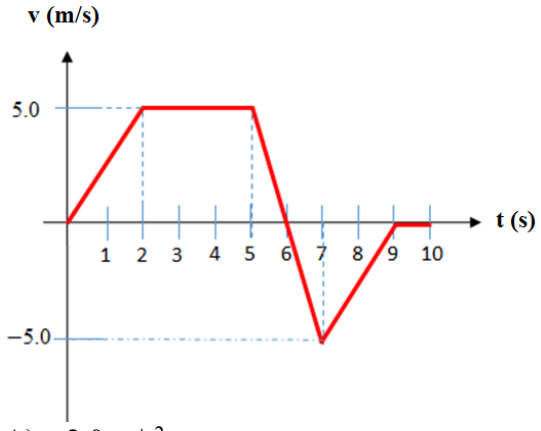
Q1.
Work is defined as the scalar product of force and displacement. Power is defined as the rate of change of work with time. The dimension of power is:

A) ML^2T^{-3}
B) $M^2L^2T^3$
C) $ML^{-1}T^{-2}$
D) $M^2L^2T^2$
E) $ML^{-1}T^{-1}$

Q2.
A bullet is fired through a wooden board, 5.52 inches thick, with its line of motion perpendicular to the face of the board. If it enters with a speed of 450 m/s and emerges with a speed of 220 m/s, what is the bullet's acceleration as it passes through the board? (Assume the acceleration is constant and take 1 inch = 2.54 cm.)

A) -550 km/s^2
B) $+360$ km/s^2
C) -360 km/s^2
D) $+550$ km/s^2
E) $+275$ km/s^2

Q3.
A person pushes a cart along a straight track. The velocity of the cart changes over time as shown in **Figure 1**. What is the average acceleration of the cart between t = 2 s and t = 7 s?



A) -2.0 m/s^2
B) -3.5 m/s^2
C) $+2.0$ m/s^2
D) $+3.5$ m/s^2
E) zero

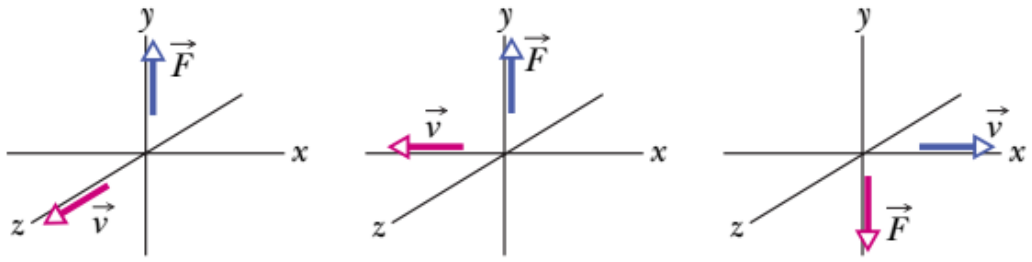
Q4.
A rock is dropped vertically down from rest from the top of a 100-m high building. At what time and with what speed will the rock reach 50.0 m below the top of the building? (Ignore air resistance)

A) 3.18 s, 31.3 m/s
B) 1.50 s, 19.8 m/s
C) 4.36 s, 24.5 m/s
D) 3.18 s, 11.6 m/s
E) 9.80 s, 59.1 m/s

Q5.
The position of a particle moving along the *x* axis is given by: $x = 2.0 + 6.0t^2 - 2.0t^3$ (in SI units). Find the magnitude of the acceleration at the instant when the particle reaches the maximum position along the positive x-axis.

A) 12 m/s^2
B) 6.0 m/s^2
C) 24 m/s^2
D) 18 m/s^2
E) zero

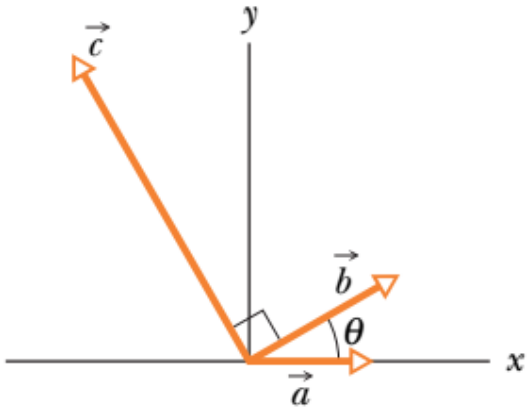
Q6.
A vector $\vec{F}$ is given as $\vec{F} = q(\vec{v} \times \vec{B})$, where $\vec{v}$ is perpendicular to $\vec{B}$. In which of the situations, shown in **Figure 2**, is the direction of $\vec{B}$ in the positive z-axis if q is a positive constant



A) 2 and 3 only
B) 1 only
C) 2 only
D) 3 only
E) 1 and 3 only

Q7.

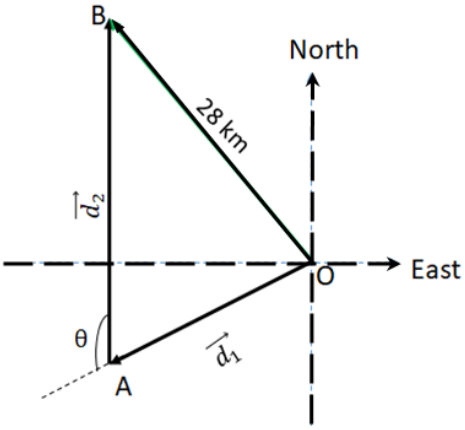
The three vectors in **Figure 3** have magnitudes a = 3.00 m, b = 4.00 m, and c = 10.0 m and angle θ = 30.0°. If $\vec{c} = p\vec{a} + q\vec{b}$, what are the values of p and q, respectively?



A) −6.66 and 4.33
B) −5.00 and 8.66
C) 3.00 and −5.00
D) −2.44 and −3.55
E) 12.5 and 9.86

Q8.

Starting from origin O, a camel walks 25 km south of west ($\vec{d}_1$) and reaches to point A as shown in **Figure 4**. Then it walks 30 km directly up to the north ($\vec{d}_2$) and reaches to point B. If point B is 28 km away from the origin, find the angle (θ) between $\vec{d}_1$ and $\vec{d}_2$.



A) 120°
B) 150°
C) 105°

D) 130°
E) 159°

Q9.
A particle moves in the *xy* plane, starting from the origin at $t = 0$ with an initial velocity $\vec{v}_0 = 20.0\hat{i} - 3.00\hat{j}$, where the unit of velocity is m/s. The particle experiences an acceleration in the *x* direction only that is given by $a_x = -4.00$ m/s^2. Find the magnitude of its average velocity from $t = 0$ to $t = 5.00$ s.

A) 10.4 m/s
B) 15.7 m/s
C) 22.5 m/s
D) 35.1 m/s
E) 46.3 m/s

Q10.
The pilot of an aircraft flies due north relative to the ground in a wind blowing at 40 km/h toward the east. If his speed relative to the ground is 80 km/h, what is the velocity of his airplane relative to the air? (Considering $\hat{i}$ = East and $\hat{j}$ = North)

A) $-40\hat{i} + 80\hat{j}$ (km/h)
B) $-40\hat{i} - 80\hat{j}$ (km/h)
C) $40\hat{i} + 80\hat{j}$ (km/h)
D) $40\hat{i} - 80\hat{j}$ (km/h)
E) $40\hat{i} + 40\hat{j}$ (km/h)

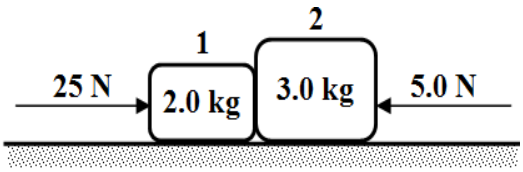
Q11.
An Earth satellite moves in a circular orbit of radius 7010 km with a period of 98 min. What is the magnitude of the centripetal acceleration of the satellite?

A) 8.0 m/s^2
B) 5.0 m/s^2
C) 3.0 m/s^2
D) 2.0 m/s^2
E) 4.0 m/s^2

Q12.
A stone is thrown from the top of a building at an angle of 30° above the horizontal with an initial speed of 20 m/s. The height from which the stone is thrown is 45 m above the ground. What is the final speed of the stone just before it hits the ground? (Ignore air resistance)

A) 36 m/s
B) 20 m/s
C) 15 m/s
D) 43 m/s
E) 54 m/s

Q13.
Two blocks of masses 2.0 kg and 3.0 kg move on a horizontal frictionless surface and are subjected to two horizontal forces of magnitudes 25 N and 5.0 N, respectively, as shown in **Figure 5**. What is the magnitude of the force exerted by block 2 on block 1?



A) 17 N
B) 21 N
C) 29 N
D) 37 N
E) 11 N

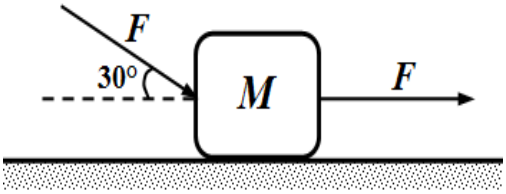
Q14.
A block is projected up a frictionless inclined plane with initial speed v_o = 3.50 m/s. The angle of the inclined plane is $\theta = 32.0°$. How far up the plane does the block go?

A) 1.18 m
B) 2.91 m
C) 5.27 m
D) 6.34 m
E) 3.75 m

Q15.
Using a rope that will break completely if the tension in it exceeds 600 N, you need to lift vertically a block weighing 449 N from the ground. What magnitude of acceleration will put the rope on the verge of breaking?

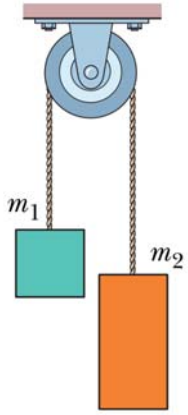
A) 3.3 m/s^2
B) 1.4 m/s^2
C) 7.5 m/s^2
D) 4.6 m/s^2
E) 9.1 m/s^2

Q16.
A block slides on a frictionless horizontal surface under the action of two forces, as shown in **Figure 6**. If $\boldsymbol{F}$ = 20 N and M = 5.0 kg, find the magnitudes of the resulting acceleration of the block and the normal force on the block, respectively.



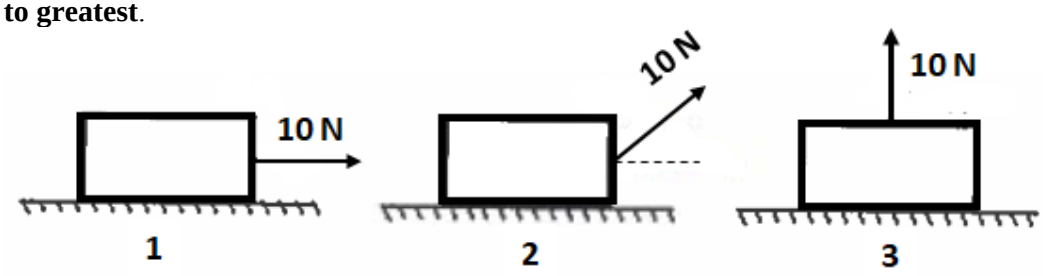
A) 7.5 m/s^2 and 59 N
B) 7.5 m/s^2 and 84 N
C) 4.5 m/s^2 and 47 N
D) 4.5 m/s^2 and 59 N
E) 3.0 m/s^2 and 84 N

Q17.
A massless rope passes over a massless and frictionless pulley suspended from the ceiling as shown in **Figure 7**. A block of mass m_1 = 4 kg is attached to one end, and another block of mass m_2 = 5 kg is attached to the other end. The acceleration of the 5-kg block is:



A) *g/9*
B) *5g/9*
C) *4g/9*
D) *g/5*
E) *g/4*

Q18.
A crate rests on a rough horizontal surface and a person pulls on it with a 10-N force. No matter what the orientation of the force**, the crate does not move**. Rank the situations shown in **Figure 8** according to the magnitude of the frictional force of the surface on the crate, **least to greatest**.

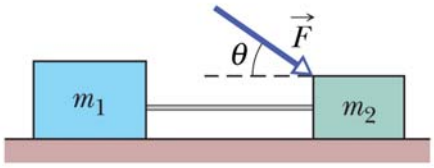


A) 3, 2, 1
B) 1, 2, 3
C) 2, 1, 3
D) 3, 1, 2
E) All tie

Q19.
A coin placed 30.0 cm from the center of a rotating horizontal turntable slips when its speed reaches 50.0 cm/s. What is the coefficient of static friction between the coin and the turntable?

A) 0.085
B) 0.027
C) 0.045
D) 0.064
E) 0.019

Q20.
In **Figure 9**, block 1 of mass m_1 = 2.0 kg and block 2 of mass m_2 = 1.0 kg are connected by a string of negligible mass. Block 2 is pushed by a force of magnitude 20 N making an angle $\theta = 35°$ as shown. The coefficient of kinetic friction between each block and the horizontal surface is 0.20. What is the tension in the string?



A) 9.4 N
B) 6.2 N
C) 2.5 N
D) 7.1 N
E) 4.7 N
