Newton's 2nd Law

U78-2 When a force F is acted on two bodies of masses m_1 and m_2 successively it produces accelerations of 8 m s^{-2} and 24 m s^{-2} respectively. When the same force is acted on a body of mass ($m_1 + m_2$), the acceleration produced is _______

A A. 6 m s^{-2} B. 8 m s^{-2} C. $2\sqrt{2}$ m s^{-2} D. 16 m s^{-2}

U78-4 A spring and an object of mass m are used in an experiment on a frictionless surface. It is found that when the spring is stretched by x, the object attached to it experiences an acceleration a. Now, four similar springs of this kind are connected in parallel to a mass of $3m$ as shown in Fig.U78-4. Such spring is stretched by x. The acceleration is thus equal to ____.

D A. $\frac{1}{3}a$ B. $\frac{2}{3}a$

C. $\frac{3}{4}a$ D. $\frac{4}{3}a$

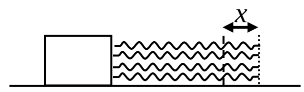

Fig.U78-4

U82-3 A man of mass 60 kg stands on a weighing machine, which is placed on the floor of a lift. When the lift is moving upwards with an acceleration of 0.5 m s^{-2}, the reading of the weighing machine would be ___ N. [take g = 10 m s^{-2}]

D A. 570 B. 600 C. 605 D. 630 E. 770

U83-3 A man of mass 60 kg stands on the floor of a lift, which is ascending with an acceleration of 2 m s^{-2}. Given that the acceleration due to gravity is 10 m s^{-2}, find the magnitude of the force exerted on the floor of the lift by the man.

D A. 120 N B. 480 N C. 600 N D. 720 N E. 1200 N

U84-2 A stationary body of mass 5 kg is acted by a force, which causes it to attain a speed of 3 ms^{-1} in 5 s. If the same force is to act on another stationary object of mass 8 kg, how many seconds would be needed to cause it to move through a distance of 15 m?

E A. 2.5 s B. $2\sqrt{2}$ s C. 3 s D. 7 s E. $4\sqrt{5}$ s

U85-P3a What is *mechanical energy*?

What is meant by *the Law of Conservation of Mechanical Energy*?

(b) m_1 and m_2 are two bodies of masses 4 kg and 8 kg respectively, being tied to a light string which passes over a fixed pulley, as shown in Fig.U85-P3b. Initially, m_1 is held against the ground and m_2 is at a point 3 m above the ground. When m_1 is released, it starts to rise with acceleration while m_2 falls downward. Assume that the string is inextensible under force, and that it's mass, the mass of the pulley and their frictional forces are all negligible. Find

(i) the acceleration of m_1 when it is rising;

(ii) the tension of the string when m_1 is rising;

(iii) the velocity of m_2 when it strikes the ground.

[Take g = 10 m s^{-2}] [3.33 m s^{-2}; 53.33 N; 4.47 m s^{-1}]

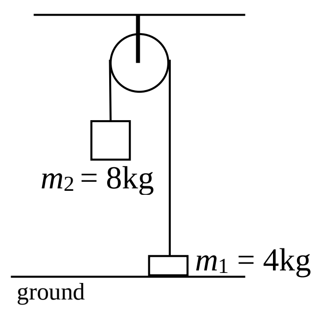

Fig.U85-P3b

U87-P1a What is meant by *speed* and *velocity*? How do they differ?

(b) A body of mass 1.5 kg is being pulled along a rough horizontal surface by a constant horizontal force of 36 N. The speed-time graph for the first 0.8 s is shown in Fig.U87-P1b.

(i) What is the magnitude of the frictional force acting on the body in the first 0.20 s?

(ii) What is the magnitude of the frictional force acting on the body during the time interval from 0.20 s to 0.80 s?

(iii) What is the average speed of the body during the first 0.80 s?

(iv) How much energy is used to overcome frictional force during the first 0.80 s? [6 N; 36 N; 3.5 m s^{-1}; 88.8 J]

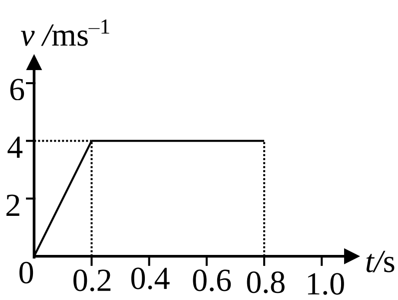

Fig.U87-P1b

U88-1 A helicopter of mass 2.5×10^3 kg rises vertically with a constant speed of 10 m s^{-1}. If the acceleration due to gravity is 10 N kg^{-1}, calculate the resultant of all the external forces acting on the helicopter.

E A. 2.5×10^4 N, downwards B. 2.5×10^4 N, upwards C. 5.0×10^4 N, downwards

D. 5.0x10^4 N, upwards E. 0

U88-3 When a body of mass m on the surface of the Earth is pushed along with a force F in a horizontal direction, it acquired an acceleration a. What would be the acceleration if the same experiment is repeat on the surface of the moon (m and F remaining unchanged) where the acceleration due to gravity is $\frac{1}{6}$ of that at the Earth's surface?

C A. 0 B. $\frac{1}{6}a$ C. a D. $6a$ E. cannot be ascertained

U88-7 As shown in Fig.3, two spheres of mass m_1 and m_2 ($m_1 > m_2$) are connected to both ends of a light string of negligible mass which passes over a light and frictionless pulley. Both spheres, originally at rest at the rest position, are released at the same time. What is their common speed v when both have moved a distance h?

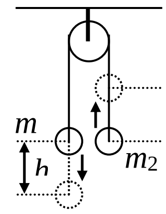

Fig.U88-7

E A. $v = \sqrt{2gh}$ B. $v = \sqrt{\frac{(m_1 + m_2)gh}{m_1}}$

C. $v = \sqrt{\frac{2(m_1 + m_2)gh}{m_1}}$ D. $v = \sqrt{\frac{2(m_1 - m_2)gh}{m_1}}$ E. $v = \sqrt{\frac{2(m_1 - m_2)gh}{m_1 + m_2}}$

U88-P2a State *Newton's 2nd Law of Motion*.

(b) In 1966, an experiment to measure the mass of a flying object in orbit based on Newton's 2nd Law of Motion was carried out by scientists in the outer orbit around the Earth. This is how it was done:
A space-ship (with a known mass m_1) was steered near a rocket in orbit (whose mass m_2 was to be measured) and then made to couple with so that they formed a system. After coupling, the booster at the back of the space-ship was made to fire for 7.0 s enabling the system to acquire an increase of velocity of 0.91 m s^{-1}. The average push (F) of the booster was 895 N.
(i) Given that m_1= 3400 kg, calculate the mass of the rocket m_2.
(ii) Before the experiment, m_2 was accurately measured by another method to be equal to 3660 kg. Estimate the percentage error in this experiment.
(iii)Explain the scientific and practical significance of this experiment.
[3484.62 kg; 4.79 %]

U89-2 A body of mass m, acting under the influence of a variable force F, is moving on a smooth horizontal surface. The relation between the force F and the displacement x of the body is indicated in Fig.U89-2. Which parts of the graph signify that the body is moving with acceleration?

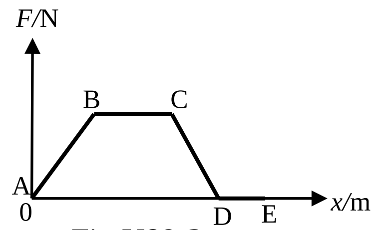

Fig.U89-2

E A. AB and BC B. CD and DE
C. AB and CD D. BC and DE E. AB, BC and CD

U89-P1b A light inextensible string, passing over a fixed pulley, is attached to two bodies of masses m_1 and m_2, as shown in Fig.U89-P1b. Assume that the mass of the pulley and that of string are both negligible, and m_1 = 5 kg, m_2 = 8 kg.
(i) Draw diagrams to show all the external forces acting on m_1 and m_2;
(ii) Find the acceleration of m_2 and the tension in the string.
[2.26 m s^{-1}]

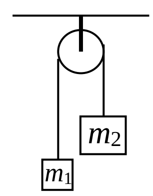

Fig.U89-P1b

U92-5 Two cars, one made of metal and the other made of wood, are placed at rest on a smooth horizontal surface and are acted on by two equal forces respectively. Given that the mass of the metal car is twice that of the wooden one, and that the acceleration of this metal car is 1 m s^{-1}, what is the speed of the wooden car 4 seconds after being acted on by the force?

B A. 10 m s^{-1} B. 8 m s^{-1} C. 6 m s^{-1} D. 4 m s^{-1}

U92-6 A small sphere of mass m is suspended in a state of equilibrium by two rubber bands PQ and QR as shown in Fig.U92-6, where QR is held in a horizontal position. When QR is suddenly cut, the acceleration of the sphere would be _________.

D A. zero B. g sinθ C. g cosθ D. g tanθ

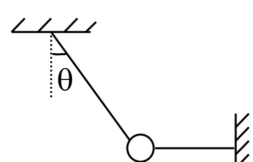

Fig.U92-6

U90-P2a State Newton's 2nd Law of Motion.

(b) From Newton's 2nd Law of Motion, we learn that no matter how small a force is applied, an acceleration is always produced. But if we try to lift a very massive body, we can hardly move it. Does this contradict the second law? Explain.

(c) A man weighing 700 N stands on the ground with a light rope tied to his waist. The other end of the rope is held by his hands after passing it through a fixed pulley, as shown in Fig.U90-P2b.

(i) How much force is exerted on the ground when he pulls the rope with a 300 N force?

(ii) What is the tension of the rope X above the pulley under the circumstance described in part (i) above?

(iii) What is the minimum pull to be exerted on the rope by the man if he wants to lift himself from the ground? [100 N; 600 N; 350]

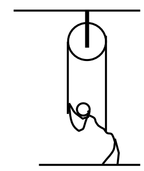

Fig.U90-P2b

U91-P3a Starting from Newton's 2nd Law of Motion, show that $F = ma$, where F is the force acting on a body of constant mass m and a is the acceleration of the body.

(b) A ship of mass 2.0×10^{7} kg is moving backwards into a dock with a speed of 0.40 m s^{-1}. In order to bring the ship to standstill immediately after it has entered the dock, the engines are operated at full speed in the forward direction.

(i) Calculate the initial kinetic energy of the ship.

(ii) Assuming that the viscous effects of the seawater are negligible, calculate the magnitude of the force (provided by the engines, assumed to be constant) which must be exerted on the ship if it is to stop in a distance of 10 m.

(iii) How many seconds will the ship take to stop under the conditions mentioned above? [1.6×10^{6} J; 1.6×10^{5} N; 50 s]

U92-1 From Newton's 2nd Law of Motion, we know that a force, no matter how small, would produce an acceleration when applied to a body. But when we try to push a stationary heavy car with a small force, it would not move at all --- that is, there is totally no acceleration at all. This is due to the fact that __________.

C A. Newton's 2nd Law of Motion does not apply to stationary bodies.
B. the car does have an acceleration, but it is too small to be detectable.
C. after this force has been added, the resultant force acting on the car is still zero.
D. Newton's 2nd Law of Motion is good only for small particles and not for a huge body such as a car.

U93-8 A crane lifts a load. When the load __________, the tension of the cable of the crane will be the smallest.

C A. keeps stationary in air B. descends with retardation
C. descends with acceleration D. descends with constant speed

U93-11 Fig.U93-11 shows two rectangular metal block P and Q, of weights 100 N and 200 N respectively, connected by a light string through a small pulley. The weights of both the string and pulley are negligible and the pulley produces no friction when rotating. If the coefficient of sliding friction between all surfaces are 0.5, whatever the speed is varied, what is the force F, applied horizontally, needed to make Q move with uniform speed to the left?

A A. 250 N B.200 N C. 150 N D. 100 N

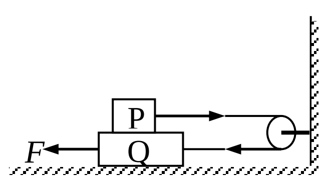

Fig.U93-11

U94-11 A light rope passing through a smooth pulley has its two ends each attached with an object of mass m. If another object of mass x is added to the hanging weight on the right, as shown in Fig.U94-11, a downward acceleration a is obtained, and so the value of x is _____.

D A. $\frac{ma}{g+a}$ B. $\frac{ma}{g-a}$
C. $\frac{2ma}{g+a}$ D. $\frac{2ma}{g-a}$

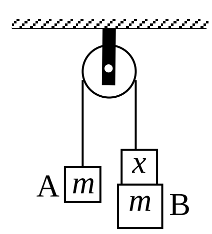

Fig.U94-11

U95-7 A slowly reducing but non-zero force acts on a moving body. The direction of the force is the same as that of the velocity of the body. This is ___________.

B A. decelerated rectilinear motion B. an accelerated rectilinear motion
C. a rectilinear motion with constant velocity D. a uniformly accelerated rectilinear motion

U95-8 A man, standing on a balance placed on the platform of an elevator, finds that his weight is reduced by 20% of his real weight. Which of the following statements is **true**? [Note: g is gravitational acceleration.]

D A. The elevator is ascending with an upward acceleration of 0.8g.
B. The elevator is ascending with an upward acceleration of 0.2g.
C. The elevator is descending with a downward acceleration of 0.8g.
D. The elevator is descending with a downward acceleration of 0.2g.

U95-11 A block of mass m is placed on a horizontal ground. The coefficient of sliding friction between the block and the ground is μ. When the block is exerted by a force F, which makes an angle θ with the horizontal, it moves uniformly as shown in Fig.U95-11. Which of the following concerning the frictional forces between the block and the ground are **true**?

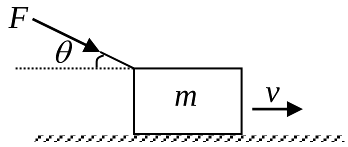

Fig.U95-11

I. μmg II $F\cos\theta$ III. $\mu(mg - F\sin\theta)$ IV. $\mu(mg + F\sin\theta)$

C A. I, II B. I, III C. II, IV D. III, IV

U95-P5 A body W with 50 N of weight is placed on a rough inclined plane as shown in Fig.U95-P5. The length, base and height of the inclined plane are in the ratio of 5: 4: 3.

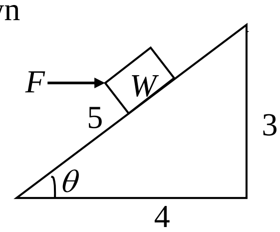

Fig.U95-P5

(a) The body slides down with a uniform velocity along the inclined plane when a horizontal force F = 5 N acts on it. Calculate
(i) the frictional force acting on the body that slides down the inclined place with uniform velocity;
(ii) the normal press acting on the body;
(iii)the coefficient of friction μ between the body and the surface of the inclined plane.
(b) What is the magnitude of a horizontal force required to push the body up the inclined plane with uniform velocity? [26 N; 43 N; 0.6; 122.73 N]

U97-5 A moving particle is acted on by three forces of equal magnitude. The directions of the three forces are shown in Fig.U97-5. What is the stage of motion of the particle?

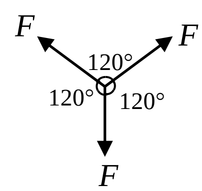

Fig.U97-5

C A. At rest
B. Moving with uniform circular motion
C. Moving with uniform velocity along the original direction
D. Moving with uniform acceleration along the original direction

U97-P3 Three metal blocks A, B and C of masses 4 kg, 5 kg and 6 kg respectively are connected in the way as shown in Fig.12. The length of block A is $\frac{1}{5}$ that of block B. The coefficient of sliding friction between block B and the supporting plane is μ_k = 0.10, while that between block A and block B is μ_1 = 0.40. If the length of block B is 50 cm, after the system is released, block C pulls block A and block B to move to the right.
(a) Draw the vector diagrams of the forces acting on A, B and C respectively.
(b) What are the respective accelerations of A, B and C as the system is released?
(c) Find the velocity of B and the distance traveled by B at the instant block A has just left block B.

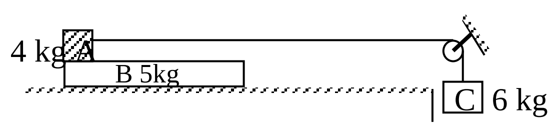

Fig.U97-P3

U99-7 Two wooden blocks of masses m_1 and m_2 respectively in contact with each other are put on a horizontal rough surface as shown in Fig.U99-7. Given that m_1 = 3 kg and m_2 = 2 kg. The coefficient of sliding friction between the wooden blocks and the surface is 0.1. When a force of 10 N is pushing on m_1, the force acting on m_2 by m_1 will be _______N

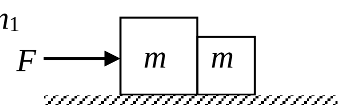

Fig.U99-7

B A. 2 B. 4 C. 5 D. 10

U99-8 A body of mass m at rest is pushed by a force F and displaced a distance s in time t. Which of the following expressions is **true**?

A A. With similar force F in similar time t, a body of mass ½ m will move a distance of 2s.
B. With similar force F in similar time 2t, a body of mass 2m will move a distance s.
C. With similar force 2F in similar time ½ t, a body of mass 2m will move a distance s.
D. With similar force ½ F in similar time t, a body of mass ½ m will moved a distance ½ s.

U2k-P3 With the use of a smooth fixed pulley, three objects A, B and C are connected with a light string as shown in Fig.U2k-P3. The masses of the three objects are m_A = 150 g, m_B = 90 g and m_C = 80 g respectively. Object A is initially at rest on the table. When object B and object C drop from rest for 8 seconds, object C comes off suddenly. Find

(a) the acceleration of the system before C comes off;
(b) the velocity of C at the moment it comes off;
(c) the height of A above the table at the moment C comes off;
(d) the acceleration of the system after C comes off;
(e) the time object A takes to come back to the table after C comes off.
[0.61 m s^{-2}; 4.9 m s^{-1}; 19.6 m; 2.45 m s^{-2}; 6.47 s]

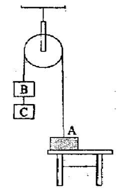

Fig.U2k-P3

U2k2-6 Two objects P and Q with the same mass are placed in contact on a smooth horizontal plane. Two collinear forces F_1 and F_2 act on P and Q respectively in the opposite directions, as shown in Fig.U2k2-6. If $F_1 > F_2$, then the action – reaction forces between P and Q is ____.

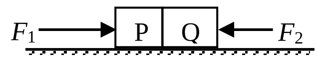

Fig.U2k2-6

C A. $F_1 + F_2$ B. $F_1 - F_2$ C. ½ ($F_1 + F_2$) D. ½ ($F_1 - F_2$)

U2k2-9 An object of mass 2 kg was horizontally acted by a constant force of 36 N and moved along a rough horizontal surface. The v-t diagram was shown in Fig.U2k2-9. If the frictional force between the object and the horizontal surface at these two parts of distance OA and AB is f_{OA} and f_{AB} respectively, then f_{OA}: f_{AB} =?

B A. 1: 1 B. 2: 3 C. 3: 4 D. 3: 2

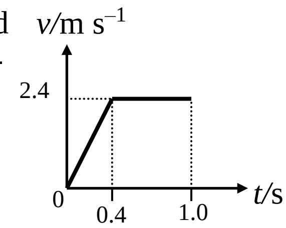

Fig.U2k2-9

U2k2-P4 (a) State Newton's second law of motion
Under what physical conditions can this law be reduced to the form $\Sigma F = ma$?

(b) In Fig.U2k2-P4b, a man of mass m_1 = 60 kg is standing on the floor of an elevator which is connected to a light pulley system. The mass of the elevator is 30 kg. The friction between the rope and the pulley can be neglected. Find the force acted by the man on the floor of the elevator when the elevator is descending with
(i) a uniform speed;
(ii) a downward acceleration of 2 m s^{-2}. [600 N; 480 N]

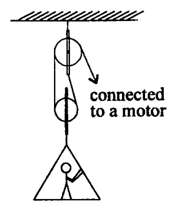

Fig.U2k2-P4b

(c) In the system of part(b) if the man on the elevator ascends the elevator by pulling the rope himself (Fig.U2k2-P4c), find the tension in the rope when the elevator is ascending
(i) with a uniform speed;
(ii) with an upward acceleration of 1 m s^{-2}. (take g =10 m s^{-2})
[300 N; 330 N]

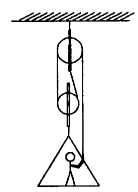
Fig.U2k2-P4c

U2k03-5 As shown in Fig.U2k03-5, a body P placed on a table is tied to a string of negligible mass. The string passes through a pulley (its mass and the friction produced whether at rest or in motion are all negligible) and drops vertically. When the end of the string Q is pulled downwards with a force of 10 N, the body P has an acceleration of a_1, but when a weight of 10 N is hung at Q and released from rest, P moves with an acceleration a_2. The relationship between a_1 and a_2 is ______.

C A. $a_1 \leq a_2$
B. $a_1 < a_2$
C. $a_1 > a_2$
D. $a_1 = a_2$

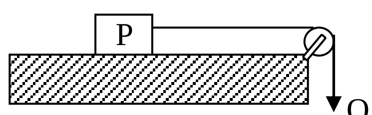

Fig.U2k3-5

U2k05-P2 (a) Briefly describe the state of motion of an object of mass m, when
(i) the total external force exerted $\Sigma F = 0$;
(ii) the total external force exerted ΣF is constant. [3%]

U2k04-7 A string can only support the maximum tension of 5 kN. In which of the following cases would be the tension of string exceed its supporting limit?

C A. To raise a weight of 4.9 kN in uniform speed
B. To let a weight of 4.9 kN rise with a deceleration of 2 m s^{-2}
C. To let a weight of 4.9 kN rise with an acceleration of 2 m s^{-2}
D. To let a weight of 4.9 kN descend with an acceleration of 2 m s^{-2}

U2k04-P3a Define Newton's second law of motion.

(b) The rated power of the engine of a car is 60 kW and the mass of the car is 5 t. When the car is moving on a horizontal road surface, its resistant force is constant and its maximum speed that can be achieved is 12 m s^{-1}.

(i) What is the magnitude of the resistance force?

(ii) What is the acceleration of the car at v_1 = 10 m s^{-1} if the car maintains its rated power and starts from rest?

(iii) How long can the car maintain a uniform acceleration of 1 m s^{-2} if it starts from rest?

[5×10^3 N; 0.2 m s^{-2}; 6 s]

U2k05-5 As shown in Fig.U2k05-5, two balls A and B are connected to two ends of a light spring and A is also connected to point O at the wall with a thin string. The mass of A is 1 kg while that of B is 2 kg. Both the balls rest on the smooth horizontal floor after a pulling force of 10 N acting on B horizontally. What are the instantaneous acceleration of A and B when the string is burned and broken?

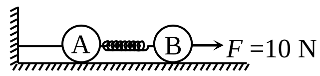

Fig.U2k05-5

B A. A is 0, B is also 0 B. A is 10 m s^{-2}, B is 0
C. A is 0, B is 10 m s^{-2} D. A is 10 m s^{-2}, B is also 10 m s^{-2}

U2k06-6 A body initially in linear motion, experiences a force with increasing magnitude but acts in the opposite direction to the motion. What is the subsequent motion of the body?

A A. Linear motion at decreasing velocity. B. Curvilinear motion at decreasing velocity.
C. Linear motion with uniform deceleration. D. Linear motion with uniform acceleration.

U2k06-7 Two bodies A and B, connected by a string that passes over a smooth pulley as shown in Fig.U2k06-7, are accelerating when released from rest. If the mass of A is 4 kg, while that of B is 10 kg, neglecting the mass of the pan, what is the net force exerted on B?

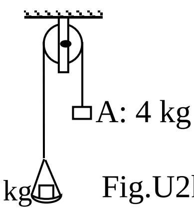

Fig.U2k06-7

B A. 37 N B. 42 N C. 56 N D. 63 N

U2k06-P2 A wooden block A of mass 1 kg is placed at the right side on top of a wooden plank B with mass 4 kg. The wooden plank B is placed on a horizontal plane of negligible friction. It is connected to a wooden block C of mass 3 kg by a string that passes over a smooth pulley, as shown in Fig.U2k06-P2. Block C falls off just after B moves forward a distance of 2 m. Finally, A is at the left side of block B and is relatively at rest with respect to B such that they move together with the same speed of 3.56 m s^{-1}. If the coefficient of kinetic friction between A and B is 0.2, find

(a) the accelerations of A and B respectively after the system starts to move. [3%]

(b) the velocities of A and B and their relative displacement when C falls off. [4%]

(c) the minimum length of the plank B. [3%]

[1.96 m s^{-2}, 3.92 m s^{-2}; 3.96 m s^{-1},1.98 m s^{-1}, 1.0 m; 1.84 m]

Fig.U2k06-P2

U2k06-9 A body which is put on a horizontal plane moves with a constant acceleration when a constant force acts on it. Fig.U2k06-9 shows that change of its acceleration a with respect to the force F. From this diagram, determine the coefficient of kinetic friction μ between the body and the plane. (Taking g = 10 m s^{-2})

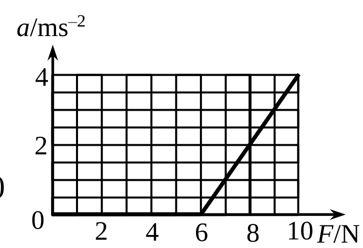

Fig.U2k06-9

D A. 0.3 B. 0.4 C. 0.5 D. 0.6

U2k06-14 Fig.Uk206-14 indicates a combination of pulleys hanging with two objects of masses m_1 and m_2. The object m_2 is released from rest. If the weight and the friction acting on the pulleys are negligible, what is the speed of m_2 after dropping a distance of h?

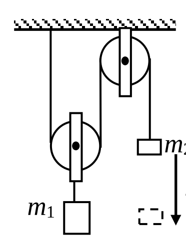

Fig.U2k06-14

D A. $\sqrt{2gh}$ B. $\sqrt{\dfrac{(m_2-m_1)gh}{2(m_1+m_2)}}$

C. $\sqrt{\dfrac{2(m_2-m_1)gh}{(m_1+m_2)}}$ D. $\sqrt{\dfrac{4(2m_2-m_1)gh}{m_1+4m_2}}$

U2k07-14 An object with mass M is placed on a horizontal table. A force, F, is applied parallel to the table to move the object, and obtained its acceleration-Force relationship (a - F) as a straight line as shown in Fig. U2k07-14. If only the frictional force is considered, which of the following descriptions is **true**?

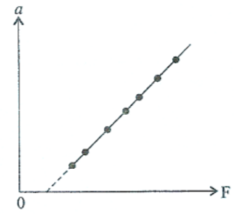

Fig.U2k07-14

A A. The gradient of the straight line will vary with M.
B. The gradient of the straight line will vary with the table material.
C. The intercept of the straight line on F-axis will not depend on the changes of M.
D. The intercept of the straight line on F-axis will not depend on the table material.

U2k07-P3a Fig.U2k07-P3ai shows a block of mass 2 kg resting on a horizontal table. A horizontal force, F, is applied by a person pulling the block at an interval of 10 s. The force increases uniformly with time as shows in Fig.U2k07-P3aii. Result shows that the block starts to move at t = 5 s. Assume the difference between the coefficient of static friction and dynamic friction is very small. Answer the following questions by referring to Fig.U2k07-P3ai and Fig.U2k07-P3aii.
(i) while t = 2 s, what is the friction acting on the object?
(ii) while t = 7 s, what is the friction acting on the object?
(iii) while t = 10 s, what is the acceleration of the object?
(iv) while t = 10 s, what is the speed of the object?
(v) after t =10 s, how far will be the object continuously sliding until it comes to a stop?
[2 N; 5 N; 2.5 m s^{-2}; 6.25 m s^{-1}; 7.81 m]

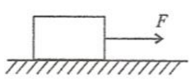

Fig. 3

Fig.U2k07-P3ai

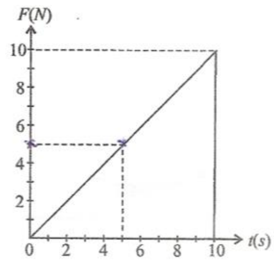

Fig.U2k07-P3aii

U2k07-P6a (i) Describe the five steps to apply Newton Second Law of Motion to solve problems in mechanics.
(ii) Based on the Newton′s Second Law of Motion, derive the formula Force = mass × acceleration.
(b) As shown in Fig. U2k07-P6b, a worker of mass 60 kg is standing on a working platform of mass 20 kg. Determine the reaction force acting on the man by the platform, if the platform is moving
(i) upward with a constant speed;
(ii) upward with a retardation of 2 m s^{-2} .
[196 N; 156 N]

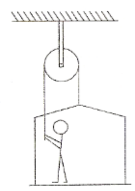
Fig.U2k07-P6b

U2k08-4 As shown in Fig.U2k08-4, five identical wooden blocks are placed on a smooth floor. A man pushed the first block, so all the blocks are moving rightward with a constant acceleration. If the net forces act on m_1, m_3 and m_5 are F_1, F_3 and F_5 respectively, which of the following statements about these forces is **correct**?
D A. F_1 is the largest.
B. F_3 is the largest.
C. F_5 is the largest.
D. All of them are equal.

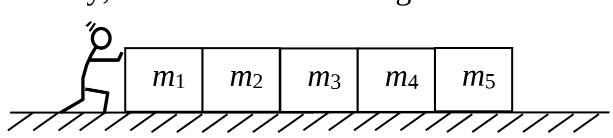

Fig.U2k08-4

U2k10-8. Fig.U2k10-8 shows the variation of force F with time t exerted on an object during a given time interval. Which of the following descriptions regarding the state of motion of the object during the time interval is **true**?
C A. The object is first accelerated, then moving with uniform velocity.
B. The object is first decelerated, then moving with uniform velocity.
C. The object is first moving with variable acceleration and then with constant acceleration.
D. The average velocity of first part of the journey is greater than that of the second part of the journey.

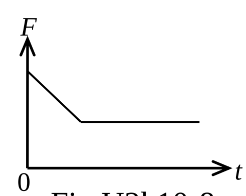

Fig.U2k10-8

U2k10-P3 A child with mass 40 kg stands on a scale in a lift, and at $t = 0$ the lift starts to move upward from rest. In the interval of 0 to 6 s, the scale's reading F varies with time t as shown in Fig.U2k10-P3. (Take $g = 10$ m s^{-2})

(a) Briefly describe the motion of the lift in the 6 seconds;
(b) Find the **maximum** velocity of the lift;
(c) Draw the $v - t$ graph of the lift and find the height raised by the lift within the 6 seconds.
[2 m s^{-1}; 9 m]

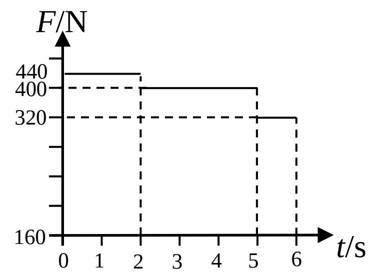

Fig.U2k10-P3

U2k11-7 A truck of mass 3000 kg tows a car of mass 1000 kg. The resistance against the motion of the truck and the car are 2000 N and 1000 N respectively. If the two vehicles accelerate at 2.0 m s^{-2}, what is the tension exerted on the tow bar between the truck and the car?

A A. 3000 N B. 4000 N C. 6000 N D. 7000 N

U2k-11-P2 As shown in Fig. U2k11-P2, a wooden block of mass 5 kg is placed on a rough plane inclined at 30° to the horizontal. The block is just able to slide down the inclined plane with uniform speed.

(a) Draw a labeled diagram to show the forces acting on the block.
(b) Find the frictional force and the coefficient of kinetic friction between the block and the inclined plane. [24.5 N; 0.58]
(c) As shown in Fig.U2k11-P2(c), what is the acceleration a along the horizontal direction to left needed for the object to slide up the inclined plane with uniform speed? [17.05 m s^{-2}]

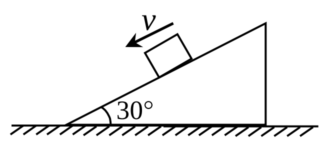

Fig.U2k11-P2

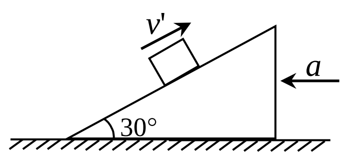

Fig.U2k11-P2(c)

U2k13-P4 (c) In Fig.U2k13-P4c, a block of mass 2 kg is sliding up a long-inclined plane with an initial velocity $u = 10$ m s^{-1}. The plane is inclined at an angle of 37° with the horizon, and the coefficient of friction between the block and the plane is 0.4. Find

(i) the accelerations of the block when it is sliding up and it is sliding down the plane;
(ii) the net displacement of the block in the first two seconds.
[-9.02 m s^{-2}, 2.74 m s^{-2}; 4.45 m]

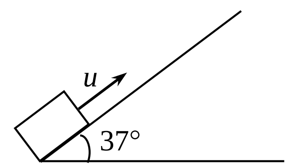

Fig.U2k13-P4c

U2k15-P2 Fig.U2k15-P2 shows a slope AB of length 3 m, which is inclined at angle of 37° with the horizontal plane BC. A small smooth ball of mass 0.5 kg is placed into a rectangular box of mass 1.5 kg. The box slides down from the top point A along the slope from rest. The coefficient of friction between the box and both the slope and the horizontal place BC is 0.3. The coefficient of friction between the ball and the box and the length of the box are negligible. [Given: $g = 10$ m s^{-2}]

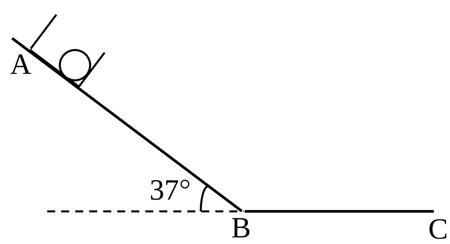

Fig.U2k15-P2

Find,

(a) the acceleration a_1 of the box with the ball when sliding down the slope; [3%]
(b) the deceleration a_2 of the box with the ball when sliding on the horizontal plane; [1.5%]
(c) the force N_1 exerted by the ball to the wall of the box when sliding down the slope; [1.5%]
(d) the force N_2 exerted by the ball to the wall of the box when sliding on the horizontal plane; [1%]
(e) the velocity of the box with the ball when passing point B; [1%]
(f) the distance travelled by the box in 3 seconds after passing point B. [2%]
[3.6 m s^{-2}; 1.20 N; -3.0 m s^{-2}; 1.50 N; 4.65 m s^{-1}; 3.60 m]

U2k16-P1b Two wooden blocks of masses $m_1 = 1.5$ kg and $m_2 = 2$ kg are attached to each other by strings and two smooth pulleys, as shown in Fig.U2k16-Pb. The block m_1 rest on a frictionless table. (The mass of strings and pulleys are negligible.) If m_1 and m_2 are being released from rest, determine the acceleration of m_1.
[4.90 m s^{-2}]

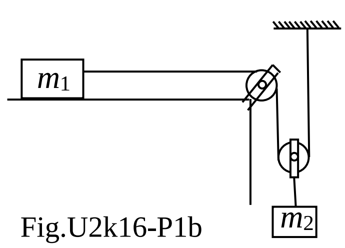

Fig.U2k16-P1b

U2k15-P3 Fig.U2k15-P3 shows one of the lifts in Kuala Lumpur Tower which ascends from the ground floor to the revolving restaurant at height 280 m within 60 seconds. The total weight of the lift and the tourists is 6000 N. The motion of the lift consists of three stages. In the first 10 seconds, it ascends from rest with uniform acceleration, reaching the speed v at the end of 10^{th} second. It then ascends with uniform speed v. During the last 50 m journey, it ascends with uniform retardation and stops exactly at the revolving restaurant. Given that g = 10 m s^{-2}, find

(a) the speed v; [3%]
(b) the acceleration in the first 10 seconds; [1%]
(c) the retardation and the time take during the final part of the journey of 50 m; [2%]
(d) Given the resistive force acting on the lift during its motion is 0.2 times its total load, plot a graph ($F – t$ graph) showing the tension of its cable F varies with time t during the motion in the 60 seconds. Given suitable values on both axes in your graph. [4%]

[6 m s^{-1}; 0.6 m s^{-2}; -0.36 m s^{-2}, 16.67 s; 7560 N, 7200 N, 6984 N]

U2k17-7 In Fig.U2k17-7, a body of mass m is being pulled by a force F directed at an angle θ above the horizontal. If the body is moving in a straight line with constant velocity, and the coefficient of friction between the body and the surface is μ, what is the magnitude of the frictional force acting on the body?

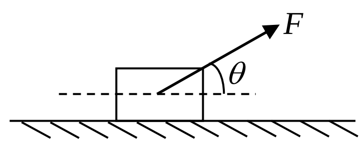

Fig.U2k17-7

D A. μmg B. $\mu F \sin\theta$

C. $\mu(mg - F\cos\theta)$ D. $\mu(mg + F\cos\theta)$

U2k17-P3 Fig.U2k17-P3 shows a long-inclined plane at an angle of θ = 37° with the horizontal. At the bottom of the inclined plane A, an object of mass m = 5 kg starts to move from rest after being acted by an upward force F = 50 N along an inclined plane. After 2 seconds, the force F is removed. If the object is displaced by 4 m in the first 2 seconds, find

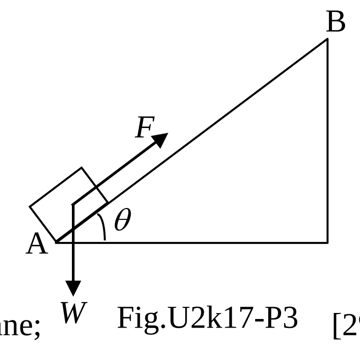

Fig.U2k17-P3

(a) the acceleration of the object in the first 2 seconds; [1%]
(b) the velocity of the object at the end of the first 2 seconds; [1%]
(c) the coefficient of dynamic friction μ between the object and the plane; [2%]
(d) the acceleration of the object in the upward motion after the force is removed; [2%]
(e) the upwards displacement of the object after the force is removed; [1%]
(f) the speed of the object when it returns to the point A. [3%]

(sin37° = 0.6, cos37° = 0.8, g = 10 m s^{-2})

[2 m s^{-2}; 4 m s^{-1}; 0.25; - 8 m s^{-2}; 1 m; 6.32 m s^{-1}]

U2k19-07 An object is accelerated from rest by a constant force. Which of the following graphs correctly shows the variation of its momentum (p) with time (t)?

B