		Surname		Type
Group Number		Name		A
List Number		e-mail		
Student ID		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.

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.

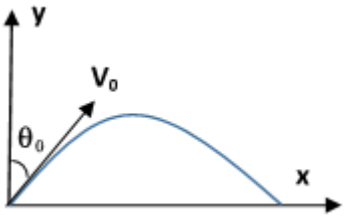
1. If the magnitudes of vectors are $A = 3$ and $B = 4$, find magnitude of the vector $\vec{A} - \vec{B}$.
(a) -4 (b) $\sqrt{17}$ (c) 12 (d) 5 (e) $-\sqrt{17}$

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) $(-\sqrt{5}\hat{\imath} + \sqrt{12}\hat{\jmath})/\sqrt{17}$

Questions 4-9

An object is thrown from ground with initial speed $V_0 = 10$ m/s at an angle $\theta_0 = 30°$ with the vertical axis as shown in the figure. (Ignore air resistance and take, g $\approx$ 10 m/s^2, $\sin 30° = 1/2$)



4. What is the acceleration of the object at the highest point?
(a) $\vec{a} = g\hat{\jmath}$ (b) $\vec{a} = g\hat{\imath}$ (c) $\vec{a} = -g\hat{\jmath}$ (d) $\vec{a} = 0$ (e) $\vec{a} = 2g\hat{\jmath}$

5. What is the maximum height that the object can reach?
(a) 15m (b) 5/4m (c) 1/2m (d) 15/4m (e) 5m

6. What is the time for the object to reach the maximum height?
(a) 15/4s (b) 5/4s (c) 1/2s (d) 2s (e) $\sqrt{3}$/2s

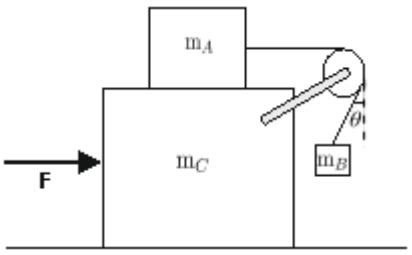
7. What is the horizontal range that the object can reach?
(a) 10m (b) $20\sqrt{3}$m (c) $10\sqrt{3}$m (d) 5m (e) $5\sqrt{3}$m

8. A little time after the take-off, the object passes from point (x=$\sqrt{3}$m, y). What is y?
(a) $3\sqrt{3}$m (b) $(\sqrt{3} - 1)$m (c) $\sqrt{3}$/2m (d) 12/5m (e) 1m

9. What is the velocity (in m/s) of the object when it hits the ground?
(a) $-5\hat{\imath} + 5\sqrt{3}\hat{\jmath}$ (b) $5\sqrt{3}\hat{\imath} + 5\hat{\jmath}$ (c) $5\hat{\imath} + 5\sqrt{3}\hat{\jmath}$ (d) $5\hat{\imath} - 5\sqrt{3}\hat{\jmath}$ (e) $-5\hat{\imath} - 5\sqrt{3}\hat{\jmath}$

Questions 10-14

A block of mass m_A=3 kg rests on another block of mass m_C=5 kg. Block m_A is connected by a thin string that passes over a pulley to a third block of mass m_B=1 kg. A force $\vec{\mathbf{F}}$ is exerted on the large block m_C so that the mass m_A does not move relative to m_C. Ignore all friction. Assume m_B does not make contact with m_C. g = 10 m/s^2.



10. What is the tension (in units of N) in the string in terms of the acceleration (a) of the system?
(a) 3a (b) 2a (c) 4a (d) a (e) 5a

11. What is the tension (in units of N) in the string?
(a) $\frac{10}{\cos\theta}$ (b) 40 (c) 20 (d) 10 (e) $\frac{10}{\sin\theta}$

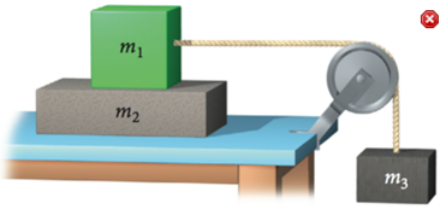
12. What is the value of $\sin\theta$?
(a) 3/5 (b) 1/3 (c) 0.5 (d) $\frac{\sqrt{3}}{2}$ (e) 2/5

13. What is the magnitude of $\vec{\mathbf{F}}$ in units of N?
(a) 120 (b) 30 (c) $\frac{90}{\sqrt{8}}$ (d) 50 (e) 60

14. What is the acceleration (in m/s^2) of the block of mass m_B?
(a) $\frac{10}{3}$ (b) $\frac{20}{3}$ (c) $\frac{10}{\sqrt{8}}$ (d) $\frac{40}{3}$ (e) $\frac{50}{\sqrt{8}}$

Questions 15-19

Two blocks with masses m_1 and m_2 ($m_1\mu_s < m_2$) are on a frictionless table, and the blocks with masses, m_1 and m_3 are connected by a string as shown in the figure. The coefficients of static and kinetic friction between m_1 and m_2 are μ_s and μ_k, respectively. The three blocks are initially at rest and then left free to move.



15. If block m_1 slips on block m_2 what is the force of kinetic friction?

(a) $\frac{(-\mu_k m_1 - m_3)g}{m_1 - m_3}$ (b) $\frac{(-\mu_k m_1 - \mu_k m_2 + m_3)g}{m_1 + m_2 + m_3}$ (c) $\frac{\mu_k m_1 g}{m_1 + m_2 + m_3}$ (d) $\mu_k m_1 g$ (e) $\frac{(-\mu_k m_1 - \mu_k m_2 + m_3)g}{m_1 + m_2 - m_3}$

16. If block m_1 slips on block m_2 what is the acceleration of m_2?

(a) $\mu_k g\frac{m_1 - m_2}{m_2}$ (b) $\mu_k g\frac{m_1}{m_2}$ (c) $\mu_k g\frac{m_2}{m_1 + m_2}$ (d) $\mu_k g\frac{m_1 + m_2}{m_2}$ (e) $\mu_k g\frac{m_1}{m_1 + m_2}$

17. If block m_1 slips on block m_2 what is the acceleration of m_3?

(a) $\frac{(-\mu_k m_1 - \mu_s m_2 + m_3)g}{m_1 + m_2 + m_3}$ (b) $\frac{(-\mu_k m_1 - \mu_k m_2 + m_3)g}{m_1 + m_2 + m_3}$ (c) $\frac{(-\mu_k m_1 - m_3)g}{m_1 - m_3}$ (d) $\frac{(-\mu_k m_1 + m_3)g}{m_1 + m_3}$ (e) $\frac{(-\mu_k m_1 - \mu_k m_2 + m_3)g}{m_1 + m_2 - m_3}$

18. If block m_1 slips on block m_2 what is the tension in the string?

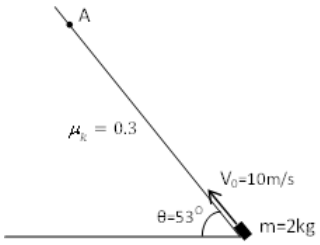
(a) $\frac{m_1 m_3 g}{m_1 + m_3}(1 + \mu_k)$ (b) $\frac{m_1 m_3 g}{m_2}(1 + \mu_s)$ (c) $\frac{m_3 g}{m_1 + m_3}(1 + \mu_s)$ (d) $\frac{m_1 g}{m_1 + m_3}(1 + \mu_s)$ (e) $\frac{m_1 m_2 m_3 g}{m_1 + m2 + m_3}(1 + \mu_k)$

19. What is the condition to be satisfied for the blocks with masses m_1 and m_2 move together without slipping?

(a) $m_3 \leq \mu_s\frac{m_2}{m_1}(-m_1 + m_2)$ (b) $m_3 \leq \frac{m_1(m_1 + m_2)\mu_s}{m_2 - m_1\mu_s}$ (c) $m_3 \leq \mu_s(m_1 + m_2)$ (d) $m_3 \leq \mu_k\frac{m_1}{m_2}(m_1 + m_2)$ (e) $m_3 \leq \mu_k\frac{m_2}{m_1}(-m_1 + m_2)$

Questions 20-25

An object of mass m=2kg is thrown up with the speed 10 m/s on an inclined surface of angle 53° as shown in the figure. The kinetic friction coefficient between the object and the surface is 0.3. (Take cos53° = 0.6, sin53° =0.8 and gravitational acceleration g=10 m/s^2)



20. What is the work (in Joule, J) done by the friction when the object reaches the point A, at a distance of 2 m from its initial point?

(a) +12 (b) +9.6 (c) -3.6 (d) 0 (e) -7.2

21. What is the work (in Joule) done by normal force up to the point A?

(a) +12 (b) 0 (c) +7.2 (d) +3.6 (e) -3

22. What is the work (in Joule) done by the net force up to the point A?

(a) -39.2 (b) -10.8 (c) +10.8 (d) +39.2 (e) -32

23. What is the speed (in m/s) of the object at the point A?

(a) $\sqrt{10.8}$ (b) $\sqrt{39.2}$ (c) $\sqrt{32}$ (d) $\sqrt{60.8}$ (e) $\sqrt{89.2}$

24. What is the approximate value of the distance (in m) that the object can travel on the inclined surface?

(a) 5.1 (b) 10.2 (c) 4.0 (d) 3.6 (e) 7.2

25. When the object turns back to its shooting point what is the speed (in m/s) of the object approximately?

(a) 5 (b) 6 (c) $\sqrt{63.3}$ (d) $\sqrt{36.7}$ (e) $\sqrt{18.4}$