Name:	Target Grade:	Actual Grade:

BRIGHT CULTURE

DYNAMICS
MCQ and STRUCTURED QUESTIONS

READ THESE INSTRUCTIONS FIRST

INSTRUCTIONS TO CANDIDATES

1. Find a quiet, comfortable spot free place from distractions.

2. Spend one minute on each mark.

3. Time yourself for every single question.

4. Every chapter has their own question types. Ensure that you know the different question type for each chapter.

5. Make a conscientious effort to remember your mistakes, especially in terms of answering techniques. E.g Take a picture for the mistakes that you made, keep it in a photo album, and revise it over and over again.

6. Highlight question types that you tend to keep making mistakes and review them nearing exams.

7. Always review the common questions and question type that you tend to make mistakes nearing exams.

8. During exams, classify the question type and recall what you have learnt, how you need to analvse the questions for the different question type, what you need to take note of and answer with the correct answering techniques!

✨ **Wishing you all the best for this test!**

You've got this!

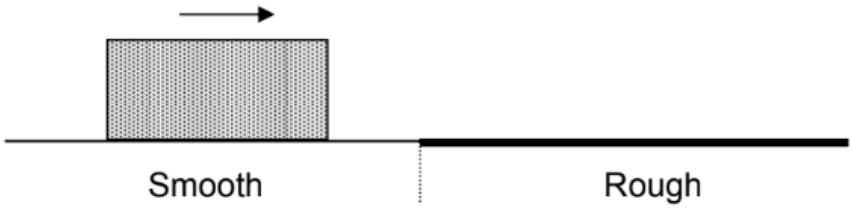
💡 **With lots of love,**
Bright Culture 💛

GOOD LUCK FOR YOUR EXAM!

MARKS

DYNAMICS MCQ

1 A box is moving horizontally at a constant speed towards the right along a smooth ground, and is about to enter a region where the ground is rough.



What is the motion of the box as it moves onto the rough ground?

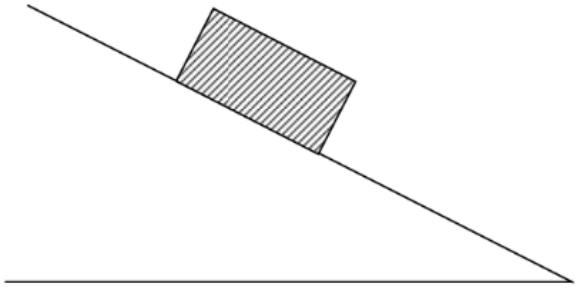
A The object stops immediately before the rough ground.

B The object decelerates to a stop then remains at rest.

C The object decelerates to a stop then accelerates in the opposite direction.

D The object continues moving at constant lower speed.

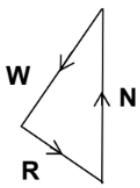
2 The diagram below shows a block accelerating down a smooth slope.



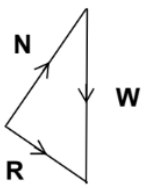
It is known that there are two forces acting on the block, namely the weight of the block, W, and the normal contact force, N.

Which vector diagram correctly represents the forces acting on the block, where R is the resultant force?

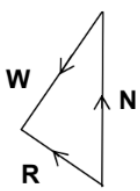
A



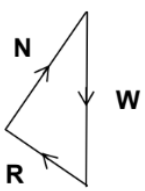
B



C



D



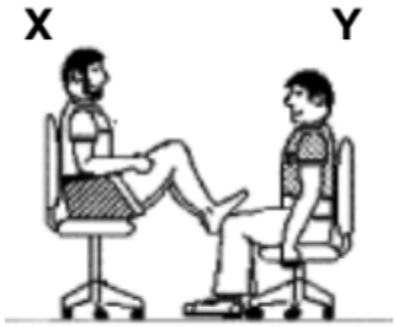
3 A man of mass 60 kg enters a lift of mass 600 kg. The lift then accelerates upwards at 2.0 ms-2. What is the magnitude of the force exerted by the man on the lift as the lift is accelerating?

A 480 N **B** 600 N

C 720 N **D** 1080 N

4 The diagram shows two students sitting on rolling chairs facing each other.

Student X then pushes against student Y.



Which of the following statements is true?

A Student **X** exerts a force on student **Y** but student **Y** does not exert a force on student **X**.

B Student **X** exerts a greater force on student **Y** than student **Y** on student **X**.

C Student **X** exerts less force on student **Y** than student **Y** on student **X**.

D The force that student **X** exerts on student **Y** and the force that student **Y** exerts on student **X** are equal in magnitude.

5. A heavy box is suspended from a ceiling by a metal chain as shown in **Fig. 5.1**. The box is pulled to one side and is stationary in **Fig. 5.2**.

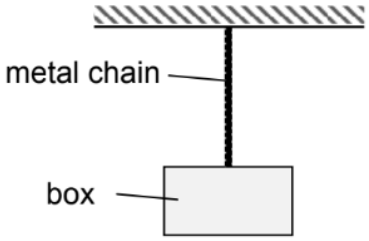


Fig. 5.1

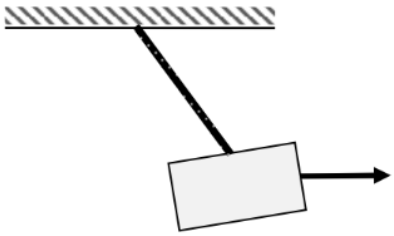
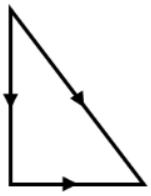


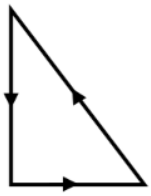
Fig. 5.2

Which diagram represents the forces acting on the box in **Fig. 5.2**?

A



B



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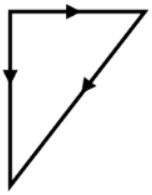
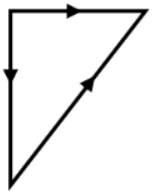


D



6 A container of mass 450 kg is suspended by cable to a crane.

What is the tension of the cable when the crane lowers the container vertically with a constant acceleration of 1.20 m s-2?

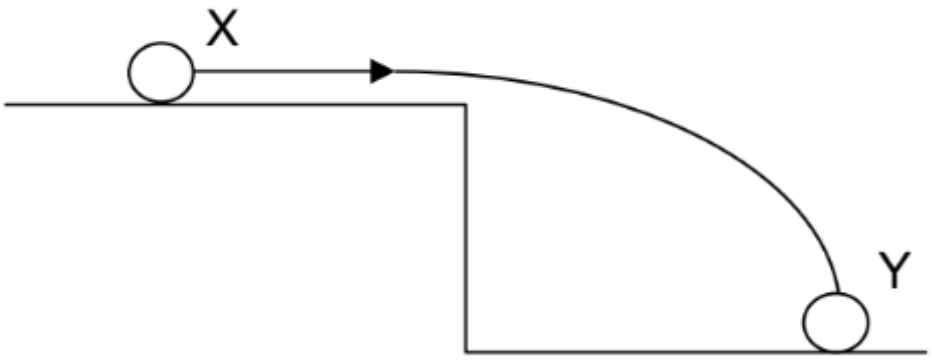
A 5040 N

B 4500 N

C 3960 N

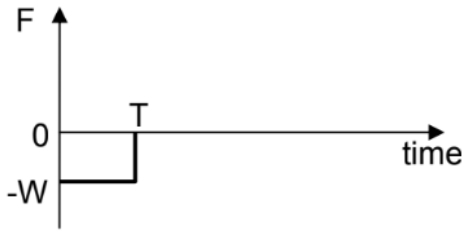
D 540 N

7 A ball of weight W slides along a horizontal surface until it falls off the edge at time T as shown in the diagram below.

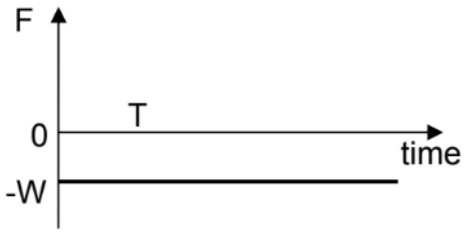


Which of the following graphs represents how the resultant vertical force F varies with the time as the ball moves from position X to Y?

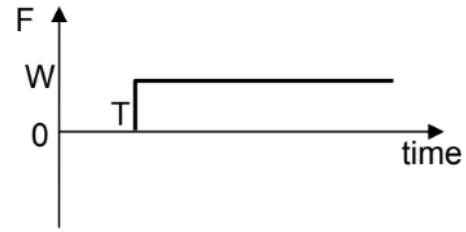
A



C

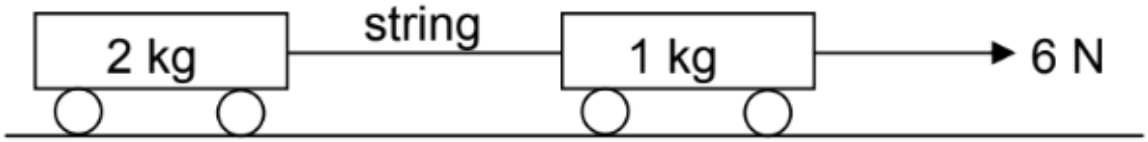


B



D

8 Two trolleys of masses 2 kg and 1 kg are connected by a piece of string. An unbalanced force of 6 N acts on them as shown in the diagram below.



What is the tension in the string?

A 0 N **C** 4 N

B 3 N **D** 6 N

9 The greater the resistance of an object to any change of its position, the more stable the object is considered to be.

Which of the following factors does not affect the stability of an object as defined above?

A The weight of the object.

B The area of the base of the object.

C The distribution of the mass of the object.

D The angle to which the object is displaced.

10 Which of the following statements concerning gravitational fields is not true?

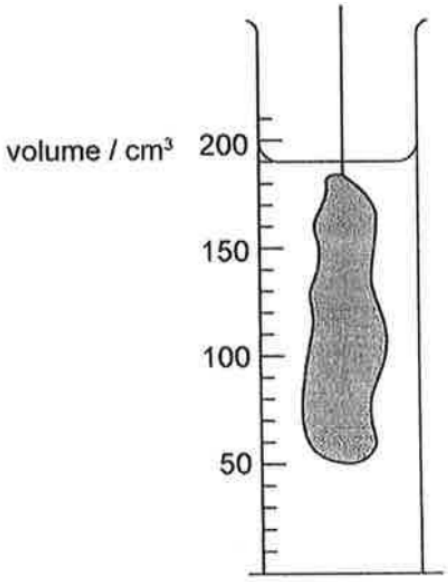
A A gravitational field is a region in which a mass experiences a force due to gravitational attraction.

B Gravitational field strength is numerically equal to the acceleration due to gravity.

C The gravitational field of the Earth acts outwards from the Earth's magnetic north pole.

D The strength of the Earth's gravitational field decreases as the distance from the surface of the Earth increases

11 A measuring cylinder filled with 100 cm3 of water has a mass of 105.0 g. The diagram below shows a body being suspended by a piece of thread in the cylinder with 100 cm3 of water.



If the total mass of the measuring cylinder containing 100 cm3 of water together with the body immersed is 385.0 g, what is the density of the body?

A 1.47 g cm·3

B 2.00 g cm·3

C 2.80 g cm·3

D 3.11 g cm·3

12 In a laboratory on Earth, measurements using an electronic balance and a spring balance show that an object has a mass of 2.0 kg and a weight of 20 N respectively.

The same balances and object are then taken to the Moon, where the gravitational field strength is less than on the Earth.

Are the mass and weight of the object on the Moon the same, or less, than on Earth?

	mass	weight
A	less	less
B	less	same
C	same	less
D	same	same

13 Which of the following cases is/are **NOT** an action and reaction pair of forces?

(1) gravitational force acted on you by Earth and the gravitational force acted on Earth by you

(2) the force acted on the ball by the bat and the force acted on the bat by the ball, when a bat hits a baseball

(3) your weight and the normal contact force acted on you, when you are standing on the ground

A (1) only

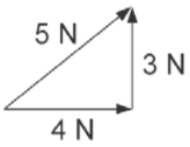
B (2) only

C (3) only

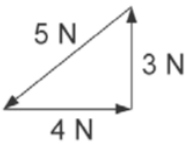
D (2) and (3) only

14 Which of the following shows the correct diagram for the addition of 3 N and 4 N forces?

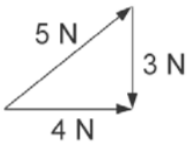
A



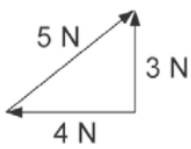
B



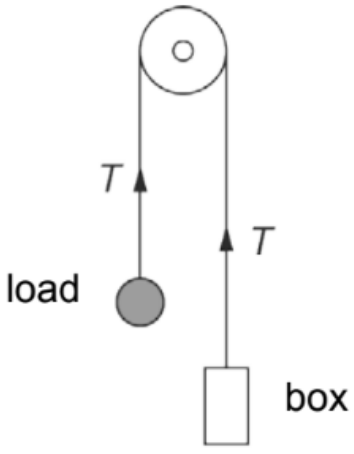
C



D



15 A man uses a pulley system with a load to slow down the falling of a box. The mass of the box is 7.0 kg and the load is 5.0 kg and the string is inextensible.



What is the acceleration of the box?

A 1.50 m s^{-2} upwards

B 1.67 m s^{-2} downwards

C 2.02 m s^{-2} upwards

D 2.87 m s^{-2} downwards

16 If a force *F* is applied to an object of mass m_1 on a smooth surface, the acceleration of this object is 4.0 m s^{-2}.

If a force 0.5F is applied to another object of mass m_2, this object has an acceleration of 7.0 m s^{-2}.

What is the ratio of m_1 to m_2?

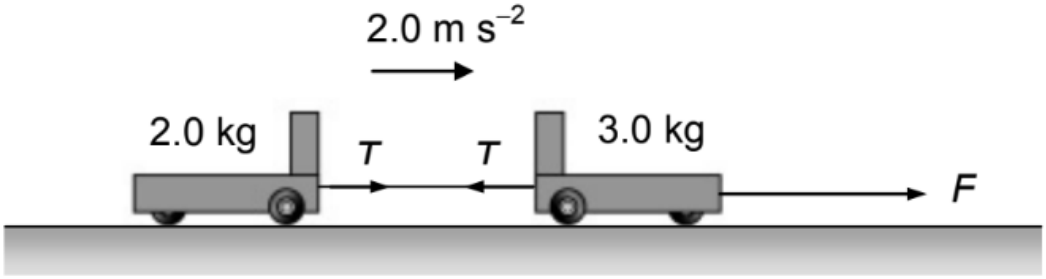
A 1 : 3

B 4 : 7

C 7 : 4

D 7 : 2

17 In the following figure, two trolleys of mass 2.0 kg and 3.0 kg are tied together on a smooth plane and a horizontal force F pulls them.

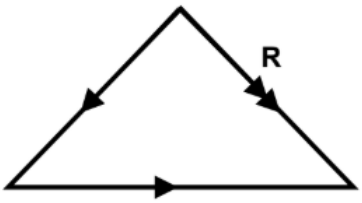


If the trolleys have an acceleration of 2.0 m s^{-2}, what are the values of tension *T* and horizontal force *F*?

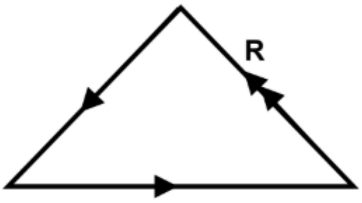
	T	*F*
A	2.0 N	6.0 N
B	4.0 N	6.0 N
C	6.0 N	10 N
D	4.0 N	10

18 Which of the following correctly shows the resultant force R of the other two given forces?

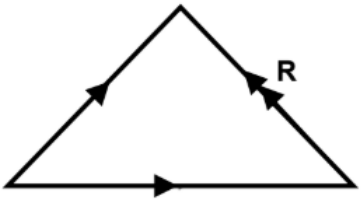
A



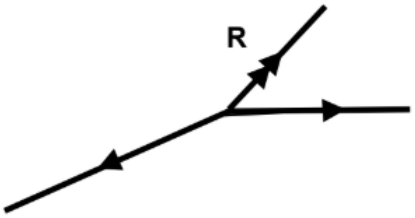
B



C

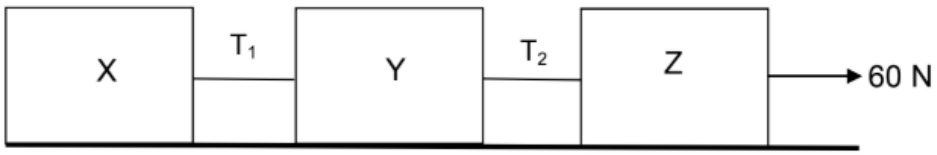


D



19 X, Y and Z are three identical blocks resting on a smooth surface. A force of 60 N is applied to Z as shown below.

What are the tensions T1 and T2?



	T_1/ N	T_2/ N
A	20	40
B	20	50
C	30	40
D	35	50

20 A water skier is being towed by a boat at a constant speed v. The frictional force on the skier is Fs and that on the boat is Fb. The power delivered by the boat's engine is

A Fs + Fb + v

B (Fs + Fb) v

C v + Fb - Fs

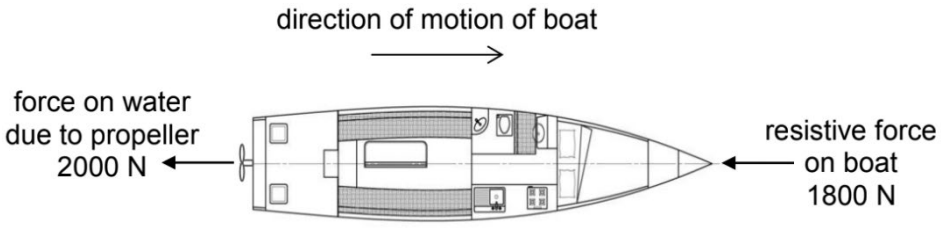
D (Fs + Fb) / v

21 A force $2F$ acting on a ball of 10 kg produces an acceleration of 60 m s^{-2}. A force $5F$ acting on another ball of mass M produces an acceleration of 50 m s^{-2}. What is the mass M?

A 3.3 kg **B** 4.8 kg

C 21 kg **D** 30 kg

22 The propeller on a boat pushes water backwards with a force of 2000 N. The boat moves through water against a total resistive force of 1800 N.

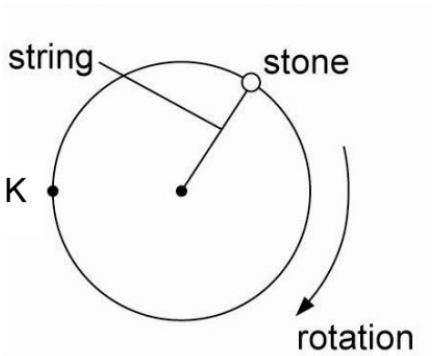


What is the forward force on the propeller due to the water?

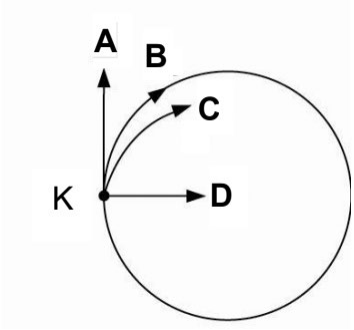
A 200 N **B** 1800 N

C 2000 N **D** 3800 N

23 A stone tied to a length of string is rotated at a steady speed in a horizontal circle on a frictionless surface as shown in the top view diagram below. The string is cut when the stone reaches point K.

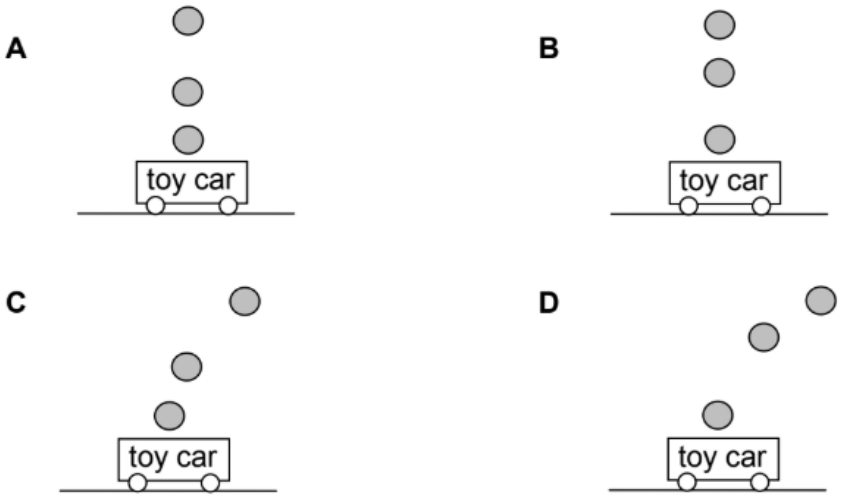


What is the path of the stone after the string is cut?



24 A toy car travels to the left at constant speed. Balls are projected vertically up at equal time intervals. Neglect air resistance and assume that the balls have not reached their maximum height.

Which diagram shows a possible snapshot of the car and the balls after the third ball has been projected?

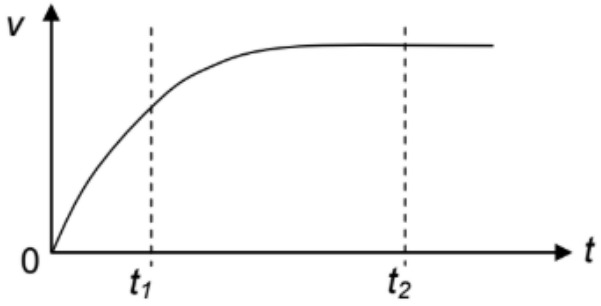


25 When a horizontal force of 4.0 N is applied to a 2.0 kg wooden block on a horizontal surface, the block moves with constant velocity.

If the horizontal force is increased to 12.0 N, what is the acceleration of the block?

A 2.0 m s-2 **B** 4.0 m s-2 **C** 6.0 m s-2 **D** 8.0 m s-2

26 A 4.0 kg object falls through considerable height and reaches terminal velocity. The graph below shows the velocity v against time t for the object.



Which row gives the air resistance R acting on the object at t = 0, t1 and t2?

	R at *t* = 0	*R* at t_1	*R* at t_2
A	10 N	10 N	10 N
B	0 N	40 N	40 N
C	40 N	20 N	0 N
D	0 N	20 N	40 N

27 A block of mass 2.0 kg is being pushed horizontally on a rough surface by a 8.0 N force. An opposing force of 2.0 N acts on the block as shown. If the block starts to accelerate at 2.0 m s^{-2}, what is the frictional force acting on the block?

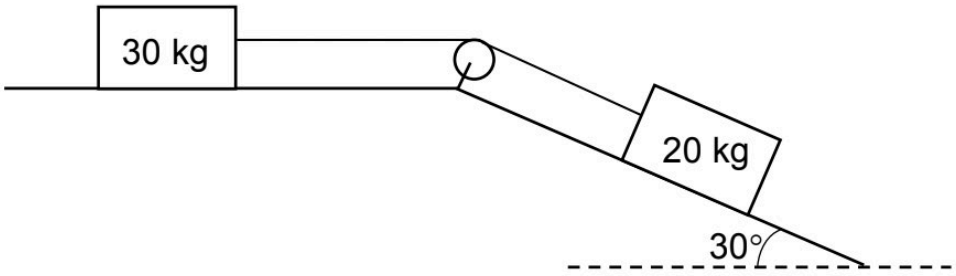
A 1.0 N

B 2.0 N

C 4.0 N

D 6.0 N

28 A 30 kg mass and a 20 kg mass rest on smooth surfaces as shown. The string linking them passes through a smooth pulley.



What is the speed of the 20 kg mass 2 seconds after the system is released from rest?

A 2.0 m s^{-1}

B 4.0 m s^{-1}

C 5.0 m s^{-1}

D 10.0 m s^{-1}

29 Two balls are dropped one after another from the same height from the same position. If air resistance is negligible, which of the statements is true?

A The distance between the two balls will depend on their relative masses.

B The two balls will drop with a constant distance between them.

C The two balls will drop with a decreasing distance between them.

D The two balls will drop with an increasing distance between them.

30 A ball is fired horizontally away from the top of a 125 m tall building with an initial speed of 12.0 m s-1

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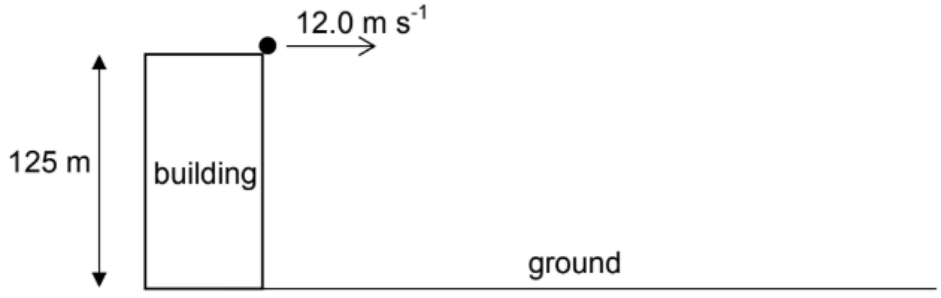


Neglecting the effects of air resistance, what is the distance between the foot of the building and the landing point of the ball on the ground?

A 10.5 m **B** 60.0 m **C** 120 m **D** 150 m

31 A lift moves downwards at a constant speed of 1.5 m s-1.If the lift has a mass of 600 kg, what is the tension in the cable?

A 900 N **B** 3000 N **C** 6000 N **D** 9000 N

32 A hot air balloon of mass m rises with acceleration x. What is the additional mass needed to be attached to the balloon so that the balloon will travel downwards with an acceleration of 2x? Take gravitational acceleration to be g.

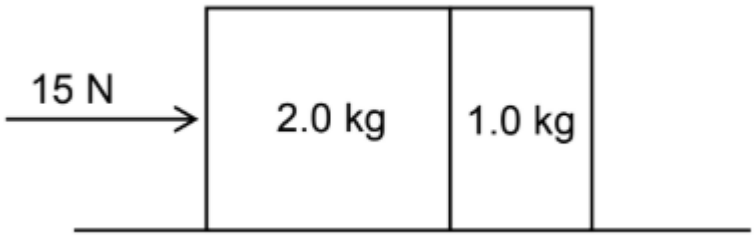
A 3mxg

B 3mxg − 2x

C 2mxg

D 2mxg − x

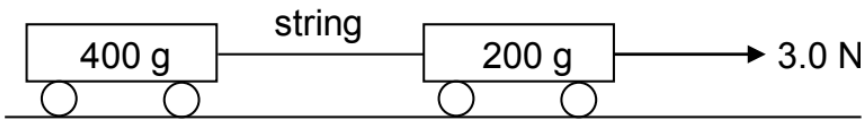
33 A 15 N force acts on a 2.0 kg mass and a 1.0 kg mass resting on a smooth surface as shown below.



Which of the following is correct?

	Force exerted by 2.0 kg mass on 1.0 kg mass / N	Resultant force on 2.0 kg mass / N
A	5.0	10
B	10	10
C	10	5.0
D	5.0	5.0

34 Two trolleys of masses 400 g and 200 g travelling on a smooth surface are connected by a piece of string. A force of 3.0 N acts on them as shown in the diagram below.

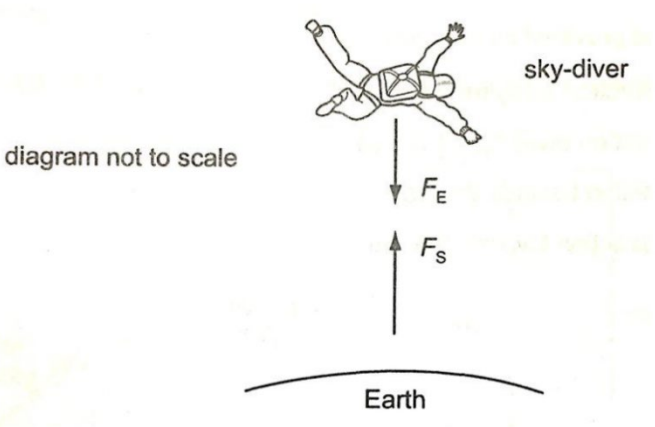


What is the tension in the string joining them?

A 1.0 N **B** 1.5 N

C 2.0 N **D** 3.0 N

35 A sky-diver jumps from an aircraft. The Earth exerts a downward force FE on the sky-diver who also exerts an upward force FS on the Earth.



Which statement is correct?

A the magnitude of FE > the magnitude of FS

B the magnitude of FE < the magnitude of FS

C the magnitude of FE = the magnitude of FS, hence the net force on the sky diver must be zero

D the magnitude of FE = the magnitude of FS, but the net force on the sky-diver may not be zero

36 A lady of weight W stands inside a lift. The lift is moving upwards at a constant acceleration. Let the normal contact force exerted on the lady by the floor be R.

Which of the following statements is/are correct?

(1) *R* is greater than *W* in magnitude.

(2) *R* and *W* are in opposite directions.

(3) *R* and *W* form an action-and-reaction pair according to Newton's third law of motion.

A (1) and (2) only

B (1) and (3) only

C (2) and (3) only

D (1), (2) and (3)

37 When does a girl in an elevator have the least apparent weight?

A when the elevator is moving downward at constant speed

B when the elevator is moving upward at constant speed

C when the elevator is moving downward with decreasing speed

D when the elevator is moving upward with decreasing speed

38 A helium balloon is tied to the floor of a car. When the car is stationary, the balloon string is vertical. As the car starts to accelerate forward, what will happen to the balloon?

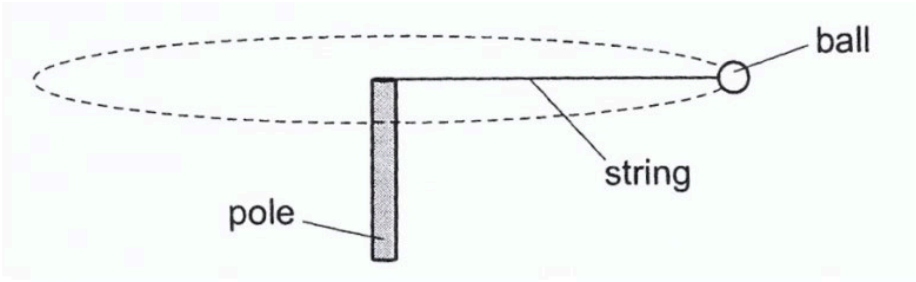
A It will move towards the back of the car

B It will move towards the front of the car

C It will start to float upwards.

D It will remain with the string in a vertical position.

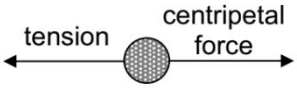
39 A ball is connected to a string and spun around horizontally as shown.



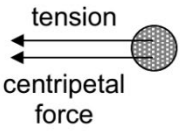
Which diagram correctly shows the horizontal forces acting on the ball at the instant shown?

A

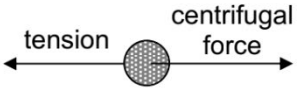
B



C



D



40 The SpaceX rocket has a launch mass of 550 000 kg. It is powered by rocket engines which produce a total thrust of 7.6 MN.

What will be the acceleration of the rocket at lift-off?

A 0.0 m s^{-2} **B** 3.8 m s^{-2}

C 38 m s^{-2} **D** 380 m s^{-2}

41 If you are to go to the moon, which of your following physical quantities will change?

(i) Weight

(ii) Mass

(iii) Density

A (i) only

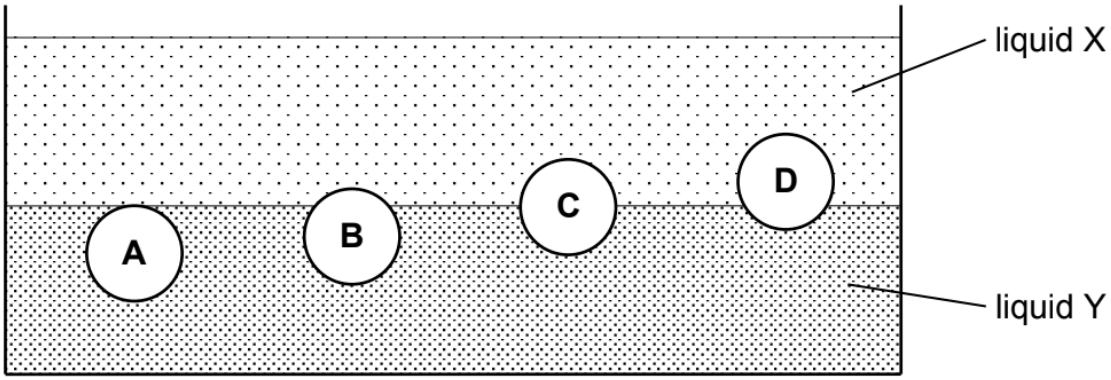
B (i) and (ii) only

C (i) and (iii) only

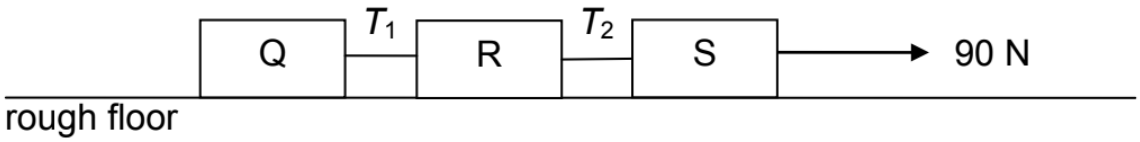
D (ii) and (iii) only

42 A sphere of density 2.5 g cm^{-3} finds an equilibrium position between liquid X of density 1.0 g cm^{-3} and liquid Y of density 3.0 g cm^{-3}.

Which of the following represents this sphere?



43 Three blocks, Q, R and S rest on a rough floor. A force of 90 N is applied at one end as shown in the diagram below. The masses of Q, R and S are 1.0 kg, 2.0 kg and 3.0 kg respectively. The frictional forces acting on the blocks are 1.0 N, 2.0 N and 3.0 N respectively. What are the tensions T_1 and T_2?



	T_1/ N	T_2/ N
A	15	30
B	30	45
C	15	45
D	30	30

44 Only 2 forces act on an object. If the object is in equilibrium, which of the following condition(s) is/are required?

(1) The 2 forces are of the same magnitude.

(2) The 2 forces act in opposite directions.

(3) The 2 forces act in the same direction.

(4) The 2 forces are of the same nature.

A (1) only

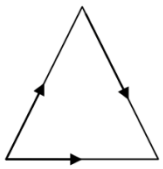
B (1) and (2) only

C (3) and (4) only

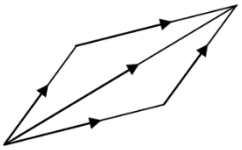
D (2) and (4) only

45 Which of the following diagrams shows forces in equilibrium?

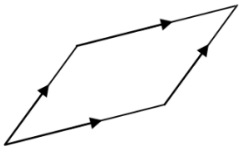
A



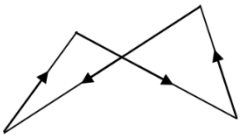
B



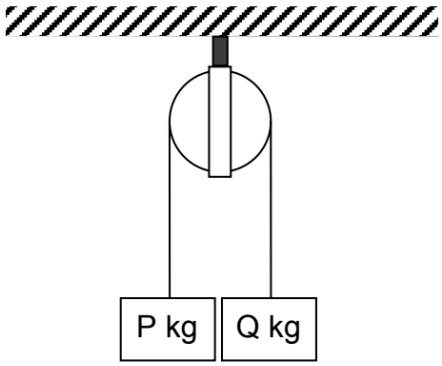
C



D



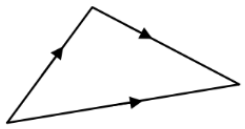
46 The diagram below shows a smooth pulley with two blocks of masses P kg and Q kg hanging on each side. Given that P < Q, and taking g to be the acceleration due to gravity, what is the acceleration of the system when the system is released?



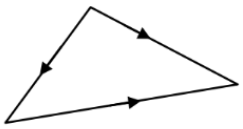
A $\frac{(P+Q)\,g}{P-Q}$ **B** $\frac{(Q-P)\,g}{P+Q}$ **C** $\frac{(Q-P)\,g}{Q}$ **D** g

47 Three forces act on an object. Which of the following diagrams correctly shows the forces to be at equilibrium?

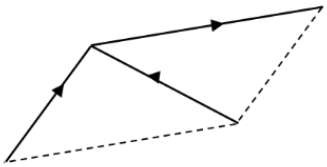
A



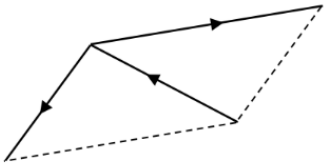
B



C



D



48 A juggler throws balls into air. He throws one whenever the previous one is at the highest point.

How high do the balls rise if he throws n balls each second?

A g / (4n^2)

B 2n^2g

C g / (2n^2)

D g/n

49 A person is pushing horizontally on a box with a constant force, causing it to slide across the floor with a constant speed. If the person suddenly stops pushing on the box, what will happen to the box?

A The box will immediately come to a stop.

B The box will continue moving at a constant speed for a while, then gradually slow down to a stop.

C The box will immediately move at a slower but constant speed.

D The box will immediately begin to slow down and eventually stop.

50 When does a girl in an elevator have the greatest apparent weight?

A when the elevator is moving downward at constant speed

B when the elevator is moving upward at constant speed

C when the elevator is moving downward with decreasing speed

D when the elevator is moving upward with decreasing speed

51 A racing car of mass 500 kg, including driver but not fuel, decelerates from a speed of 50 m s-1 to 30 m s-1 when approaching a bend.

The brakes exert a fixed retarding force of 7000 N. The time for the car to decelerate when it is almost out of fuel is t1. The time for it to decelerate when it has a full load of 130 kg of fuel is t2.

What is the difference (t2 - t1) in the two timings?

A 0.37 s **B** 0.56 s **C** 0.93 s **D** 1.43 s

52 A force of 25 N pushes an object of mass 2.0 kg along a rough horizontal surface with an acceleration of 4.0 m s-2. What is the magnitude of the frictional force acting on the object?

A 6.3 N

B 8.0 N

C 17 N

D 25 N

53 Which of the statements about inertia is true?

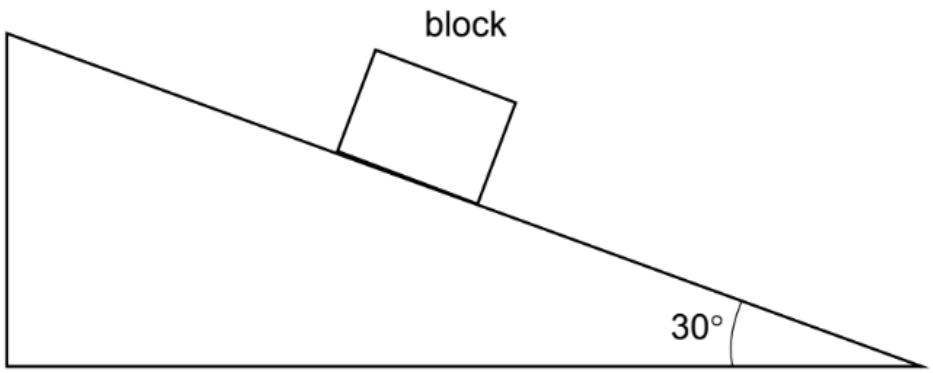
A Inertia is a force that keeps a body moving at constant velocity.

B Inertia is a force that prevents a stationary body from moving.

C Inertia opposes motion and slows down a moving body.

D Inertia is not affected even when a body is in a vacuum.

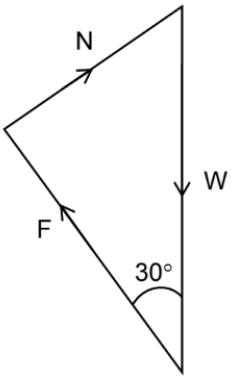
54 A stationary block rests on a ramp as shown.



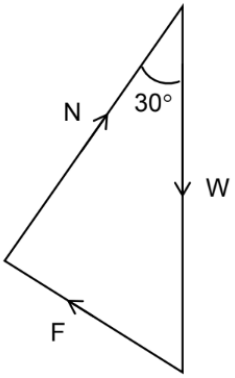
Three forces act on the block, its weight W, the normal contact force N and the frictional force long the slope F.

Which diagram represents the three forces correctly?

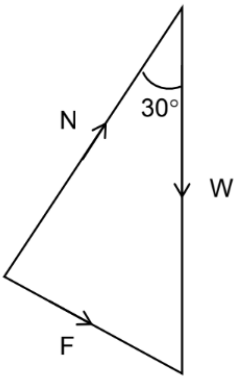
A



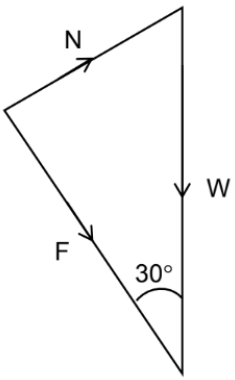
B



C



D



DYNAMICS STRUCTURED QUESTIONS

1 A uniform plank of weight 50 N is held stationary by a force, F, applied horizontally to the left as shown in Fig. 2.1. The plank is held in an inclined position with one end, P, on a rough ground.

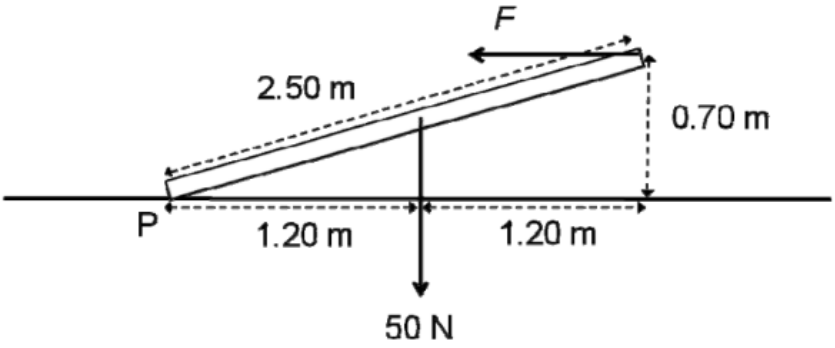


Fig. 2.1

(a) Calculate the moment due to the weight of the plank about the point, P.

moment due to weight = ... [1]

(b) Calculate the gain in gravitational potential energy of the plank when it is lifted from the inclined position in Fig. 2.1 to the vertical position in Fig. 2.2.

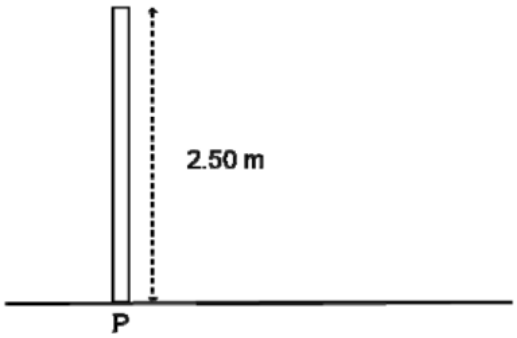


Fig. 2.2

gain in gravitational potential energy = ... [2]

2 Boat X is being pulled by two tow boats. Fig. 14.1 shows the top view of the boats.

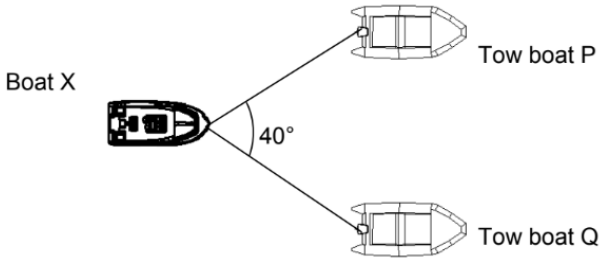


Fig. 14.1

The tension in the two ropes used by the two tow boats are of equal magnitude. It is known that the magnitude of tension is 800 N.

(a) Boat X is towed from rest. As the speed of boat X increases, the magnitude of the drag force acting on it increases. The speed of boat X increases until it reaches a maximum speed.

(i) Explain why boat X reaches a maximum speed.

.....

.....

.....

..... [2]

(ii) In the space below, draw the free body diagram of boat X when it is travelling at maximum speed. Label all the forces clearly. [2]

(iii) By drawing a scaled vector diagram, determine the magnitude of the drag force when boat X is travelling at maximum speed.

magnitude of drag force = ... [4]

(b) Boat X continues moving at its maximum speed of 8.0 m s-1 for 5.0 s.

Calculate the total power developed by the tow boats over that 5.0 s.

total power developed = ... [2]

3 Fig. 16.1 shows two boxes, A and B, each of mass 1.8 kg, tied together by an inextensible string hung across a frictionless pulley. Treat all surfaces as frictionless.

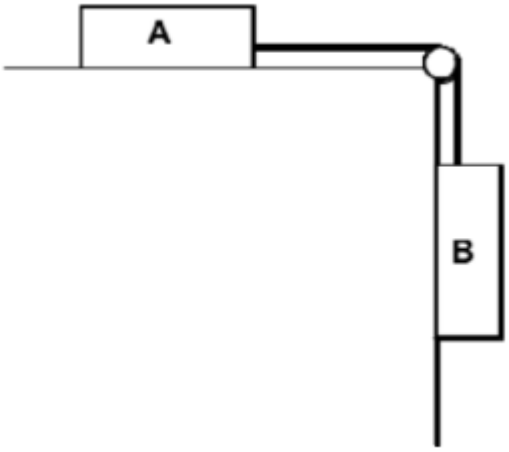


Fig. 16.1

The system is then released. B starts to fall, pulling A along.

(a) Determine an expression for net force acting on A, in terms of T, the tension in the string.

net force acting on A = ... [1]

(b) Determine an expression for the acceleration of A, in terms of T.

acceleration of A = ... [1]

(c) Determine an expression for the downward acceleration of B, in terms of T.

acceleration of B = ... [1]

(d) Calculate the tension in the string, T.

tension in the string = ... [2]

4 Fig. 10 shows a truck moving to the left along a straight road. The air resistance acting on the truck and the weight of the truck have been marked for you.

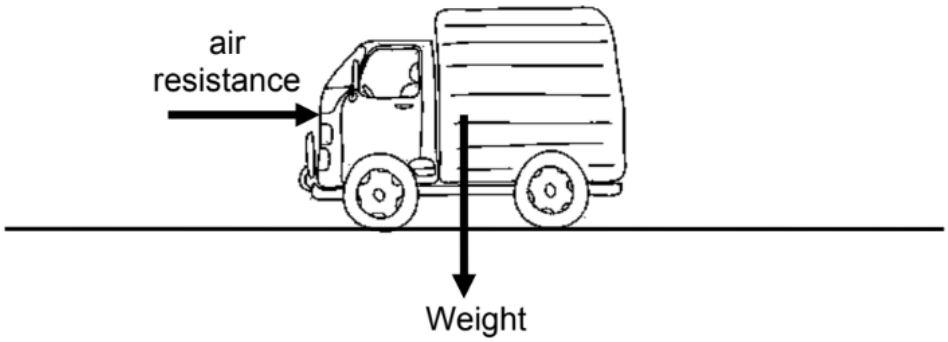


Fig. 10

(a) If the front wheels of the truck are driven by the engine, mark and label on Fig. 10 above, the other forces acting on the front and back wheels. [3]

(b) The table below shows some information on the 4500 kg truck.

	With a load of 1200 kg	With a load of 600 kg
Maximum speed / m s^{-1}	18.5	18.5
Initial acceleration / m s^{-2}	1.97	2.20

(i) Calculate the initial net force on the truck with a load of 1200 kg.

net force = ... [2]

(ii) When the load on the truck is halved from 1200 kg to 600 kg, the initial acceleration of the truck increases slightly. Explain why the acceleration increases but does not increase by two times.

.....

.....

.....

.....

..... [2]

(iii) Describe the motion of the moving truck when net force on it is zero.

.....

.....

..... [1]

(iv) Calculate the kinetic energy of the truck carrying the load of 1200 kg when travelling along a straight road at maximum speed.

kinetic energy = ... [2]

5 A horizontal force *F* pulls a cart towards the right. A pendulum bob of mass 0.70 kgis hanging from a retort stand on the cart. As the cart moves, the pendulum remains tilted at an angle of 20° to the vertical as shown in Fig. 1.1.

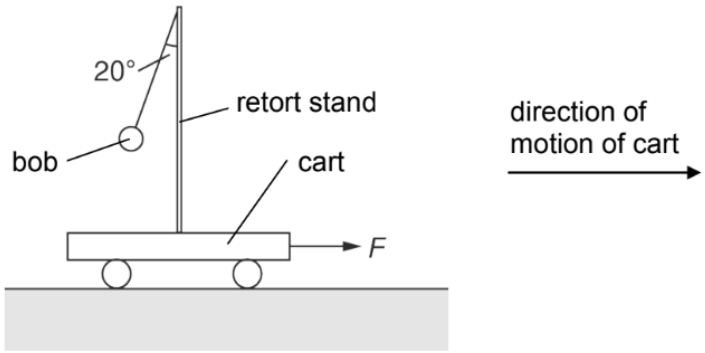


Fig. 1.1

(a) Draw a free body diagram and clearly label the forces acting on the pendulum bob. [2]

bob ○

(b) By drawing a scaled diagram or otherwise, determine the net force on the pendulum bob when it is moving horizontally towards the right.

net force = ... [2]

(c) Hence, calculate the acceleration of the pendulum bob.

acceleration = ... [2]

5 A spring balance is attached to the ceiling of a lift, with a book of 1.0 kg hung from the spring balance. The lift then moves to the ground floor from the tenth floor.

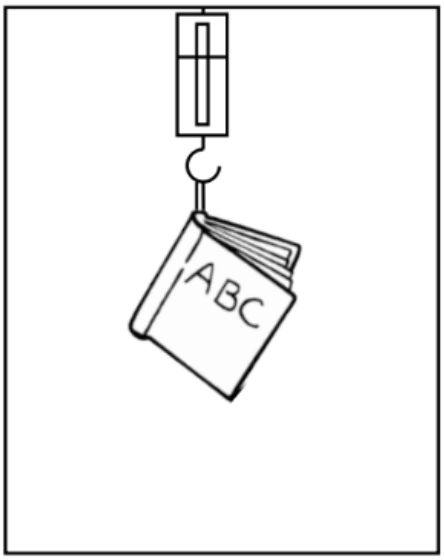


Fig. 2.1

Book is retrieved from http://www.imgion.com/images/01/book-of-basic-back-to-school.gif

Determine the reading on the balance (in newtons) when

(a) the lift is travelling up at a constant speed;

reading on balance = ... [1]

(b) the lift is travelling down with an acceleration of 1.5 m s^{-2}.

reading on balance = ... [2]

6 (a) The figures below show two ways of hanging a picture frame on a wall. The weight of the picture frame is 80 N.

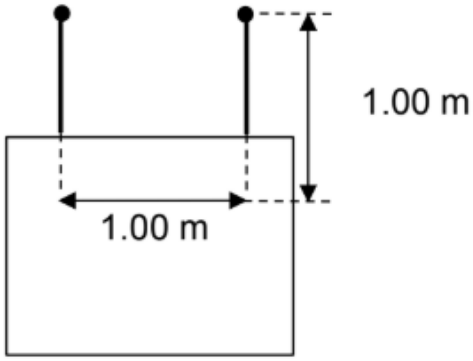


Fig. 11.1

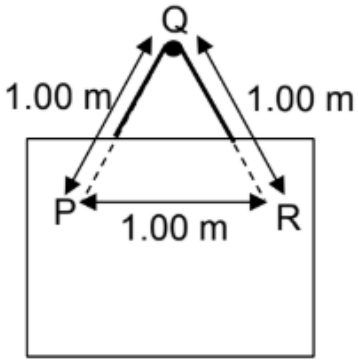


Fig. 11.2

In Fig. 11.1, the frame is hung from two identical vertical cords, each of length 1.00 m and placed 1.00 m apart.

In Fig. 11.2, a similar cord of length 2.00 m (from P to Q to R) is used to suspend the frame from a single point Q.

(i) Calculate the tension in each cord in Fig. 11.1.

tension = ... [1]

(ii) Draw a labelled scaled diagram to determine the tension of the cord in Fig. 11.2.

tension = ...[4]

(b) A man of mass 60 kg enters a lift of mass 800 kg and steps onto a weighing scale.

Determine the reading on the weighing scale in newtons if

(i) the lift is moving upwards with an acceleration of 1.0 m s-2

reading on weighing scale = ...N [2]

(ii) the lift is moving upwards with a deceleration of 2.0 m s-2

reading on weighing scale = ...N [2]

(iii) the cable of the lift snaps, causing the lift to undergo free fall (accelerating downwards at 10 m s-2).

reading on weighing scale = ...N [1]

7 Bales of wool are to be lifted onto a 2.0 m high platform. Two methods of moving the bales of wool are shown in Fig. 10.1.

They are pulled up a 6.0 m long rough inclined ramp with a force X or they are lifted vertically onto the platform with a force Y.

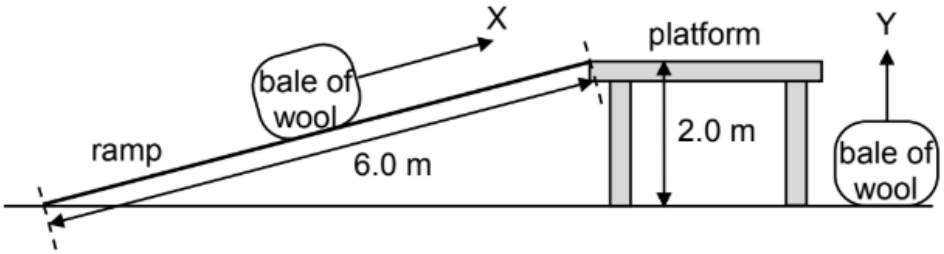


Fig. 10.1

(a) Fig. 10.2 shows a bale of wool resting on the ramp without the force X.

Draw and label the forces acting on the bale. [3]

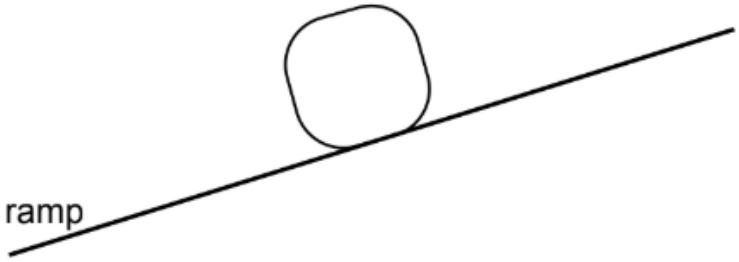


Fig. 10.2

(b) The bales of wool have a mass of 120 kg each. The force X used to pull each bale up along the ramp at a constant speed is 550 N.

The frictional force acting between the ramp and a bale of wool is 150 N.

(i) Calculate the minimum magnitude of force Y required to lift a bale of wool.

minimum magnitude of Y = ... [1]

(ii) Calculate the work done against friction along the ramp.

work done against friction = ... [2]

(c) Two suggestions were made to move the bales of wool up the ramp differently.

For each suggestion, explain clearly if the suggestion will reduce the amount of work required to move a bale of wool onto the same platform using the ramp.

(i) Suggestion 1:

Pull up each bale of wool on one corner of the bale, as shown in Fig. 10.3 to reduce the contact surface area between the bale and the ramp.

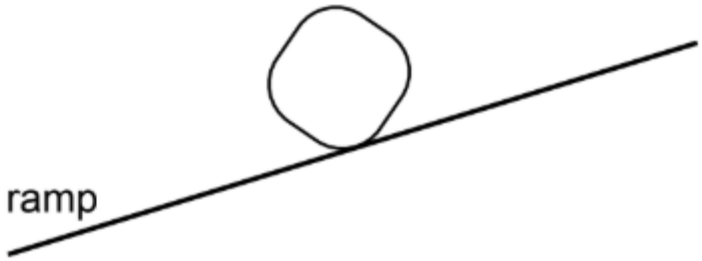


Fig. 10.3

.....

.....

.....

..... [2]

(ii) Suggestion 2:

Pull each bale of wool onto the same platform using a shorter ramp, such that the slope is steeper.

.....

.....

.....

..... [2]

8 A man in a lift stands on a balance to measure his own weight as shown in Fig. 2.1. Under different conditions, he finds that his weight W is not always equal to the supporting force R acting on him (shown by the reading on the balance).

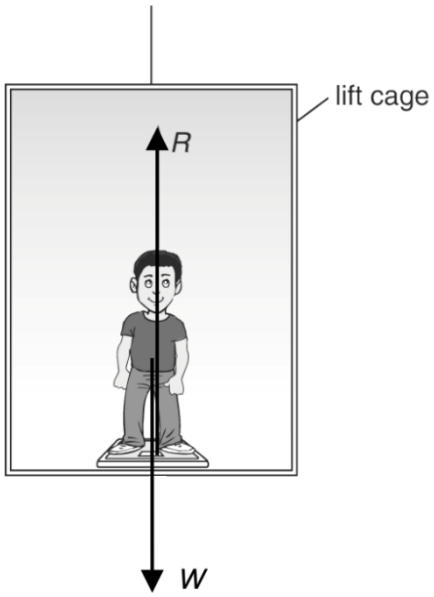


Fig. 2.1

(a) Determine the magnitude of the acceleration of the lift if the supporting force R on the man is 1.1 times his weight W.

acceleration = ... [2]

(b) Later, he notices that the supporting force R on him is 0.8 times his weight W.

Determine the magnitude and direction of the acceleration of the lift.

acceleration = ... [1]

direction = ... [1]

(c) If he notices that his weight W is equal to the supporting force R, suggest the state of motion of the lift.

.....

.....

..... [1]

9 An object is held in place by strings as shown in Fig 2.1 (not drawn to scale). If the tension in string 1 is 18 N and the mass of the object is 2.6 kg.

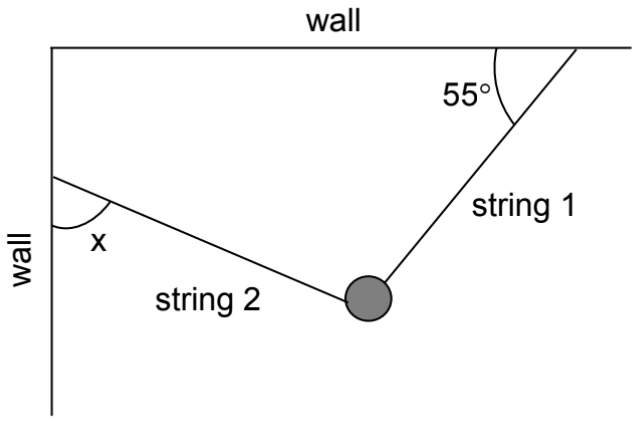


Fig 2.1

(a) Determine the weight of the object.

weight of object = ... [1]

(b) Find the magnitude of the tension in string 2 and the angle x by drawing a scaled vector diagram in the space below. State the scale used and label your diagram clearly.

scale used: .....

tension in string 2 = ...; angle x = ... [4]

10 Fig. 10.1 shows a box sliding down a hill with two different slopes. It is observed that when the box reaches the gentler slope, the acceleration of the box is always zero.

(a) On Fig.10.1, indicate the forces acting on the box and label each force clearly.

[1]

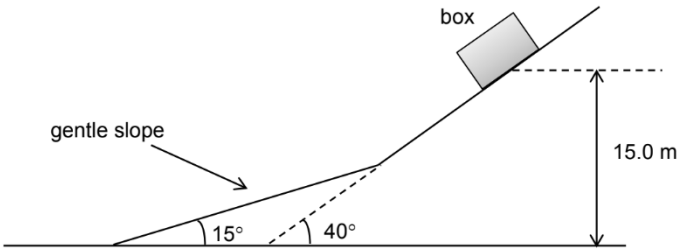


Fig. 10.1

(b) Explain why there is no acceleration when the box reaches the gentle slope.

.....

.....

.....

..... [1]

(c) If the gentle slope makes an angle of 15° with the ground and mass of the box is 8.0 kg, calculate the resistive force acting on the box along the gentle slope.

resistive force = ...[2]

(d) If the steeper slope makes an angle of 40° with the ground and the box experiences an acceleration of 3.0 m s-2 along this slope, calculate the resistive force acting on the box along this slope.

resistive force = ...[2]

(e) Calculate the gravitational potential energy that the box possesses at the height of 15.0 m above the ground.

gravitational potential energy = ...[1]

(f) If work done against friction as the box moved down the hill is 900 J, determine the speed at which the box will reach the ground.

speed of box = ...[2]

11 Fig. 1.1 shows a 8.0 kg rectangular block that rests on a rough horizontal surface. It is under the action of a horizontal force F that varies with time as shown in the graph in Fig. 1.2.

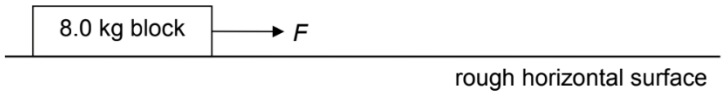


Fig. 1.1

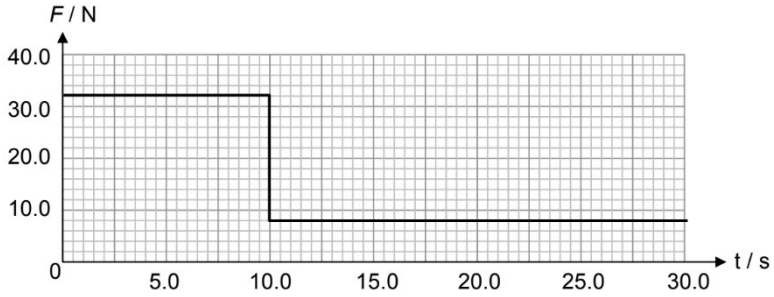


Fig. 1.2

(a) If the block is moving at a constant velocity of 12 m s-1 for the first 10.0 s,

(i) state the net force acting on the block, and

net force = ... [1]

(ii) determine the frictional force acting on the block.

frictional force = ... [1]

(b) Describe in detail the motion of the block from 10.0 s onwards. Show calculations for any values stated.

.....

.....

.....

.....

.....

..... [3]

12 A car accelerates to the right. A pendulum bob of mass 600 g is hanging from the roof of the car on a 20 cm string. As the car moves, the pendulum remains tilted at an angle of 25° to the vertical as shown in Fig. 10.1.

Fig. 10.1

(a) Draw a free body diagram and clearly label the forces acting on the pendulum bob. [2]

bob ○

(b) By drawing a scaled diagram, or otherwise, determine the magnitude of the net force on the pendulum bob when the car is accelerating horizontally towards the right, as shown in Fig. 10.1,

scale .....

net force = ... [3]

(c) Hence, calculate the acceleration of the pendulum bob.

acceleration = ... [2]

(d) If the pendulum string had been increased from 20 cm to 40 cm in length and the acceleration of the car had remained the same, explain how the angle the pendulum makes with the vertical would be different (if at all) from that shown in Fig. 10.1.

.....

.....

..... [1]

(e) Later, a passenger in the car observes the pendulum bob hanging vertically down.

State one possible state of motion of the car at this instant. Explain your answer clearly.

.....

.....

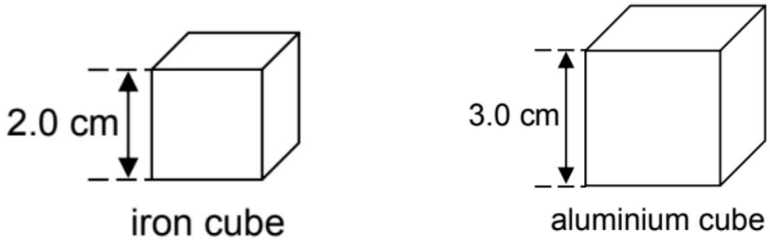
.....

..... [2]

13 Fig. 3.1 shows an iron cube and an aluminium cube.

The iron cube, of length 2.0 cm, has a density of 7.9 g cm-3. The aluminium cube, of length 3.0 cm, has a density of 2.7 g cm-3.

Fig. 3.1



The two cubes are melted to form an alloy. Calculate the density of this alloy.

density of alloy = ... [2].

DYNAMICS PRACTICAL QUESTIONS

1 The Earth is located 1.50×10^{11} m from the Sun as shown in Fig. 1.1.

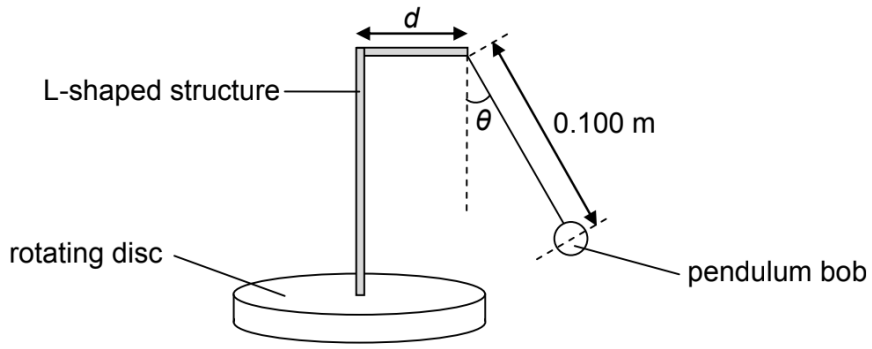


Fig. 2.1

At point Z, the resultant gravitational field strength from the Earth and the Sun is zero.

(a) If Z is 2.59×10^{8} m from the Earth, determine the mass of the Sun. Take the mass of the Earth to be 5.97×10^{24} kg.

mass of the Sun ..... [ ]

(b) Ignoring the rotational motion between the Sun and the Earth, state and explain what would happen to a point mass if it is brought to point Z and released at rest.

.....

.....

.....[2]

(c) Suppose the mass of the pendulum bob increases, but the disc continues to rotate at the same speed. State if θ will increase, decrease or remain constant.

.....[1]

2 A truck runs into the back of a car of mass 1500 kg. The car experiences a constant force of 5.5×10^4 N that acts for 0.20 s.

(a) If the car is initially at rest, determine the magnitude of its final velocity after 0.20 s.

final velocity …… [2]

(b) By considering the concept of impulse, explain how the use of seat belts ensures greater safety for the passengers in the car.

.....

.....

.....[2]

ANSWERS FOR DYNAMICS MCQ

Q1: B	Q11: D	Q21: D	Q31: C	Q41: A	Q51: A
Q2: B	Q12: C	Q22: C	Q32: B	Q42: B	Q52: C
Q3: C	Q13: C	Q23: A	Q33: A	Q43: C	Q53: D
Q4: D	Q14: A	Q24: B	Q34: C	Q44: B	Q54: B
Q5: B	Q15: B	Q25: B	Q35: D	Q45: D	
Q6: C	Q16: D	Q26: D	Q36: A	Q46: B	
Q7: B	Q17: D	Q27: B	Q37: D	Q47: D	
Q8: C	Q18: A	Q28: B	Q38: B	Q48: C	
Q9: D	Q19: A	Q29: D	Q39: A	Q49: D	
Q10: C	Q20: B	Q30: B	Q40: B	Q50: C	

ANSWERS FOR DYNAMICS STRUCTURED QUESTIONS

1 A uniform plank of weight 50 N is held stationary by a force, F, applied horizontally to the left as shown in Fig. 2.1. The plank is held in an inclined position with one end, P, on a rough ground.

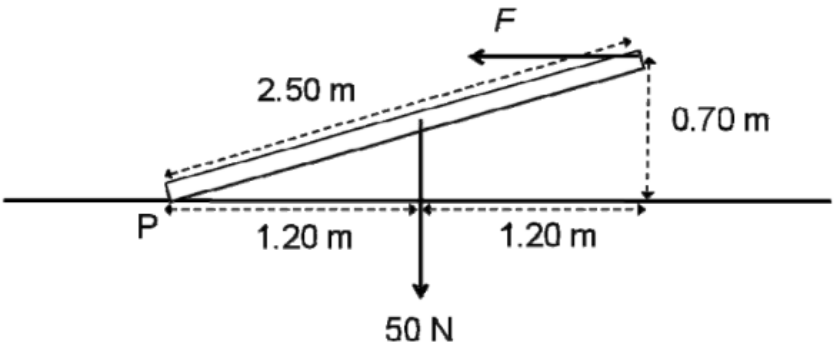


Fig. 2.1

(a) Calculate the moment due to the weight of the plank about the point, P.

1.20 x 50 = 60 Nm

moment due to weight = 60 Nm [1]

(b) Calculate the gain in gravitational potential energy of the plank when it is lifted from the inclined position in Fig. 2.1 to the vertical position in Fig. 2.2.

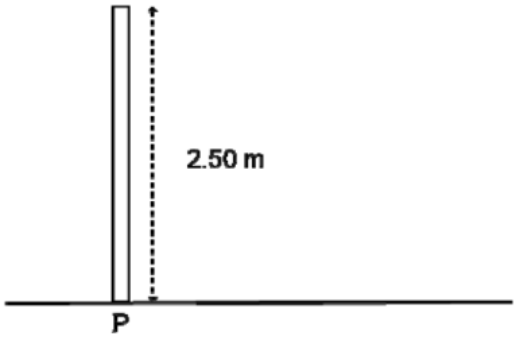


Fig. 2.2

gain in gravitational potential energy = mg (1.25 – 0.35) [1]

Award 1 mark for any correct

= 45 J [1] height (1.25 m or 0.35 m) [2]

2 Boat X is being pulled by two tow boats. Fig. 14.1 shows the top view of the boats.

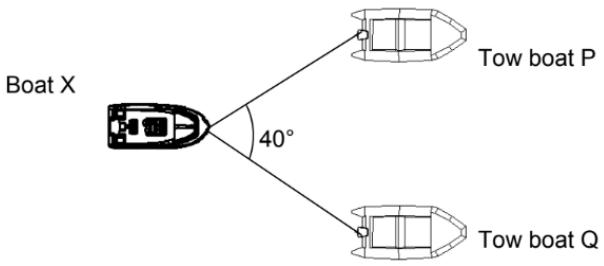


Fig. 14.1

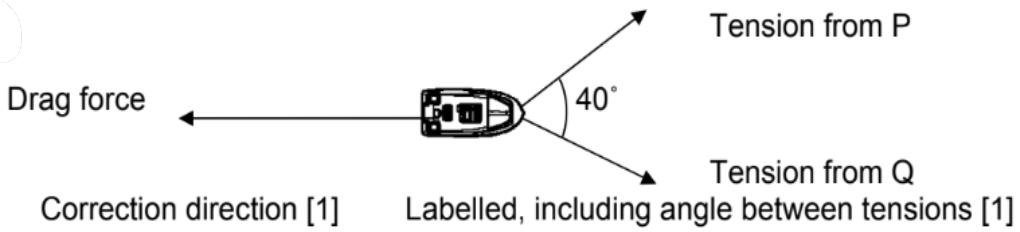
The tension in the two ropes used by the two tow boats are of equal magnitude. It is known that the magnitude of tension is 800 N.

(a) Boat X is towed from rest. As the speed of boat X increases, the magnitude of the drag force acting on it increases. The speed of boat X increases until it reaches a maximum speed.

(i) Explain why boat X reaches a maximum speed.

At the start, a net force acts on boat X, causing it to accelerate. The drag force then continues to increases until a point where it balances the combined tension force from the tow boats [1]. At this point, there is no net force acting on boat X. Thus, boat X stops accelerating [1] and the speed of boat X remains constant. [2]

(ii) In the space below, draw the free body diagram of boat X when it is travelling at maximum speed. Label all the forces clearly. [2]



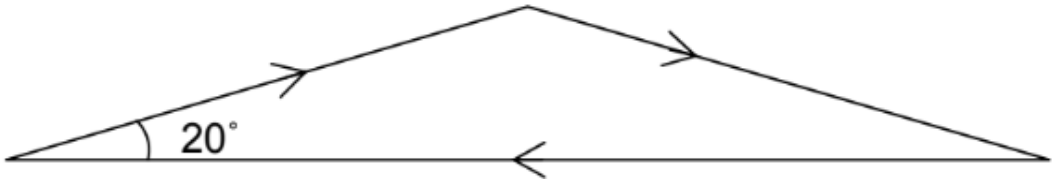
(iii) By drawing a scaled vector diagram, determine the magnitude of the drag force when boat X is travelling at maximum speed.

scale: 1 cm represents 100 N [1]

Closed triangle (arrows pointing in one direction) [1]

Forces and angle (20˚) correctly labelled [1]

magnitude of drag force = . 1450 N to 1550 N [1] [4]



(b) Boat X continues moving at its maximum speed of 8.0 m s-1 for 5.0 s.

Calculate the total power developed by the tow boats over that 5.0 s.

distance travelled in 5.0 s = 8.0 x 5.0 = 40 m

Work done by boats = (answer in a(iii) x 40 m) = 1500 x 40

= 60 000 J [1]

Power developed = 60 000 / 5.0 = 12 000 W [1] [2]

3 Fig. 16.1 shows two boxes, A and B, each of mass 1.8 kg, tied together by an inextensible string hung across a frictionless pulley. Treat all surfaces as frictionless.

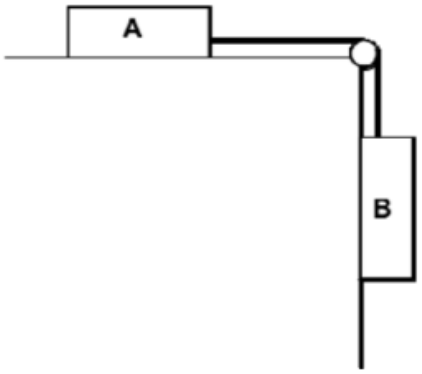


Fig. 16.1

The system is then released. B starts to fall, pulling A along.

(a) Determine an expression for net force acting on A, in terms of T, the tension in the string.

net force acting on A = T [1]

(b) Determine an expression for the acceleration of A, in terms of T.

acceleration of A = $\frac{T}{1.8}$ [1]

(c) Determine an expression for the downward acceleration of B, in terms of T.

acceleration of B = $\frac{18-T}{1.8}$ [1]

(d) Calculate the tension in the string, T.

$\frac{18-T}{1.8} = \frac{T}{1.8}$

T = 9

Therefore, tension in the string = 9.0 N

OR

Net force acting on both masses (considered one system)

= weight of B = 18 N

Acceleration of A = 18 N / (3.6 kg) = 5.0 m/s2

Therefore, tension in the string = 9.0 N [2]

4 Fig. 10 shows a truck moving to the left along a straight road. The air resistance acting on the truck and the weight of the truck have been marked for you.

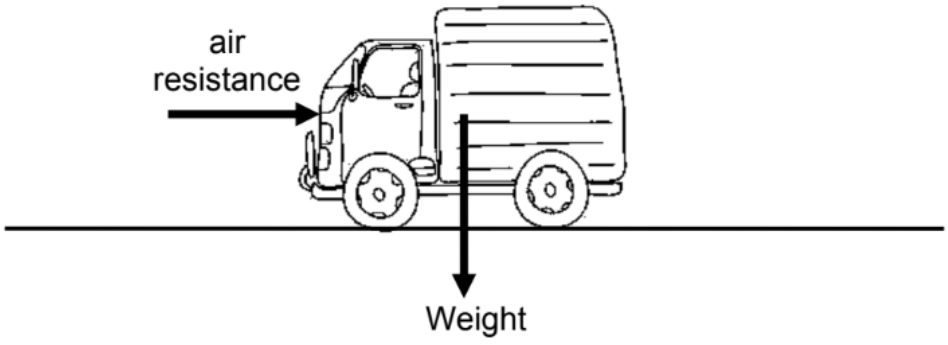


Fig. 10

(a) If the front wheels of the truck are driven by the engine, mark and label on Fig. 10 above, the other forces acting on the front and back wheels. [3]

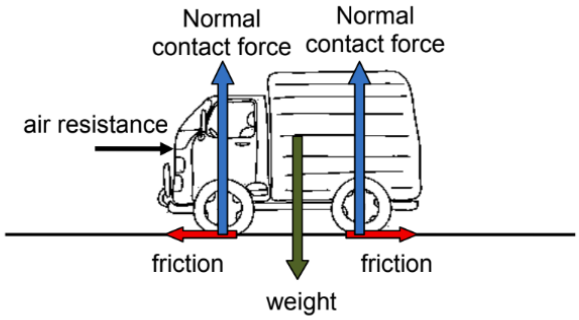


Fig. 12.1

- *Friction on front wheels acts to the left*
- *Friction on back wheels to the right*
- *Normal contact forces – acceptable if only one arrow or 2 arrows are used.*

(b) The table below shows some information on the 4500 kg truck.

	With a load of 1200 kg	With a load of 600 kg
Maximum speed / m s^{-1}	18.5	18.5
Initial acceleration / m s^{-2}	1.97	2.20

(i) Calculate the initial net force on the truck with a load of 1200 kg.

Initial Net Force = ma = (4500 +1200) 1.97 = 11229 N = 11200 N (3sf)

[2]

(ii) When the load on the truck is halved from 1200 kg to 600 kg, the initial acceleration of the truck increases slightly. Explain why the acceleration increases but does not increase by two times.

Even though the load is halved, the total mass of the truck is not halved.

The total mass is only reduced by 600 kg from 5700 kg to 5100 kg.

Based on F = ma; for the same resultant force since 5100 kg is not half of 5700 kg, the acceleration will only increase slightly and not increase by two times.

[2]

(iii) Describe the motion of the moving truck when net force on it is zero.

When net force is zero, the truck will be moving at constant velocity.

[1]

(iv) Calculate the kinetic energy of the truck carrying the load of 1200 kg when travelling along a straight road at maximum speed.

KE = ½ m v2

= 0.5 x 5700 x 18.52 = 975412.5 J = 975 kJ (3 sf)

[2]

5 A horizontal force *F* pulls a cart towards the right. A pendulum bob of mass 0.70 kgis hanging from a retort stand on the cart. As the cart moves, the pendulum remains tilted at an angle of 20° to the vertical as shown in Fig. 1.1.

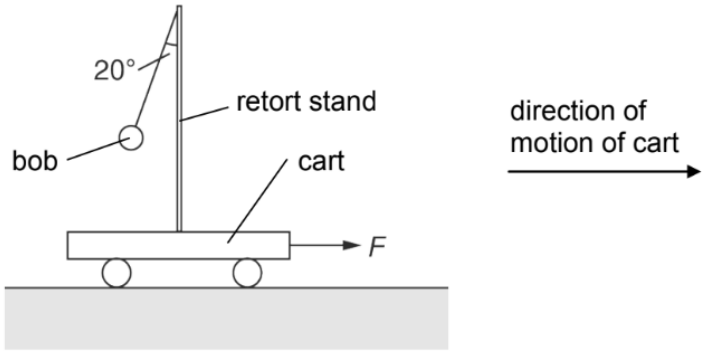
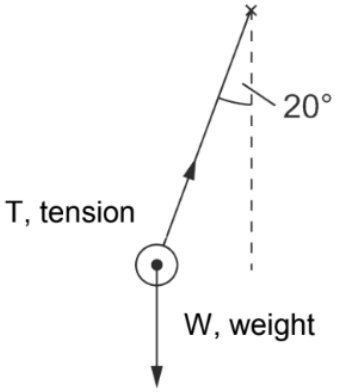
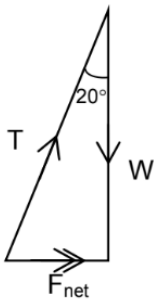


Fig. 1.1

(a) Draw a free body diagram and clearly label the forces acting on the pendulum bob. [2]



(b) By drawing a scaled diagram or otherwise, determine the net force on the pendulum bob when it is moving horizontally towards the right.



Fnet / W = tan 20°

Fnet = mg tan 20° = 0.70 x 10 tan 20°

= 2.548 ≈ 2.5 N [2]

(c) Hence, calculate the acceleration of the pendulum bob.

$F_{net} = ma$ $a = F_{net} / m = 2.548 / 0.7$

$= 3.640 \approx \underline{3.6\ m\ s^{-2}}$ [2]

5 A spring balance is attached to the ceiling of a lift, with a book of 1.0 kg hung from the spring balance. The lift then moves to the ground floor from the tenth floor.

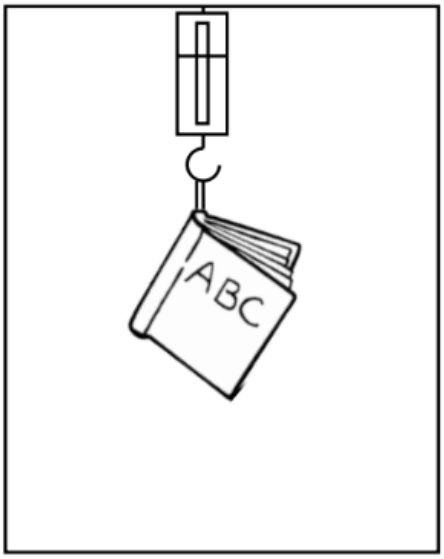


Fig. 2.1

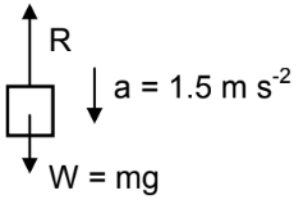
Book is retrieved from http://www.imgion.com/images/01/book-of-basic-back-to-school.gif

Determine the reading on the balance (in newtons) when

(a) the lift is travelling up at a constant speed;

Fnet = 0, so reading of balance R = W = mg = 10 N [1]

(b) the lift is travelling down with an acceleration of 1.5 m s^{-2}.



$F_{net} = ma$ ➔ $W - R = ma$

$(1)(10) - R = 1.5\ m\ s^{-2}$

$R = 10 - 1.5 = \underline{8.5\ N}$

[2]

6 (a) The figures below show two ways of hanging a picture frame on a wall. The weight of the picture frame is 80 N.

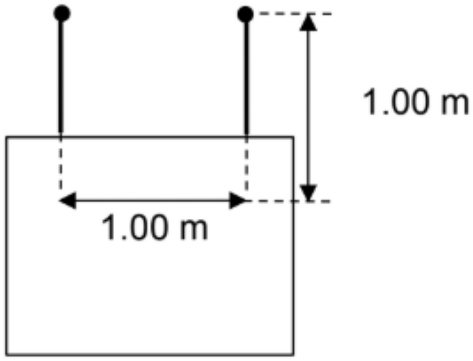


Fig. 11.1

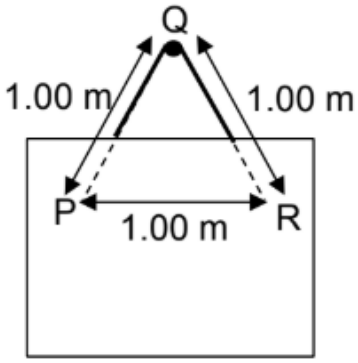


Fig. 11.2

In Fig. 11.1, the frame is hung from two identical vertical cords, each of length 1.00 m and placed 1.00 m apart.

In Fig. 11.2, a similar cord of length 2.00 m (from P to Q to R) is used to suspend the frame from a single point Q.

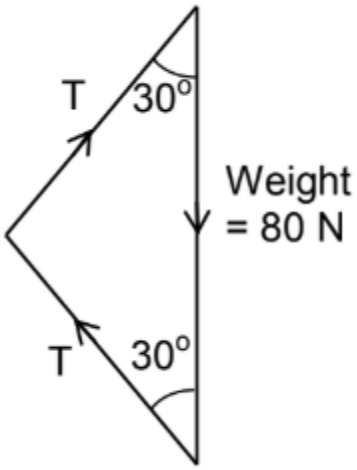
(i) Calculate the tension in each cord in Fig. 11.1.

tension = 80 ÷ 2 = 40 N

[1]

(ii) Draw a labelled scaled diagram to determine the tension of the cord in Fig. 11.2.

Suitable scale (1.0 cm:10 N)



Tension = 46 N ± 2 N

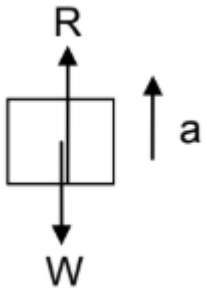
[4]

(b) A man of mass 60 kg enters a lift of mass 800 kg and steps onto a weighing scale.

Determine the reading on the weighing scale in newtons if

(i) the lift is moving upwards with an acceleration of 1.0 m s-2

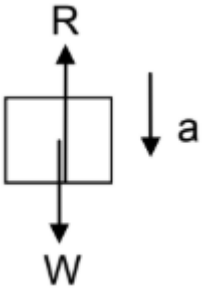
Take upwards as positive.



Net force = ma = (60.0)(1.0) = 60.0 N (upwards)
R – W = net force
Reading on weighing scale, R = mg + ma
= 600 + 60 = 660 N [2]

(ii) the lift is moving upwards with a deceleration of 2.0 m s-2

Net force = ma = (60.0)(-2.0) = -120.0 N (downwards)
R – W = net force
Reading on weighing scale R = mg – ma
= 600 – 120 = 480 N



[2]

(iii) the cable of the lift snaps, causing the lift to undergo free fall (accelerating downwards at 10 m s-2).

reading on weighing scale = 0 N [1]

7 Bales of wool are to be lifted onto a 2.0 m high platform. Two methods of moving the bales of wool are shown in Fig. 10.1.

They are pulled up a 6.0 m long rough inclined ramp with a force X or they are lifted vertically onto the platform with a force Y.

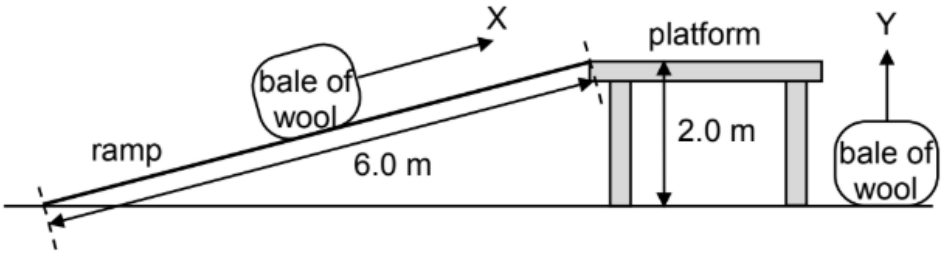
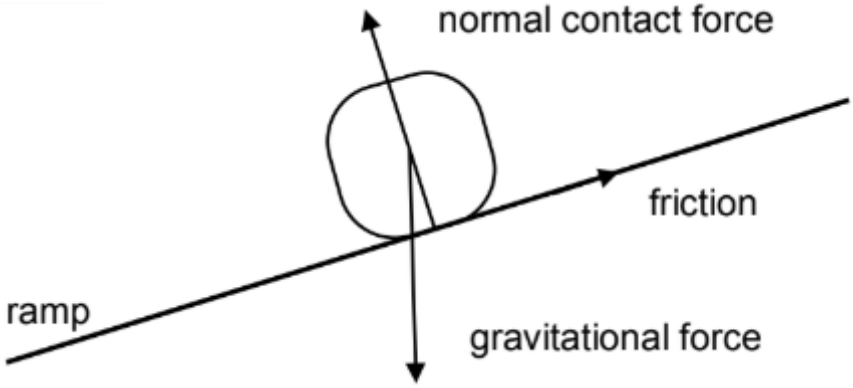


Fig. 10.1

(a) Fig. 10.2 shows a bale of wool resting on the ramp without the force X.

Draw and label the forces acting on the bale. [3]

½ mark can be awarded for each correct force arrow if named incorrectly.
Round down to nearest mark.



(b) The bales of wool have a mass of 120 kg each. The force X used to pull each bale up along the ramp at a constant speed is 550 N.

The frictional force acting between the ramp and a bale of wool is 150 N.

(i) Calculate the minimum magnitude of force Y required to lift a bale of wool.

W = mg = 120 x 10 = 1200 N

minimum magnitude of Y = ... [1]

(iv) Calculate the work done against friction along the ramp.

work done = F x d = 150 x 6.0

= 900 J [2]

(c) Two suggestions were made to move the bales of wool up the ramp differently.

For each suggestion, explain clearly if the suggestion will reduce the amount of work required to move a bale of wool onto the same platform using the ramp.

(i) Suggestion 1:

Pull up each bale of wool on one corner of the bale, as shown in Fig. 10.3 to reduce the contact surface area between the bale and the ramp.

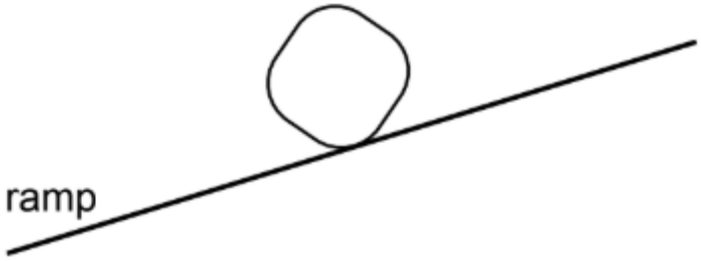


Fig. 10.3

Friction is independent of area of contact, so no change in force.

Since distance moved is unchanged, then amount of work remains unchanged.

[2]

(ii) Suggestion 2:

Pull each bale of wool onto the same platform using a shorter ramp, such that the slope is steeper.

The bale gains the same amount of GPE, but friction will act for a shorter distance / less work done against friction.

Hence there is less work done. [2]

8 A man in a lift stands on a balance to measure his own weight as shown in Fig. 2.1. Under different conditions, he finds that his weight W is not always equal to the supporting force R acting on him (shown by the reading on the balance).

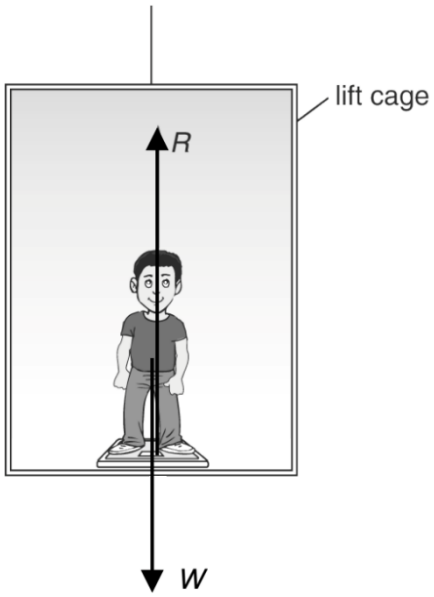


Fig. 2.1

(a) Determine the magnitude of the acceleration of the lift if the supporting force R on the man is 1.1 times his weight W.

W = mg = m(10)

F = ma, upwards is positive

R – W = ma → 1.1W – W = ma → a = 0.1W / m = 0.1(g) [1] a = 1.0 m s^{-2} [1]

[2]

(b) Later, he notices that the supporting force R on him is 0.8 times his weight W.

Determine the magnitude and direction of the acceleration of the lift.

R – W = ma → 0.8W – W = ma → a = - 0.2W / m = - 0.2(10) [1]

a = - 2.0 m s^{-2} acceleration is 2.0 m s^{-2} in the downward direction. [1]

(c) If he notices that his weight W is equal to the supporting force R, suggest the state of motion of the lift.

The lift may be stationary or / and moving (upwards or downwards) with constant velocity. [1]. [1]

9 An object is held in place by strings as shown in Fig 2.1 (not drawn to scale). If the tension in string 1 is 18 N and the mass of the object is 2.6 kg.

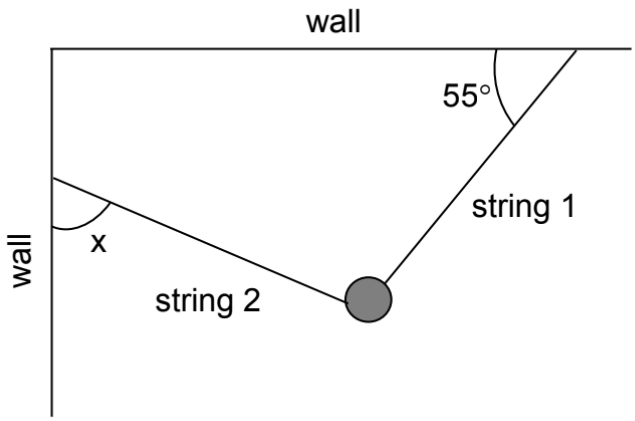


Fig 2.1

(a) Determine the weight of the object.

W = mg = 2.6 × 10 = 26 N (working must be presented to earn the mark)

[1]

(b) Find the magnitude of the tension in string 2 and the angle x by drawing a scaled vector diagram in the space below. State the scale used and label your diagram clearly.

Scale: 1.0 cm represents 5.0 N [includes proper labelling]

Three forces drawn with correct magnitude, correct angles, labelling and arrows in correct direction

Tension in string 2 as (15 ± 1) N Angle as (43 ± 1) ° correct precision of the protractor must be reflected

Mark for tension and angle is only awarded if diagram is correct.

[4]

10 Fig. 10.1 shows a box sliding down a hill with two different slopes. It is observed that when the box reaches the gentler slope, the acceleration of the box is always zero.

(a) On Fig.10.1, indicate the forces acting on the box and label each force clearly. [1]

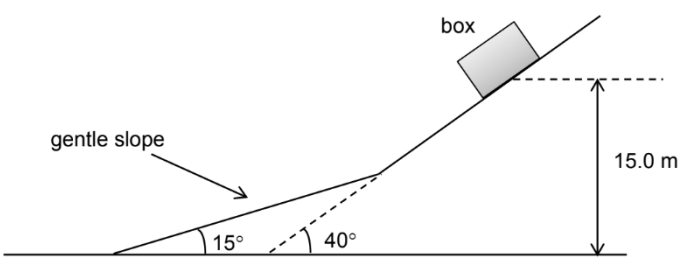
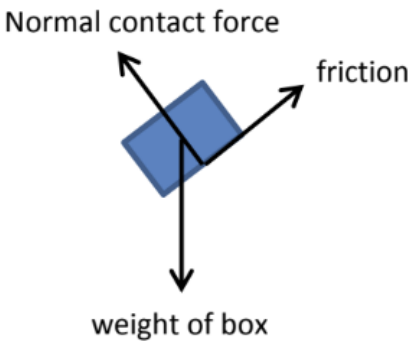


Fig. 10.1



(b) Explain why there is no acceleration when the box reaches the gentle slope.

Friction is balanced by mg sin 15 (or the component of the weight that is parallel to the slope) [1]

(c) If the gentle slope makes an angle of 15° with the ground and mass of the box is 8.0 kg, calculate the resistive force acting on the box along the gentle slope.

Resistive force = friction = mg sin 15 = 80 (sin 15) = 20.7 N 2 [2]

(d) If the steeper slope makes an angle of 40° with the ground and the box experiences an acceleration of 3.0 m s-2 along this slope, calculate the resistive force acting on the box along this slope.

F = ma

80 sin 40 - R = 8(3)

R = 27.4 N [2]

(e) Calculate the gravitational potential energy that the box possesses at the height of 15.0 m above the ground.

Gravitational potential energy = mgh = 80 (15) = 1200 J 1 [1]

(f) If work done against friction as the box moved down the hill is 900 J, determine the speed at which the box will reach the ground.

GPE = KE + WD against friction

KE = 300 = ½ (8)v2

v = 8.7 m s-1 or 8.66 m s-1

Reject 8.6 m s-1 or 8.70 m s-1 [2]

11 Fig. 1.1 shows a 8.0 kg rectangular block that rests on a rough horizontal surface. It is under the action of a horizontal force F that varies with time as shown in the graph in Fig. 1.2.

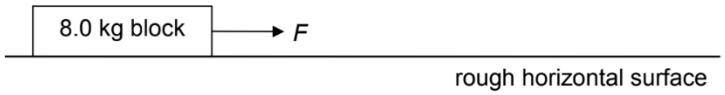


Fig. 1.1

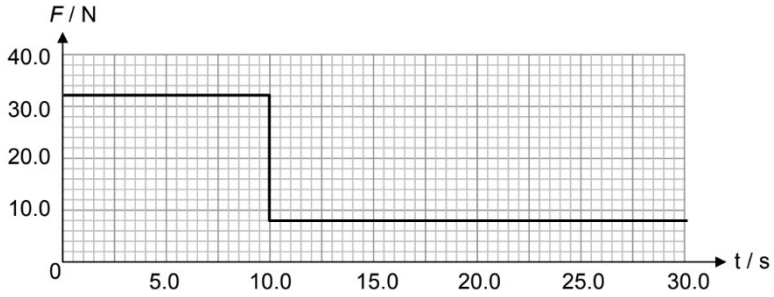


Fig. 1.2

(a) If the block is moving at a constant velocity of 12 m s-1 for the first 10.0 s,

(i) state the net force acting on the block, and

net force = 0 N [1]

(ii) determine the frictional force acting on the block.

frictional force = 32.0 N [1]

(b) Describe in detail the motion of the block from 10.0 s onwards. Show calculations for any values stated.

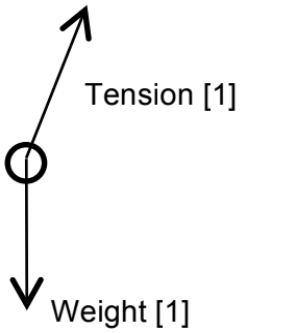
decelerates constantly at 3 m/s^2 coming to a rest at t=14.0 s (after 4.0 s)

Subsequently it remains at rest. [3]

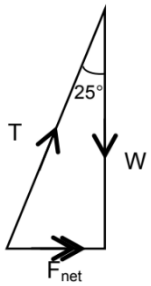
12 A car accelerates to the right. A pendulum bob of mass 600 g is hanging from the roof of the car on a 20 cm string. As the car moves, the pendulum remains tilted at an angle of 25° to the vertical as shown in Fig. 10.1.

Fig. 10.1

(a) Draw a free body diagram and clearly label the forces acting on the pendulum bob. [2]



(b) By drawing a scaled diagram, or otherwise, determine the magnitude of the net force on the pendulum bob when the car is accelerating horizontally towards the right, as shown in Fig. 10.1,



Scale: 1.0 cm : 0.5 N [1]

F_{net} / W = tan 25°

F_{net} = mg tan 25° = 0.60 x 10 tan 25° [1]

= 2.798 ≈ 2.8 N [1] [3]

(c) Hence, calculate the acceleration of the pendulum bob.

F_{net} = ma → a = F_{net} / m = 2.798 / 0.60 [1]

= 4.663 ≈ 4.7 m s^{-2} [1] [2]

(d) If the pendulum string had been increased from 20 cm to 40 cm in length and the acceleration of the car had remained the same, explain how the angle the pendulum makes with the vertical would be different (if at all) from that shown in Fig. 10.1.

the angle would remain the same as the tension / forces are independent of length of the string. [1]

(e) Later, a passenger in the car observes the pendulum bob hanging vertically down.

State one possible state of motion of the car at this instant. Explain your answer clearly.

the car is moving at constant velocity [1]

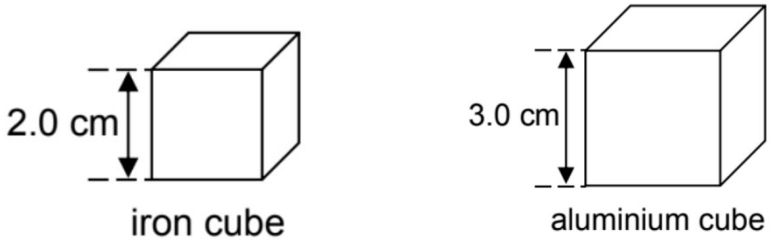
or is at rest [1]

(both are expected as shows understanding of Newton's First Law) [2]

13 Fig. 3.1 shows an iron cube and an aluminium cube.

The iron cube, of length 2.0 cm, has a density of 7.9 g cm-3. The aluminium cube, of length 3.0 cm, has a density of 2.7 g cm-3.

Fig. 3.1



The two cubes are melted to form an alloy. Calculate the density of this alloy.

mass = density x volume

Total mass = mass of steel cube + mass of Al cube = (2.0)3 × 7.9 + (3.0)3 × 2.7

= 63.2 g + 72.9 g [1]

Density of alloy = (total mass) / (total volume)

= (63.2 + 72.9) / (8.0 + 27.0)

= 136.1 / 35.0 = 3.89 g cm-3 OR 3.9 g cm-3 [1]

[2].

ANSWERS FOR DYNAMICS PRACTICAL QUESTIONS

1 The Earth is located 1.50×10^{11} m from the Sun as shown in Fig. 1.1.

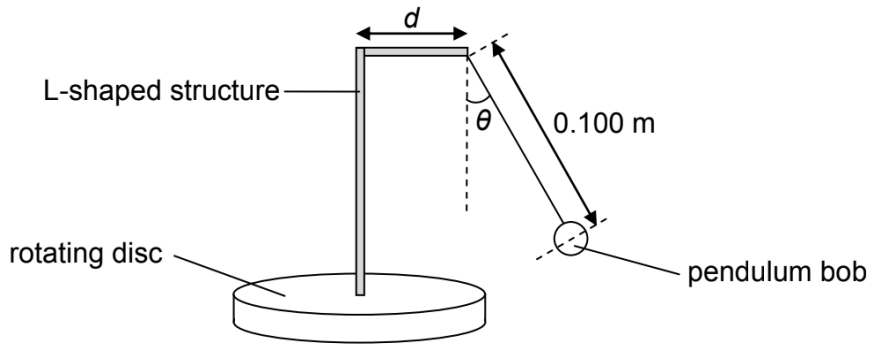
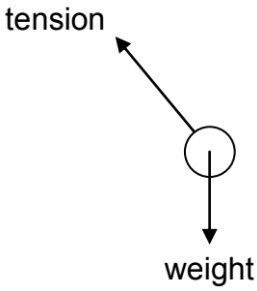


Fig. 2.1

At point Z, the resultant gravitational field strength from the Earth and the Sun is zero.

(a) If Z is 2.59×10^{8} m from the Earth, determine the mass of the Sun. Take the mass of the Earth to be 5.97×10^{24} kg.



(b) Ignoring the rotational motion between the Sun and the Earth, state and explain what would happen to a point mass if it is brought to point Z and released at rest.

$F_C = mr\omega^2$

$T \sin \theta = mr\omega^2$ $0.188 \sin 25° = 0.017\ r\ (7.0)^2$

$r = 0.09538$ m

$r = d + L \sin \theta$ $d = r - L \sin \theta$

$= 0.09538 - 0.10 \sin 25°$

$= 0.05311$

$= 0.053$ m (2 sf) [2]

(c) Suppose the mass of the pendulum bob increases, but the disc continues to rotate at the same speed. State if θ will increase, decrease or remain constant.

Remains constant [1]

2 A truck runs into the back of a car of mass 1500 kg. The car experiences a constant force of 5.5×10^4 N that acts for 0.20 s.

(a) If the car is initially at rest, determine the magnitude of its final velocity after 0.20 s.

$F\Delta t = m(v - u)$

$(5.5 \times 10^4)(0.20) = 1500\ v \quad v = 7.333$

$= 7.3\ m\ s^{-1}$ (2 sf)

OR

$F = ma$

$5.5 \times 10^4 = 1500\ a$

$a = 36.666\ m\ s^{-2}$

$v = u + at$

$= 0 + 36.666\ (0.20)$

$= 7.333$

$= 7.3\ m\ s^{-1}$ (2 sf) [2]

(b) By considering the concept of impulse, explain how the use of seat belts ensures greater safety for the passengers in the car.

The use of seat belts increases the time of impact experienced by the passenger.

For the same impulse, the force of impact becomes smaller, reducing the risk of injury to the passenger. [2]