				Type
		Surname		
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.

1. Which of the following is the unit of Power in MKS unit system?

(a) $\mathrm{kg\,m/s}$ (b) none of them (c) $\mathrm{kg\,m^2/s}$ (d) $\mathrm{kg\,m^2/s^2}$ (e) $\mathrm{kg\,m^2/s^3}$

2. Two vectors, $\vec{a} = \hat{\imath} + 2\hat{\jmath} - \hat{k}$ and $\vec{b} = \hat{\imath} + \hat{\jmath} - 2\hat{k}$ 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 $\vec{d} = -2\hat{\imath} + \hat{\jmath} - 2\hat{k}$?

(a) $\frac{2}{3}\hat{\imath} + \frac{1}{3}\hat{\jmath} - \frac{2}{3}\hat{k}$ (b) $-\frac{2}{3}\hat{\imath} + \frac{1}{3}\hat{\jmath} - \frac{2}{3}\hat{k}$ (c) $-\frac{2}{3}\hat{\imath} + \frac{1}{3}\hat{\jmath} + \frac{2}{3}\hat{k}$ (d) $\frac{2}{3}\hat{\imath} - \frac{1}{3}\hat{\jmath} + \frac{2}{3}\hat{k}$ (e) $\frac{2}{3}\hat{\imath} + \frac{1}{3}\hat{\jmath} + \frac{2}{3}\hat{k}$

5. Consider an object with acceleration function $a(t) = 3t\ \mathrm{m/s^3} - 3\ \mathrm{m/s^2}$ with initial conditions $v(t = 0) = 1$ m/s and $x(t = 0) =$ 2m. What is the magnitude of the position of the object at $t = 1$ s?

(a) 2 m (b) 5 m (c) 4 m (d) 6 m (e) 3 m

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

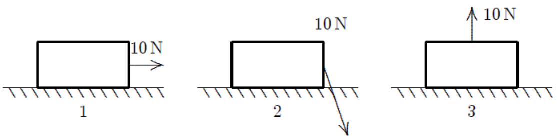
7. A cruise ship moves southward in still water at a speed of 20.0 km/h, while a passenger on the deck of the ship walks toward the east at a speed of 5.0 km/h. The passenger's velocity with respect to Earth is

(a) 20.6 km/h, west of south. (b) 25.0 km/h, east. (c) 20.6 km/h, south. (d) 25.0 km/h, south. (e) 20.6 km/h, east of south.

8. Sum of real forces acting on an astronaut who is inside a space shuttle circular orbiting the Earth is zero when the astronaut feels weightless. What can be said about the previous statement?

(a) Depends on the orbit. (b) True. (c) False. (d) If centrifugal force cancels the weight of the astronaut then it is true. (e) Depends on the kind of planet, e.g. Earth.

9. A box is pulled with a 10 N force by a woman, the crate moves 10 m to the right. Rank the situations shown below according to the work done by her force, least to greatest.



(a) 2, 1, 3 (b) 3, 2, 1 (c) 1, 3, 2 (d) 2, 3, 1 (e) 1, 2, 3

10. During a soccer game, a soccer ball is hit high into the upper rows of the tribunes. Over its entire flight the work done by gravity and the work done by air resistance, respectively, are:

(a) unknown, insufficient information (b) negative; positive (c) negative; negative (d) positive; negative (e) positive; positive

Questions 11-13

A rabbit runs in a garden such that the $x-$ and $y-$ components of its displacement as function of times are given by $x(t) = (5.0\ \mathrm{m/s})t + (6.0\ \mathrm{m/s^2})t^2$ and $y(t) = (7.0\ \mathrm{m}) - (3.0\ \mathrm{m/s^3})t^3$ (Both x and y are in meters and t is in seconds.)

11. Calculate the rabbit's velocity vector (m/s) at $t = 3.0$ s.

(a) $41\hat{\imath} - 81\hat{\jmath}$ (b) $41\hat{\imath} + 81\hat{\jmath}$ (c) $31\hat{\imath} - 81\hat{\jmath}$ (d) $31\hat{\imath} + 81\hat{\jmath}$ (e) $55\hat{\imath}$

12. Calculate the rabbit's acceleration vector ($\mathrm{m/s^2}$) at $t = 3.0$ s

(a) $54\hat{\imath} - 12\hat{\jmath}$ (b) $54\hat{\imath} + 12\hat{\jmath}$ (c) $12\hat{\imath} + 54\hat{\jmath}$ (d) $12\hat{\imath} - 54\hat{\jmath}$ (e) $54\hat{\imath}$

13. Calculate the rabbit's position vector at $t = 3.0$ s.

(a) $69\hat{\imath} - 20\hat{\jmath}$ (b) $69\hat{\imath} + 71\hat{\jmath}$ (c) $69\hat{\imath} + 74\hat{\jmath}$ (d) $69\hat{\imath} - 74\hat{\jmath}$ (e) $69\hat{\imath} - 71\hat{\jmath}$

Questions 14-15

A golf ball is kicked with an initial velocity of v_0 from the ground and initial angle of θ with respect to the horizontal. Assume the golf ball leaves the foot at ground level, and ignore air resistance and rotation of the ball.

14. How high will the golf ball be at the highest point of its trajectory?

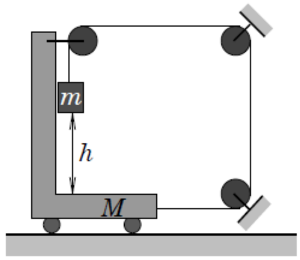
(a) $\frac{(v_0\cos\theta)^2}{2g}$ (b) $\frac{(v_0\cos\theta)^2}{g}$ (c) $\frac{(2v_0\sin\theta)^2}{g}$ (d) $\frac{(v_0\sin\theta)^2}{2g}$ (e) $\frac{\sqrt{v_0\sin\theta}}{g}$

15. Where will the golf ball fall back to the ground?

(a) $\frac{v_0^2\sin\theta}{2g}$ (b) $\frac{v_0^2\cos\theta}{2g}$ (c) $\frac{v_0^2\sin 2\theta}{g}$ (d) $\frac{v_0^2\cos 2\theta}{g}$ (e) $\frac{v_0^2\sin\theta\cos\theta}{g}$

Questions 16-20

The mass m is at rest at the beginning of the motion when it is h above the surface of M. The friction in all of the surfaces and the weight of pulleys will be neglected in this question. (Two pulleys at the right hand side are fixed and the pulley at left hand side is moving with M during the motion.)



16. What is the relationship between the x-component of the acceleration of m a_{mx} and the x-component of the acceleration of M a_{Mx}?

(a) $a_{mx} = a_{Mx}$ (b) $a_{mx} = 3a_{Mx}$ (c) $a_{mx} = 2a_{Mx}$ (d) $a_{mx} = a_{Mx}/3$ (e) $a_{mx} = a_{Mx}/2$

17. What is the relationship between the y-component of the acceleration of m a_{my} and the x-component of the acceleration of M a_{Mx}?

(a) $a_{my} = 3a_{Mx}$ (b) $a_{my} = a_{Mx}/3$ (c) $a_{my} = a_{Mx}/2$ (d) $a_{my} = 2a_{Mx}$ (e) $a_{my} = a_{Mx}$

18. Express the y-component of the acceleration of m a_{my} in terms of m, M and g.

(a) $4m\,g/(5m+M)$ (b) $5m\,g/(3m+2M)$ (c) $5m\,g/(4m+M)$ (d) $2m\,g/(5m+M)$ (e) $4m\,g/(3m+M)$

19. Express the tension in the string in terms of m, M and g.

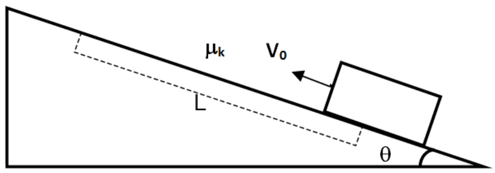
(a) $m\,g\,(m+M)/(5m+M)$ (b) $m\,g\,(m+M)/(4m+M)$ (c) $m\,g\,(m+M)/(3m+2M)$ (d) $2m\,g\,(m+M)/(4m+M)$ (e) $2m\,g\,(m+M)/(5m+M)$

20. Express the time for mass m to reach the surface if M in terms of the acceleration of m, h and g.

(a) $\sqrt{2h\,g/a_{my}}$ (b) $\sqrt{2h/a_{mx}}$ (c) $\sqrt{2h\,g/a_{mx}}$ (d) $\sqrt{g\,h/2a_{my}}$ (e) $\sqrt{2h/a_{my}}$

Questions 21-25

A box drops down from a lorry while moving with a speed of 10 m/s on the road with inclination $\theta°$, where mass of the box and kinetic friction coefficient are 10 kg and μ_k, respectively. For the moment that the box slides up and reaches possible maximum height (L), find;
(take $g = 10\text{m/s}^2$)



21. Work done on the box by the net force

(a) 0.5 kJ (b) -0.5 kJ (c) -1 kJ (d) 0 kJ (e) 1 kJ

22. The distance that the box has taken during the slide

(a) $W_{net}/mg(\sin\theta - \mu_k\cos\theta)$ (b) $W_{net}/mg(\sin\theta + \mu_k\cos\theta)$ (c) $W_{net}/(\sin\theta - \mu_k\cos\theta)$ (d) $W_{net}/mg(\cos\theta + \mu_k\sin\theta)$ (e) $W_{net}/(\sin\theta + \mu_k\cos\theta)$

23. Work done on the box by gravitation

(a) $-mgL\mu_k\cos\theta$ (b) $mgL\sin\theta$ (c) $-mgL\tan\theta$ (d) $-mgL\sin\theta$ (e) $-mgL\cos\theta$

24. Work done on the box by normal force

(a) $mg(\cos\theta - \mu_k\sin\theta)$ (b) $mgL\sin\theta$ (c) 0 (d) $mg(\cos\theta + \mu_k\sin\theta)$ (e) $-mgL\mu_k\cos\theta$

25. Work done on the box by friction

(a) $-mg\mu_k L\sin\theta$ (b) mgL (c) $-mg\mu_k\cos\theta$ (d) $-mg\mu_k L\cos\theta$ (e) $-mgL\cos\theta$