		Surname		Type
Group Number		Name		A
List Number		e-mail		
Student Number		Signature		

ATTENTION:Each question has only one correct answer and is worth one point. Be sure to fill in completely the circle that corresponds to your answer on the answer sheet. Use a pencil (not a pen). Only the answers on your answer sheet will be taken into account.

1. Which of the followings is/are true for any $\vec{A}$ and $\vec{B}$ vectors?

i. If these two vectors are perpendicular to each other, the magnitude of vector product is maximum value.
ii. If these two vectors are parallel to each other, scalar product gives the maximum value.
iii. The vector founded by the vector product of these vectors, is perpendicular to the plane constructed by these two vectors.

(a) i and ii (b) only i (c) All of them (d) i and iii (e) ii and iii

2. Which of the followings is/are always true for any $\vec{A}$, $\vec{B}$ and $\vec{C}$ vectors?

i. $\vec{A} \times (\vec{B} \times \vec{C}) = 0$
ii. $\vec{A} \times (\vec{B} \times \vec{A}) = 0$
iii. $\vec{A} \cdot (\vec{B} \times \vec{A}) = 0$

(a) All of them (b) None of them (c) Only i (d) Only iii (e) Only ii

Questions 3-5

The position of a mouse and the acceleration of a cat are given as functions of time as $\vec{r}_{\text{mouse}} = \text{At}^2\ \hat{\imath} + \text{Bt}\ \hat{\jmath}$ and $\vec{a}_{\text{cat}} = \text{C}\ \hat{\imath} + \text{Dt}\ \hat{\jmath}$. The constants are A = 1 m/s^2, B = 2 m/s, C = 2/3 m/s^2, D = 2 m/s^3. The cat is initially at rest.

3. What is the velocity of the mouse in (m/s) at t = 2 s?
(a) $4\ \hat{\imath} + 2\ \hat{\jmath}$ (b) $8\ \hat{\imath} + 2\ \hat{\jmath}$ (c) $8\ \hat{\imath} + 8\ \hat{\jmath}$ (d) $2\ \hat{\imath} + 8\ \hat{\jmath}$ (e) $2\ \hat{\imath} + 2\ \hat{\jmath}$

4. What is the velocity of the mouse in (m/s) relative to the cat at t = 2 s?
(a) $2/3\ \hat{\imath} - 6\ \hat{\jmath}$ (b) $8/3\ \hat{\imath} - 6\ \hat{\jmath}$ (c) $-2/3\ \hat{\imath} + 6\ \hat{\jmath}$ (d) $8/3\ \hat{\imath} - 2\ \hat{\jmath}$ (e) $4\ \hat{\imath} - 2\ \hat{\jmath}$

5. The cat catches the mouse at the position $\vec{r} = 9$ (m) $\hat{\imath} + 6$ (m) $\hat{\jmath}$. Find the initial position of the cat in meters (m).
(a) $23/3\ \hat{\imath} - 2\ \hat{\jmath}$ (b) $8\ \hat{\imath} - 3\ \hat{\jmath}$ (c) $6\ \hat{\imath} - 3\ \hat{\jmath}$ (d) $19/3\ \hat{\imath} - 10\ \hat{\jmath}$ (e) $7\ \hat{\imath} - 10\ \hat{\jmath}$

Questions 6-10

A ball is thrown straight up in the air with an initial speed of 20 m/s. Ignore air resistance and take $g = 10\text{m/s}^2$.

6. What is the maximum height the ball can reach?
(a) 20 m (b) $5\sqrt{2}$ m (c) 5 m (d) 10 m (e) 400 m

7. What is the speed of the ball when it reaches 5 m above the ground?
(a) 5 m/s (b) $10\sqrt{3}$ m/s (c) 300 m/s (d) $5\sqrt{3}$ m/s (e) $10\sqrt{5}$ m/s

8. How long will it take for the ball to reach 5 m above its initial position on the way up?
(a) $(2+\sqrt{5})$ s (b) $(2-\sqrt{3})$ s (c) 2 s (d) $(5+\sqrt{2})$ s (e) $(5-\sqrt{2})$ s

9. How long will it take for the ball to reach 5 m above its initial position on the way down?
(a) 4 s (b) $2\sqrt{3}$ s (c) $(\sqrt{3}+2)$ s (d) $2\sqrt{5}$ s (e) $(\sqrt{3}-2)$ s

10. What will be its final speed just before it hits the ground?
(a) 20 m/s (b) 40 m/s (c) $40\sqrt{3}$ m/s (d) 5 m/s (e) 30 m/s

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11. A particle with mass m is moving on a vertical circle with radius R under an external force F that keeps the particle speed v constant during the motion. What is the total (net) work done on the particle in completing one full revolution?
(a) mv^2/R (b) $2\pi RF$ (c) $2mgR$ (d) $mv^2/2$ (e) 0

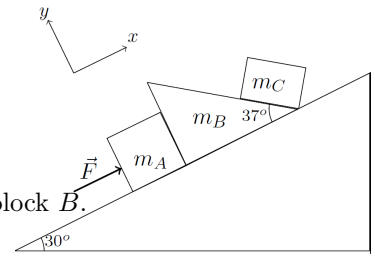
12. You can build a windmill on one of the two hills A and B. On hill A, the wind blows with a constant speed v for 24 hours every day. On hill B, the wind blows with a constant speed $2v$ for 12 hours every day. What would you expect for the relation of daily average work of mill A to mill B?
(a) Work A > Work B (b) Work B > Work A (c) There is no difference (d) It depends on the direction of the wind (e) The question can not be answered with available information

13. A father pulls his son, whose mass is m and who is sitting on a swing with ropes of length L, backward until the ropes make an angle of θ_0 with respect to the vertical. He then releases his son from rest. What is the speed of the son at the bottom of the swinging motion?

(a) $\sqrt{mgL\cos\theta_0}$ (b) $\sqrt{2gL\cos\theta_0}$ (c) $\sqrt{mgL(1-\cos\theta_0)}$ (d) $\sqrt{gL(1-\cos\theta_0)}$ (e) $\sqrt{2gL(1-\cos\theta_0)}$

Questions 14-16

Three blocks (A, B, C) on a frictionless inclined plane are in contact with each other as shown in the figure. Assume that there is no friction between the blocks. A force $\vec{F}$ parallel to the plane is applied to block A . The masses are $m_A = 5$ kg, $m_B = 2$ kg and $m_C = 1$ kg. Take $g = 10\text{m/s}^2$. ($\sin(37°) = 0.6$, $\cos(37°) = 0.8$, $\cos(30°) = 0.87$, $\sin(30°) = 0.5$)



14. What should be the magnitude of the force so that the objects remain motionless?

(a) 80 N (b) 35 N (c) 70 N (d) 40 N (e) 48 N

15. When the magnitude of the force is $36N$, find the acceleration of the blocks.

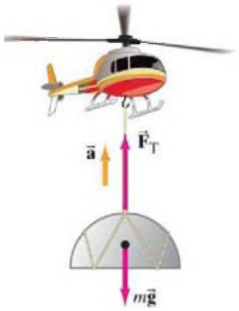
(a) 0.125 m/s^2 (b) -1.5 m/s^2 (c) -5.5 m/s^2 (d) -0.5 m/s^2 (e) -4.5 m/s^2

16. When the magnitude of the force is $36N$, find the magnitude of the force on block A due to block B.

(a) 16.5 N (b) 13.5 N (c) 8.5 N (d) 6.5 N (e) 15 N

Questions 17-19

A 7650-kg helicopter accelerates upward at 1.20 m/s^2 while lifting a 1250-kg frame at a construction site, shown in the figure at right. Take $g = 9.8$ m/s^2.



17. What is the lift force exerted by the air on the helicopter rotors?

(a) 9.80×10^3 N (b) 8.90×10^4 N (c) 9.87×10^4 N (d) 9.79×10^3 N (e) 9.79×10^4 N

18. What is the tension in the cable (ignore its mass) that connects the frame to the helicopter?

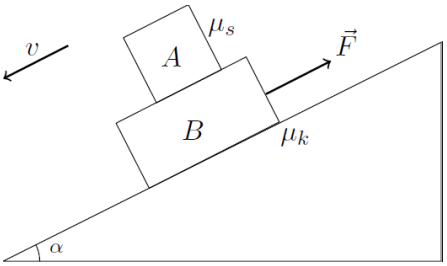
(a) 1.33×10^4 N (b) 1.375×10^3 N (c) 1.375×10^4 N (d) 1.25×10^3 N (e) 1.25×10^4 N

19. What force (and direction) does the cable exert on the helicopter?

(a) 1.25×10^3 N down (b) 1.375×10^4 N down (c) 1.33×10^4 N up (d) 1.25×10^4 N up (e) 1.375×10^4 N up

Questions 20-23

In order that two boxes, one on top of the other, are sliding down the ramp, together with the same constant speed, a force F is applied to the box B in the opposite direction of the motion, as shown in the figure. The coefficient of static friction between the two boxes is μ_s and the coefficient of kinetic friction between the box B and the ramp is μ_k. ($m_A = 1$ kg, $m_B = 9$ kg, $\mu_k = 0.5$, $\mu_s = 0.9$, $g = 10$ m/s^2, $\cos(30°) = 0.87$, $\sin(30°) = 0.5$)



20. Find the kinetic friction force if the angle is $\alpha = 30°$.

(a) 8 N (b) 10 N (c) 50 N (d) 43.5 N (e) 6.5 N

21. Find the force F if the angle is $\alpha = 30°$.

(a) 50 N (b) 8 N (c) 6.5 N (d) 15 N (e) 11 N

22. Find the static friction force between the two boxes if the angle is $\alpha = 30°$.

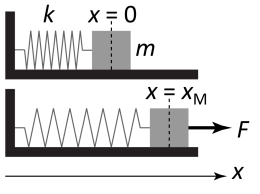
(a) 5 N (b) 45 N (c) 5.5 N (d) 2.4 N (e) 11 N

23. Find the maximum value of α such that the mass A does not move with respect to B.

(a) $\alpha_{max} = \tan^{-1}(\mu_s \cdot \mu_k)$ (b) $\alpha_{max} = \tan^{-1}(\mu_s/\mu_k)$ (c) $\alpha_{max} = \tan^{-1}(\mu_k^2/\mu_s)$
(d) $\alpha_{max} = \tan^{-1}(\mu_k)$ (e) $\alpha_{max} = \tan^{-1}(\mu_s)$

Questions 24-25

The block of mass m shown in the figure lies on a horizontal frictionless surface, and the spring constant is k. Initially, the spring is at its relaxed length and the block is stationary at position $x = 0$. Then an applied constant force F pulls the block in the positive x-direction, stretching the spring until the block stops at position $x = x_M$.



24. What is the work done by the constant force F in the pulling process?

(a) 0 (b) kx_M^2 (c) $2F^2/k$ (d) $2kx_M^2$ (e) F^2/k

25. In the pulling process, kinetic energy of the block constantly changes. What is the maximal value of kinetic energy the block will have as it moves from $x = 0$ to $x = x_M$?

(a) $kx_M^2/4$ (b) $kx_M^2/2$ (c) $2F^2/k$ (d) mgx_M (e) $F^2/(2k)$