Physics 231. Mechanics of Solids

Exam-like questions - Ch. 4-5. Newton's laws and forces

1. **Three strings exert forces on a frictionless, dry ice block simulataneously. String 1 pulls the block towards $\theta = 300°$. String 2 pulls it towards $\theta = 210°$. String 3 pulls it towards $\theta = 120°$. Each string pulls with a force of 2 N. What is the net magnitude and direction of the force on the block? (Hint: draw the picture first!)**

   (a) 2N at 300° (b) 1.8N at 190° (c) 2N at 210°
   (d) 1.8N at 230° (e) 2N at 120°

2. **A space ranger weighs himself on the Moon, where $g_{Moon} = 1.625$ m/s^2?, and the scale reads 243.75 N. What is the mass of the ranger on Earth (wearing the same gear)? Mass = _____,**

   (a) 148 N (b) 150 kg (c) 1470 N (d) 400 kg (e) 25 kg

3. **A space ranger weighs himself on the Moon, where $g_{Moon} = 1.625$ m/s^2?, and the scale reads 243.75 N. What is the weight of the ranger on Earth (wearing the same gear)? Weight = _____.**

   (a) 1470 N (b) 148 kg (c) 400 N (d) 90 kg (e) 880 N

4. **A 90 kg man travels in an elevator accelerating downward at 2 m/s^2. What force is exerted on the man by the elevator floor?**

   (a) 1060 N (b) 880 N (c) 800 N (d) 750 N (e) 700 N

5. **An elevator with a mass of 2042 kg is supported by a steel cable. What is the tension in the cable when the elevator is being accelerated upward at a rate of 2.0 m/s^2? (g=9.8 m/s^2)**

   (a) 10,005 N (b) 23,100 N (c) 24,100 N (d) 26,000 N
   (e) 40,020 N

6. **What is the *total acceleration* vector for a particle moving at 5 m/s in a circle of radius 3 m while speeding up at 3 m/s^2?**

   (a) $-8.33\hat{r} + 3\hat{\theta}$ **(b)** $-1.67\hat{r} + 3\hat{\theta}$ **(c)** $-6.67\hat{r} - 1\hat{\theta}$ **(d)** $-8.33\hat{r} + 1\hat{\theta}$
   (e) $1.67\hat{r} + 3\hat{\theta}$

7. **The force that resists the relative motion of two objects that are sliding against each other is called _____.**

   (a) static friction (b) dynamic friction (c) kinetic friction
   (d) rolling friction (e) tangential force

8. A 30 kg box is pulled horizontally with a uniform force of 181 N. If it starts at rest, what will be its acceleration? (The materials have friction with $\mu_s = 0.6$ and $\mu_k = 0.4$.)

(a) 0 m/s^2 (b) 0.2 m/s^2 (c) 1.3 m/s^2 (d) 2.1 m/s^2 (e) 5.9 m/s^2

9. A 30 kg box is pulled horizontally with a uniform force of 170 N. If it starts at rest, what will be its acceleration? (The materials have friction with $\mu_s = 0.6$ and $\mu_k = 0.4$.)

(a) 0 m/s^2 (b) 0.2 m/s^2 (c) 1.3 m/s^2 (d) 2.1 m/s^2 (e) 5.9 m/s^2

10. A block slides down a ramp at constant speed. The ramp is inclined at θ degrees relative to the horizontal. The μ_k for the ramp-block system must be _____.

(a) g/m (b) g$\sin\theta$ (c) 1.0 (d) $\frac{\cos\theta}{\sin\theta}$ (e) $\tan\theta$

11. An automobile moves on a level horizontal road in a circle of radius 30 m. The coefficient of (static) friction between tires and road is 0.50. The maximum speed with which this car can round this curve (without slipping) is:

(a) 3.0 m/s (b) 4.9 m/s (c) 9.8 m/s (d) 12. m/s (e) 13. m/s

12. A pendulum bob of mass m is offset by the angle θ from the vertical at the moment its speed is v along an arc of radius 2 m. The tension in the string is given by _____

(a) mg **(b)** $mg\sin\theta + mv^2/r$ **(c)** $mg\cos\theta + mv^2/r$ **(d)** mv^2/r **(e)** $mg\tan\theta$