		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. Given $\vec{A} = \hat{\imath} + \hat{\jmath}$ and $\vec{B} = 2\ \hat{\imath} - 2\ \hat{k}$ vectors. Find the unit vector perpendicular to both $\vec{A}$ and $\vec{B}$ vectors.

(a) $\frac{-\hat{\imath}+\hat{\jmath}-\hat{k}}{\sqrt{3}}$ (b) $\frac{-4\ \hat{\imath}+\hat{\jmath}-2\ \hat{k}}{\sqrt{21}}$ (c) $\frac{-2\ \hat{\imath}+\hat{\jmath}-\hat{k}}{\sqrt{6}}$ (d) $\frac{-\hat{\imath}+5\ \hat{\jmath}-\hat{k}}{\sqrt{27}}$ (e) $\frac{-\hat{\imath}+\hat{\jmath}-\hat{k}}{\sqrt{6}}$

2. The position of a particle is given by $\vec{x} = 3t^2\ \hat{\imath}$ (m). What is the acceleration of the particle after 3 s?

(a) $9\,m/s^2$ (b) $18\,m/s^2$ (c) $0\,m/s^2$ (d) $6\,m/s^2$ (e) $3\,m/s^2$

3. A block of mass m is sliding along a friction-free inclined plane with a slope angle of θ. The reaction force exerted by the plane on the block is

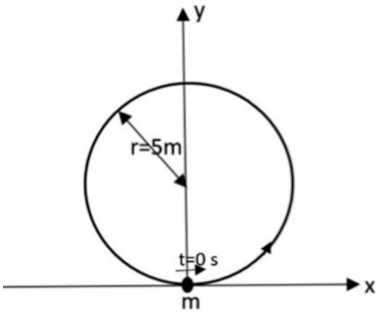
(a) mg (b) 0 (c) $mg\cos\theta\sin\theta$ (d) $mg\cos\theta$ (e) $mg\sin\theta$

4. The rocket starting its motion with speed 5 m/s on a straight way, moves for a 20 seconds with an acceleration of $a_t = 1+2t+3t^2$ (m/s^2). Find the speed of the rocket at the end of 20 seconds.

(a) 8000 m/s (b) 8420 m/s (c) 8425 m/s (d) 1260 m/s (e) 8400 m/s

Questions 5-8

A particle of mass m moves in a circle of radius 5 m at constant speed taking time 40 s for each revolution (Period: T = 40 s). Particle passes from the origin (x = 0, y = 0) at time t = 0 s.



5. Find the displacement vector of the particle between 20 s and 30 s.

(a) 0 (b) $(-5\ \hat{\imath} - 5\ \hat{\jmath})$ m (c) $(-5\ \hat{\jmath})$ m (d) $(5\ \hat{\imath} - 5\ \hat{\jmath})$ m (e) $(5\ \hat{\imath} + 5\ \hat{\jmath})$ m

6. Find the average velocity of the particle between 20 s and 30 s.

(a) $\frac{1}{2}(\hat{\imath} - \hat{\jmath})$ m/s (b) $-\frac{1}{2}(\hat{\imath} + \hat{\jmath})$ m/s (c) $-\frac{1}{2}(\hat{\imath})$ m/s (d) 0 (e) $\frac{1}{2}(\hat{\imath} + \hat{\jmath})$ m/s

7. Find the average acceleration of the particle between 20 s and 30 s. (take $\pi = 3$)

(a) $\frac{3}{40}(\hat{\imath} - \hat{\jmath})\,m/s^2$ (b) $\frac{3}{40}(\hat{\imath} + \hat{\jmath})\,m/s^2$ (c) $\frac{3}{20}(\hat{\imath} - \hat{\jmath})\,m/s^2$ (d) 0 (e) $9,8\ \hat{\jmath}\,m/s^2$

8. Find the instant acceleration at 30 s. (take $\pi = 3$)

(a) $\frac{3}{80}(\hat{\imath} - \hat{\jmath})\,m/s^2$ (b) $\frac{9}{80}(\hat{\imath} + \hat{\jmath})\,m/s^2$ (c) $9,8\ \hat{\jmath}\,m/s^2$ (d) $\frac{9}{80}(\hat{\imath})\,m/s^2$ (e) $\frac{9}{80}(\hat{\jmath})\,m/s^2$

9. A stock person at the local grocery store has a job consisting of the following five segments:

i. picking up boxes of tomatoes from the stockroom floor
ii. accelerating to a comfortable speed
iii. carrying the boxes to the tomato display at constant speed
iv. decelerating to a stop
v. lowering the boxes slowly to the floor.

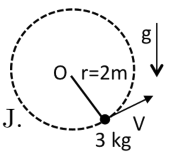
During which of the five segments of the job, does the stock person do positive work on the boxes?

(a) i, ii, iv and v (b) i only (c) i and ii (d) ii and iii (e) i and v

10. Two men, Joel and Jerry, push against a wall. Jerry stops after 10 min, while Joel is able to push for 5.0 min longer. Compare the work they do.

(a) Both men do positive work, but Joel does 25 % more work than Jerry.
(b) Both men do positive work, but Joel does 75 % more work than Jerry.
(c) Both men do positive work, but Jerry does 50 % more work than Joel.
(d) Neither of them does any work.
(e) Both men do positive work, but Joel does 50 % more work than Jerry.

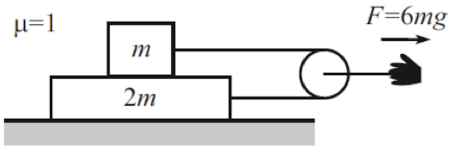
11. 3.00 kg ball swings rapidly in a complete vertical circle of radius 2.00 m by a light string that is fixed at one end. The ball moves so fast that the string is always straight and perpendicular to the velocity of the ball. As the ball swings from its lowest point to its highest point (g=10 m/s^2)



(a) the work done on it by gravity is +120 J and the work done on it by the tension in the string is -120 J.
(b) the work done on it by gravity is -120 J and the work done on it by the tension in the string is zero.
(c) the work done on it by gravity and the work done on it by the tension in the string are both equal to zero.
(d) the work done on it by gravity and the work done on it by the tension in the string are both equal to -120 J.
(e) the work done on it by gravity is -120J and the work done on it by the tension in the string is +120 J.

Questions 12-16

A block of mass m sits on top of a block of mass 2m which sits on a table. The coefficient of kinetic friction between all surfaces is $\mu = 1$. A massless string is connected to each mass and wraps halfway around a massless pulley, as shown. Assume that you pull on the pulley with a force of 6mg.



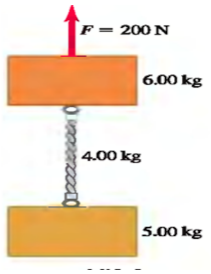
12. What is the magnitude of friction force between mass m and mass 2m?
(a) 3mg (b) 4mg (c) mg (d) 2mg (e) 5mg

13. What is the magnitude of the friction force between ground and mass 2m?
(a) 3mg (b) 2mg (c) mg (d) 4mg (e) 5mg

14. What is the magnitude of the acceleration of mass m?
(a) 2g (b) g/2 (c) g/3 (d) g (e) 3g

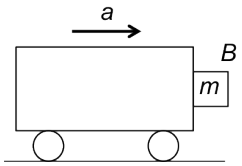
15. What is the magnitude of the acceleration of mass 2m?
(a) g (b) 2g (c) g/2 (d) g/3 (e) 3g

16. What is the acceleration of your hand?
(a) g (b) g/2 (c) (5/3)g (d) (5/4)g (e) (5/2)g



17. The two blocks shown in figure are connected by a heavy uniform rope with a mass of 4.00 kg. An upward force of 200 N is applied as shown. What is the tension at the midpoint of the rope? ($g = 10\ m/s^2$)
(a) 120 N (b) 45 N (c) 70 N (d) 93 N (e) 62 N

18. What is the minimum acceleration of mass m that is required to prevent block B from falling? Where the coefficient of static friction between the block and mass m is μ.
(a) $2g\mu$ (b) $g\mu/2$ (c) g/μ (d) $g\mu$ (e) $2g/\mu$



Questions 19-21

19. What work is done by a force $\vec{F} = (2.0x)\,\hat{\imath} - (3.0y^2)\,\hat{\jmath}$ (N), that moves a particle from a position $\vec{r}_i = 2.0\,\hat{\imath} + 3.0\,\hat{\jmath}$ (m) to a position $\vec{r}_f = -4.0\,\hat{\imath} - 3.0\,\hat{\jmath}$ (m), where $\vec{r}$, x and y are in meters? The mass of the particle is 2 kg.
(a) 66 J (b) 86 J (c) 76 J (d) 67 J (e) 42 J

20. If the initial velocity of the particle is 3.0 m/s, what is the final kinetic energy of the particle?
(a) 85 J (b) 79 J (c) 75 J (d) 81 J (e) 77 J

21. What is the magnitude of the acceleration of the particle at the position $\vec{r} = 2.0\,\hat{\imath} + 1.0\text{m}\,\hat{\jmath}$?
(a) 3.0 m/s^2 (b) 2.5 m/s^2 (c) 3.5 m/s^2 (d) 1.5 m/s^2 (e) 2.0 m/s^2

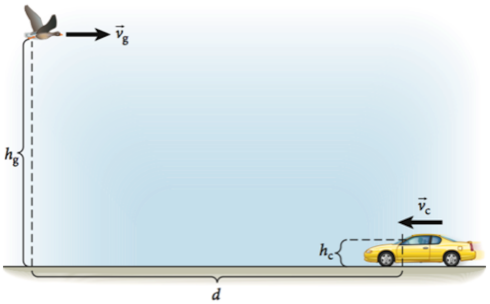
Questions 22-24

A speeding motorcyclist is traveling at a constant speed of 36 m/s when he passes a police car parked on the side of the road. At the instant the motorcycle passes the police car, the police officer starts to chase the motorcyclist with a constant acceleration of 4 m/s^2.

22. How long will it take the police officer to catch the motorcyclist?
(a) 36 s (b) 24 s (c) 18 s (d) 9 s (e) 27 s

23. What is the speed of the police car when it catches up to the motorcycle?
(a) 72 m/s (b) 108 m/s (c) 36 m/s (d) 144 m/s (e) 96 m/s

24. How far will the police car be from its original position when it catches up to the motorcycle?
(a) 1296 m (b) 648 m (c) 324 m (d) 162 m (e) 972 m



25. One goose is flying northward at a level altitude of $h_g = 46$ m above a north-south highway, when it sees a car ahead in the distance moving in the southbound lane and decides to deliver (drop) an "egg." The goose is flying at a speed of $v_g = 15$ m/s, and the car is moving at a speed of $v_c = 97.2$ km/h. The separation between the goose and the center of the front window of the car, is d = 126 m, at the instant when the goose takes action. (The center of the front window is $h_c = 1.00$ m off the ground.) When the "egg" strikes the front window, what is the relative velocity of the "egg" with respect to the car at the moment of the impact? (assume $g = 10\ m/s^2$).
(a) $\vec{V} = 15\hat{\imath} - 30\hat{\jmath}$ m/s (b) $\vec{V} = 42\hat{\imath} - 25\hat{\jmath}$ m/s (c) $\vec{V} = 12\hat{\imath} - 30\hat{\jmath}$ m/s (d) $\vec{V} = 42\hat{\imath} - 30\hat{\jmath}$ m/s (e) $\vec{V} = 15\hat{\imath} + 30\hat{\jmath}$ m/s