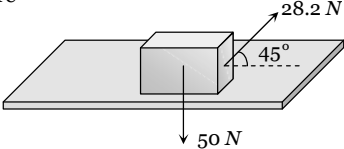
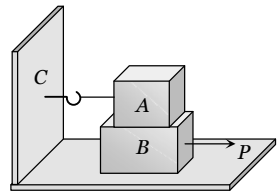
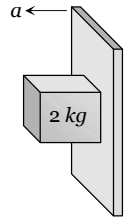


Friction

SET Self Evaluation Test - 5

1. A force of 19.6 N when applied parallel to the surface just moves a body of mass 10 kg kept on a horizontal surface. If a 5 kg mass is kept on the first mass, the force applied parallel to the surface to just move the combined body is
- (a) 29.4 N (b) 39.2 N
(c) 18.6 N (d) 42.6 N
2. If the normal force is doubled, the coefficient of friction is
- (a) Not changed (b) Halved
(c) Doubled (d) Tripled
3. A body of weight 50 N placed on a horizontal surface is just moved by a force of 28.2 N . The frictional force and the normal reaction are
- (a) $10\text{ N}, 15\text{ N}$
(b) $20\text{ N}, 30\text{ N}$
(c) $2\text{ N}, 3\text{ N}$
(d) $5\text{ N}, 6\text{ N}$
- 
4. Block A weighing 100 kg rests on a block B and is tied with a horizontal string to the wall at C. Block B weighs 200 kg . The coefficient of friction between A and B is 0.25 and between B and the surface is $1/3$. The horizontal force P necessary to move the block B should be ($g = 10\text{ m/s}^2$)
- (a) 1150 N
(b) 1250 N
(c) 1300 N
(d) 1420 N
- 
5. A rough vertical board has an acceleration ' a ' so that a 2 kg block pressing against it does not fall. The coefficient of friction between the block and the board should be
- (a) $> g/a$
(b) $< g/a$
(c) $= g/a$
(d) $> a/g$
- 
6. A stone weighing 1 kg and sliding on ice with a velocity of 2 m/s is stopped by friction in 10 sec . The force of friction (assuming it to be constant) will be
- (a) -20 N (b) -0.2 N
(c) 0.2 N (d) 20 N
7. A body of mass 10 kg slides along a rough horizontal surface. The coefficient of friction is $1/\sqrt{3}$. Taking $g = 10\text{ m/s}^2$, the least force which acts at an angle of 30° to the horizontal is
- (a) 25 N (b) 100 N
(c) 50 N (d) $\frac{50}{\sqrt{3}}\text{ N}$
8. A lift is moving downwards with an acceleration equal to acceleration due to gravity. A body of mass M kept on the floor of the lift is pulled horizontally. If the coefficient of friction is μ , then the frictional resistance offered by the body is
- (a) Mg (b) μMg
(c) $2\mu Mg$ (d) Zero
9. In the above question, if the lift is moving upwards with a uniform velocity, then the frictional resistance offered by the body is
- (a) Mg (b) μMg
(c) $2\mu Mg$ (d) Zero
10. A body of mass 2 kg is moving on the ground comes to rest after some time. The coefficient of kinetic friction between the body and the ground is 0.2 . The retardation in the body is
- (a) 9.8 m/s^2 (b) 4.73 m/s^2
(c) 2.16 m/s^2 (d) 1.96 m/s^2
11. A cyclist moves in a circular track of radius 100 m . If the coefficient of friction is 0.2 , then the maximum velocity with which the cyclist can take the turn with leaning inwards is
- (a) 9.8 m/s (b) 1.4 m/s
(c) 140 m/s (d) 14 m/s
12. A block of mass 5 kg lies on a rough horizontal table. A force of 19.6 N is enough to keep the body sliding at uniform velocity. The coefficient of sliding friction is
- (a) 0.5 (b) 0.2
(c) 0.4 (d) 0.8
13. A motor car has a width 1.1 m between wheels. Its centre of gravity is 0.62 m above the ground and the coefficient of friction between the wheels and the road is 0.8 . What is the maximum possible speed, if the centre of gravity inscribes a circle of radius 15 m ? (Road surface is horizontal)
- (a) 7.64 m/s (b) 6.28 m/s
(c) 10.84 m/s (d) 11.23 m/s
14. A child weighing 25 kg slides down a rope hanging from the branch of a tall tree. If the force of friction acting against him is 2 N , what is the acceleration of the child (Take $g = 9.8\text{ m/s}^2$)
- (a) 22.5 m/s^2 (b) 8 m/s^2
(c) 5 m/s^2 (d) 9.72 m/s^2

AS Answers and Solutions

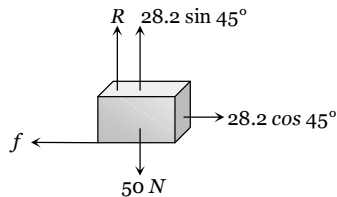
(SET -5)

1. (a) $F_f \propto R \therefore F_f \propto m$ i.e. limiting friction depends upon the mass of body. So, $\frac{(F_f)'}{(F_f)} = \frac{m'}{m} = \frac{10+5}{10}$

$$\Rightarrow (F_f)' = \frac{3}{2} \times F_f = \frac{3}{2} \times 19.6 = 29.4 \text{ N}$$

2. (a) Coefficient of friction is constant for two given surface in contact. It does not depend upon the weight or normal reaction.

3. (b)



$$\text{Frictional force} = f = 28.2 \cos 45^\circ = 28.2 \times \frac{1}{\sqrt{2}} = 20 \text{ N}$$

$$\text{Normal reaction } R = 50 - 28.2 \sin 45^\circ = 30 \text{ N}$$

4. (b) Friction between block A and block B & between block B and surface will oppose the P

$$\therefore P = F_{AB} + F_{BS} = \mu_{AB} m_A g + \mu_{BS} (m_A + m_B) g$$

$$= 0.25 \times 100 \times 10 + \frac{1}{3} (100 + 200) \times 10 = 1250 \text{ N}$$

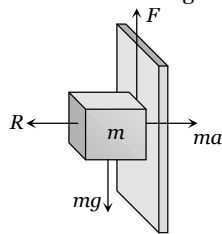
5. (a) For the limiting condition upward friction force between board and block will balance the weight of the block.

$$\text{i.e. } F > mg$$

$$\Rightarrow \mu(R) > mg$$

$$\Rightarrow \mu(ma) > mg$$

$$\Rightarrow \mu > \frac{g}{a}$$



6. (b) $u = 2 \text{ m/s}, v = 0, t = 10 \text{ sec}$

$$\therefore a = \frac{v-u}{t} = \frac{0-2}{10} = -\frac{2}{10} = -\frac{1}{5} = -0.2 \text{ m/s}^2$$

$$\therefore \text{Friction force} = ma = 1 \times (-0.2) = -0.2 \text{ N}$$

7. (c) Let P force is acting at an angle 30° with the horizontal.

$$\text{For the condition of motion } F = \mu R$$

$$P \cos 30^\circ = \mu(mg - P \sin 30^\circ)$$

$$\Rightarrow P \frac{\sqrt{3}}{2} = \frac{1}{\sqrt{3}} \left(100 - P \frac{1}{2} \right) \Rightarrow \frac{3P}{2} = \left(100 - \frac{P}{2} \right)$$

$$\Rightarrow 2P = 100 \therefore P = 50 \text{ N}$$

8. (d) $R = m(g - a)$ for downward motion of lift

$$\text{If } a = g \text{ then } R = 0 \therefore F = \mu R = 0$$

9. (b) When the lift is moving upward with constant velocity then, $R = mg \therefore F = \mu R = \mu mg$

10. (d) We know that $a = \mu g = 0.2 \times 9.8 = 1.96 \text{ m/s}^2$

11. (d) $v = \sqrt{\mu r g} = \sqrt{0.2 \times 100 \times 10} = 10\sqrt{2} = 14 \text{ m/s}$

12. (c) $\mu_k = \frac{F}{R} = \frac{19.6}{5 \times 9.8} = \frac{2}{5} = 0.4$

13. (c) $v = \sqrt{\mu g r} = \sqrt{0.8 \times 9.8 \times 15} = 10.84 \text{ m/s}$

14. (d) Net downward force = Weight - Friction

$$\therefore ma = 25 \times 9.8 - 2 \Rightarrow a = \frac{25 \times 9.8 - 2}{25} = 9.72 \text{ m/s}^2$$
