 (e) 3

15. Find a unit vector that is perpendicular to the plane defined by vectors $\vec{A}$ and $\vec{C}$?
(a) $-\frac{1}{\sqrt{2}}\hat{j} + \frac{1}{\sqrt{2}}\hat{k}$ (b) $-\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$ (c) $+\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{2}\hat{k}$ (d) $-\frac{1}{\sqrt{6}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$ (e) $+\frac{1}{\sqrt{2}}\hat{i} - \frac{1}{\sqrt{2}}\hat{j} + \frac{1}{\sqrt{2}}\hat{k}$

19. Find the projection of acceleration $a(t)$ on velocity $v(t)$ (the component of acceleration in the direction of velocity)
(a) $(\vec{a}.\vec{v})\frac{\vec{v}}{v}$ (b) $(\vec{a}.\vec{v})\frac{\vec{v}}{v^2}$ (c) $\vec{a} \times \vec{v}/v$ (d) $(\vec{a}.\vec{v})\frac{\vec{a}}{a^2}$ (e) $(\vec{a} \times \vec{v}) \times \vec{v}/v^2$

20. Find projection of acceleration on the direction orthogonal to velocity)?
(a) $\vec{a} - (\vec{a}.\vec{v})\frac{\vec{v}}{v^2}$ (b) $\vec{a} + (\vec{a}.\vec{v})\frac{\vec{v}}{v^2}$ (c) $\vec{a} - \vec{a} \times \vec{v}/v$ (d) $\vec{a} - (\vec{a}.\vec{v})\frac{\vec{a}}{a^2}$ (e) $(\vec{a} \times \vec{v}) \times \vec{v}/v^2$

Questions 9-11

$\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{B} = a\hat{i} - \hat{j} - 2\hat{k}$ vectors are given.

9. What should be the value of a to make $\vec{B}$ perpendicular to $\vec{A}$?
(a) 0 (b) 1/2 (c) -1 (d) 2 (e) 1

10. What is the unit vector in the direction of $\vec{A}$?
(a) $\frac{2\hat{i}+3\hat{j}-\hat{k}}{\sqrt{14}}$ (b) $\frac{2\hat{i}+3\hat{j}+\hat{k}}{\sqrt{12}}$ (c) $\frac{2\hat{i}-3\hat{j}-\hat{k}}{\sqrt{12}}$ (d) $\frac{-2\hat{i}+3\hat{j}-\hat{k}}{\sqrt{14}}$ (e) $\hat{i} + \hat{j} + \hat{k}$

11. What is the magnitude of the projection of $\vec{B}$ vector on $\vec{A}$ vector if a=1?
(a) $1/\sqrt{12}$ (b) $1/\sqrt{14}$ (c) $\sqrt{12}$ (d) $\sqrt{14}$ (e) $1/\sqrt{84}$

Questions 12-16

For $\vec{A}$ and $\vec{B}$ vectors given as $\vec{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{B} = -3\hat{i} - 4\hat{j} + \hat{k}$

12. Find a unit vector in the same direction with $\vec{B}$.
(a) $-3\hat{i} - 4\hat{j} + \hat{k}$ (b) $\frac{-3\hat{i}-4\hat{j}+\hat{k}}{\sqrt{8}}$ (c) $\frac{+3\hat{i}+4\hat{j}-\hat{k}}{\sqrt{8}}$ (d) $\frac{-3\hat{i}-4\hat{j}+\hat{k}}{\sqrt{26}}$ (e) $\frac{-3\hat{i}-4\hat{j}+\hat{k}}{2}$

13. Calculate $\vec{A} \bullet \vec{B}$?
(a) -14 (b) 4 (c) -12 (d) 10 (e) -16

14. Calculate $\vec{A} \times \vec{B}$?
(a) $14\hat{i} - 17\hat{j} - 10\hat{k}$ (b) $14\hat{i} - 13\hat{j} - 17\hat{k}$ (c) $13\hat{i} - 14\hat{j} - 17\hat{k}$ (d) $-13\hat{i} + 14\hat{j} - 17\hat{k}$ (e) $-13\hat{i} + 14\hat{j} + 17\hat{k}$

15. Find a unit vector, $\hat{c}$, which is perpendicular to the plane formed by $\vec{A}$ and $\vec{B}$ vectors.
(a) $\hat{c} = \pm\frac{14\hat{i}-13\hat{j}-17\hat{k}}{\sqrt{(13)^2+(-14)^2+(-17)^2}}$ (b) $\hat{c} = \pm\frac{13\hat{i}+14\hat{j}-17\hat{k}}{\sqrt{(13)^2+(-14)^2+(-17)^2}}$ (c) $\hat{c} = \pm\frac{14\hat{i}-17\hat{j}-10\hat{k}}{\sqrt{(13)^2+(-14)^2+(-17)^2}}$ (d) $\hat{c} = \pm\frac{13\hat{i}-14\hat{j}-17\hat{k}}{\sqrt{(13)^2+(-14)^2+(-17)^2}}$
(e) $-13\hat{i} + 14\hat{j} + 17\hat{k}$

16. Calculate the cosine of the angle between $\vec{A}$ and $\vec{B}$ vectors.
(a) $\frac{-14}{\sqrt{29}\cdot\sqrt{26}}$ (b) $\frac{10}{\sqrt{29}\cdot\sqrt{26}}$ (c) $\frac{-16}{\sqrt{29}\cdot\sqrt{26}}$ (d) $\frac{-4}{\sqrt{29}\cdot\sqrt{26}}$ (e) $\frac{-12}{\sqrt{29}\cdot\sqrt{26}}$

Questions 1-3

Two vectors are given as $\vec{A} = a\hat{\imath} - 2\hat{k}$ and $\vec{B} = b\hat{\jmath} - 2\hat{k}$ where a and b are positive real numbers.

1. If the magnitudes of vectors are $A = 3$ and $B = 4$, find magnitude of the vector $\vec{A} - \vec{B}$.

(a) -4 (b) $\sqrt{17}$ (c) 12 (d) 5 (e) $-\sqrt{17}$

2. Angle between the vectors $\vec{A}$ and $\vec{B}$ is

(a) $\arctan\sqrt{5/12}$ (b) $\arccos 1/3$ (c) $\arctan\sqrt{12/5}$ (d) $37°$ (e) $53°$

3. Find a unit vector which is perpendicular to both vectors $\vec{A}$ and $\vec{B}$.

(a) $(\sqrt{12}\hat{\imath} + \sqrt{5}\hat{\jmath} + \sqrt{15}\hat{k})/\sqrt{32}$ (b) $(3\hat{\imath} + 4\hat{\jmath})/5$ (c) $2(\hat{\imath} + \hat{\jmath} - \hat{k})$ (d) $-\sqrt{5}\hat{\imath} + \sqrt{12}\hat{\jmath}$ (e) $(-\sqrt{5}\hat{\imath} + \sqrt{12}\hat{\jmath})/\sqrt{17}$

1. $\vec{A} = 2\hat{\imath} - 3\hat{\jmath}$ ve $\vec{B} = -\hat{\imath} + y\hat{\jmath}$ vektörlerinin birbirine dik olması için y'nin değeri ne olmalıdır?

(a) -3/2 (b) 3/2 (c) -2/3 (d) 2/3 (e) 1/3

2. Basınç birim alan başına uygulanan kuvvettir. Basıncın SI birimi Pascal (Pa) için hangisi doğrudur?

(a) 1Pa=1J/ m^2 (b) 1Pa=1J/m^3 (c) 1Pa=1J m (d) 1Pa=1J m^3 (e) 1Pa=1J m^2