NAME:	CLASS:	NO:

RAFFLES INSTITUTION

2017 MID-YEAR COMMON TEST

Subject : PHYSICS

Level : YEAR 3

Date : 5 May 2017 (Friday)

Time : 0800 – 0930 (1 h 30 min)

INSTRUCTIONS

1. Do not turn over the page until you are told to do so.
2. Write your name, class and index number in the spaces at the top of this page.
3. Read all instructions and questions carefully.
4. This paper consists of two sections.
   - **Section A**
     Answer **all** questions. **Shade your answers in pencil on the separate OMR Sheet.**
   - **Section B**
     Answer **all** questions. Write your answers in the spaces provided. Use a blue or black pen.
     Question marked with an * is optional. Marks earned for this question will be credited as bonus marks.
5. All workings must be shown.
6. The marks shown indicate the relative credit intended for each part of a question.
7. Candidates are reminded that all quantitative answers should include appropriate units and should be given to a sensible number of significant figures. Errors in units and numbers of significant figures will be penalized.

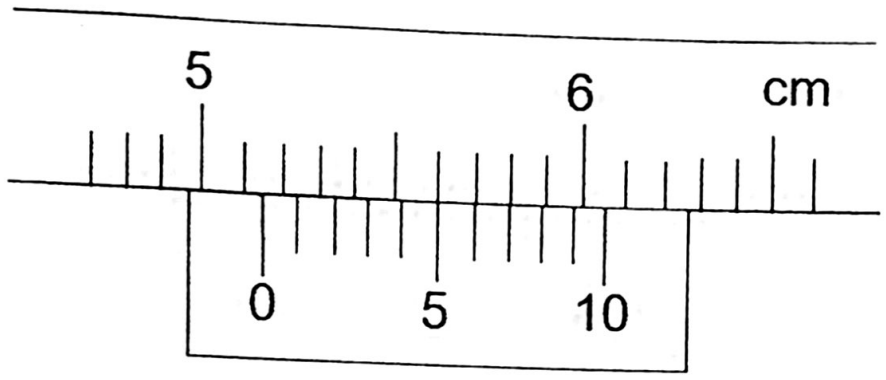
SECTION A CONSISTS OF 8 PRINTED PAGES, **EXCLUDING THE COVER PAGE.**

Where required, you may assume that the gravitational acceleration or field strength ***g*** near the earth's surface is ***9.81 m s^{-2}*** or ***9.81 N kg^{-1}***.

Section A [18 marks]

Four possible answers **A**, **B**, **C** and **D** are given for each question. Choose the **most appropriate answer** and shade your answers in pencil on the OMR answer sheet provided.

A vernier caliper is being used to measure the thickness of a book.



What is the reading of the vernier caliper?

A 0.495 cm

B 0.515 cm

C 4.95 cm

D 5.15 cm

Certain phrases are used to describe errors in experimental measurements.

X: Cannot be eliminated
Y: Have a constant sign and magnitude
Z: Cannot be reduced by averaging repeated measurements

Which phrase/s describe random errors?

A *X* only

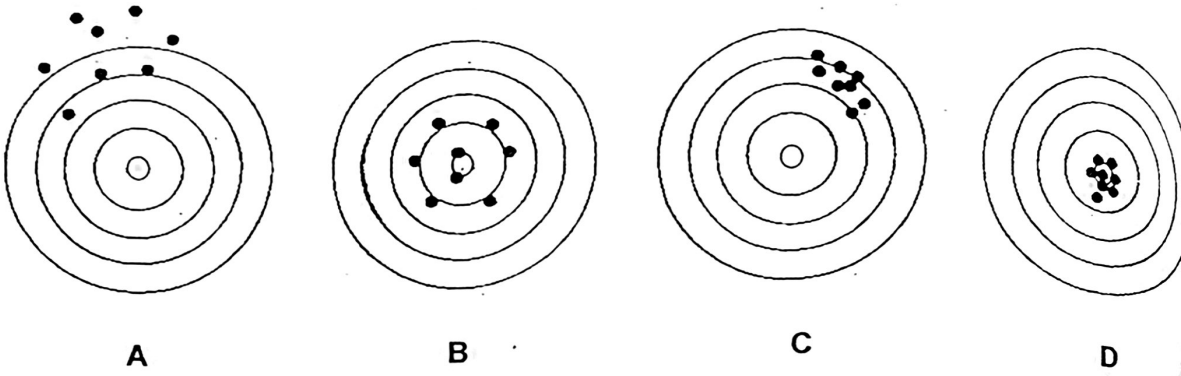
B *Y* only

C *X* and *Z*

D *Y* and *Z*

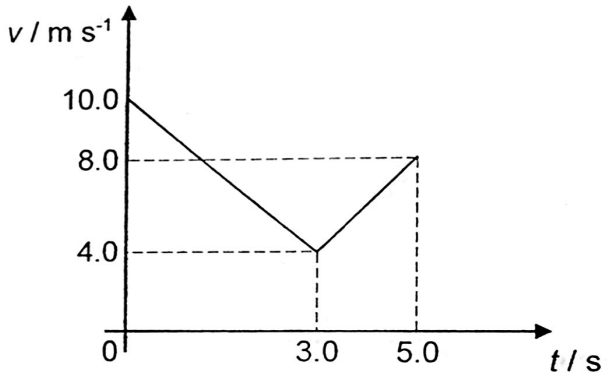
3 The following show markings made by arrows aimed at the bull's eye.

Which shows results of high precision but low accuracy?



A B C D

4 The figure below shows the speed-time graph for a car.



What is the average speed of the car?

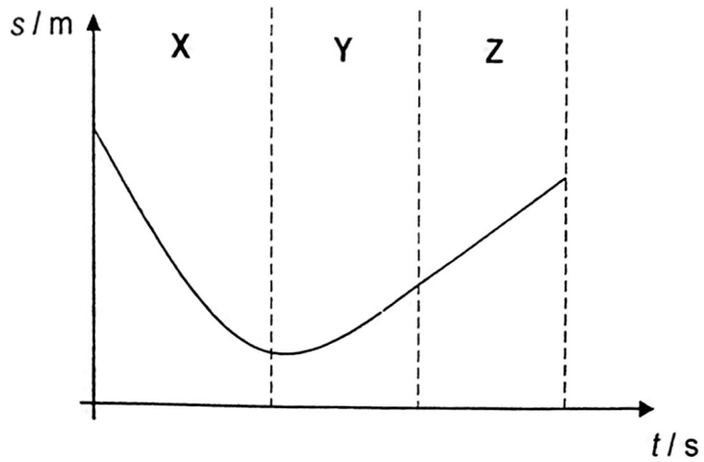
A 2.00 m s^{-1}

B 6.60 m s^{-1}

C 7.33 m s^{-1}

D 8.00 m s^{-1}

5 The graph below shows the displacement-time graph of an object.



Which of the following section(s) shows the object accelerating?

A **Z** only

B **X** and **Y** only

C **Y** and **Z** only

D **X**, **Y** and **Z**

6 A block of wood slides along a smooth horizontal surface with an initial velocity of 1.50 m s^{-1} to the right. A gust of wind blowing horizontally towards the left slows the block down and reverses its direction of motion. After 10.0 s, the block achieves a final velocity of 4.00 m s^{-1} to the left. (Assume that the block experiences uniform acceleration throughout the motion.)

What is the change in displacement of the block in that period of 10.0 s?

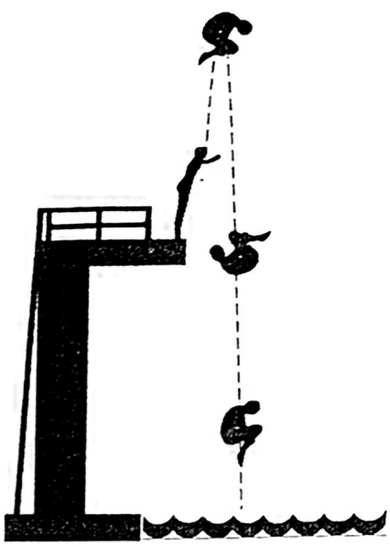
A - 27.5 m

B - 12.5 m

C 0.550 m

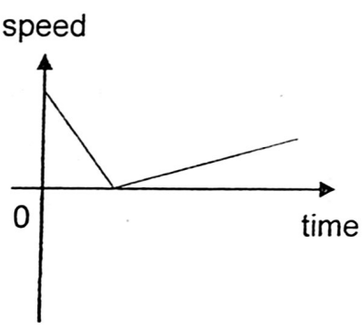
D 27.5 m

7 An Olympic diver jumps upwards from a tall diving platform. His trajectory is traced diagram below.

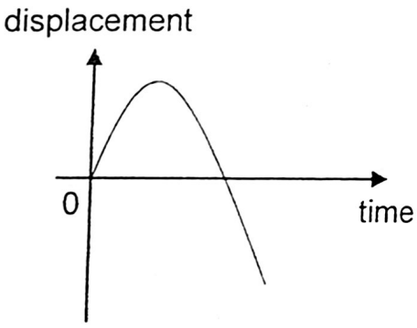


Which of the following graphs below does not describe the motion of the diver from th he jumps off the platform to just before he hits the water? (Ignore effects of air resistance)

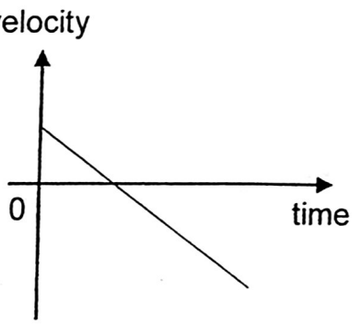
A



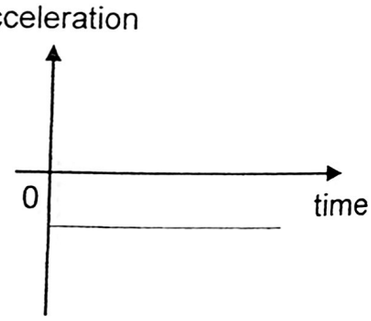
B



C

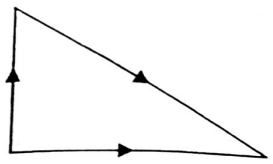


D

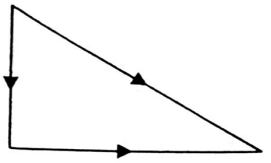


8 Which of the following vector diagrams represents three forces in equilibrium?

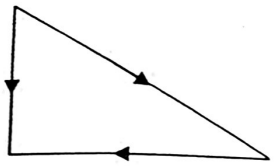
A



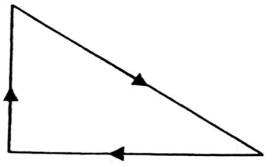
B



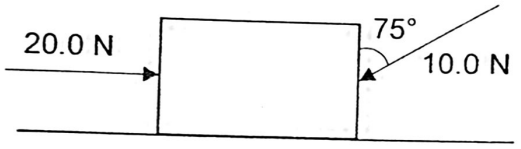
C



D



9 Two forces of magnitude 20.0 N and 10.0 N are exerted on a block resting on a smooth surface, as shown in the figure below.



What is the horizontal component of the resultant force on the block?

A $(20.0 - 10.0)$ N

B $(20.0 - 10.0 \cos 75°)$ N

C $(20.0 - 10.0 \sin 75°)$ N

D $(20.0 - 10.0 \tan 75°)$ N

10 A ball of mass m is thrown straight up into the air. Air resistance cannot be ignored.

What is the magnitude of the net force acting on the ball at the highest point of its path?

A zero

B between zero and mg

C equal to mg

D greater than mg

11 A car travelling at 30.0 m s^{-1} strikes a low overhanging fruit from a tree.

Which of the following statements about the forces of impact is true?

A The net force on the fruit is zero.

B The force on the fruit is greater than the force on the car.

C The force on the fruit is equal to the force on the car.

D The force on the fruit is smaller than the force on the car.

12 In the absence of a net force, a moving object _____.

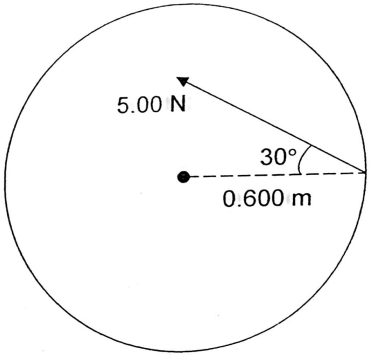
A will stop immediately

B will move with constant velocity

C may slow down and eventually stop

D may move with constant speed in a curved path

13 A circular turntable of radius 0.600 m is used for serving food and is free to rotate about its centre. A diner exerts a force of 5.00 N on the turntable as shown.



What is the magnitude of the moment due to the force about the centre?

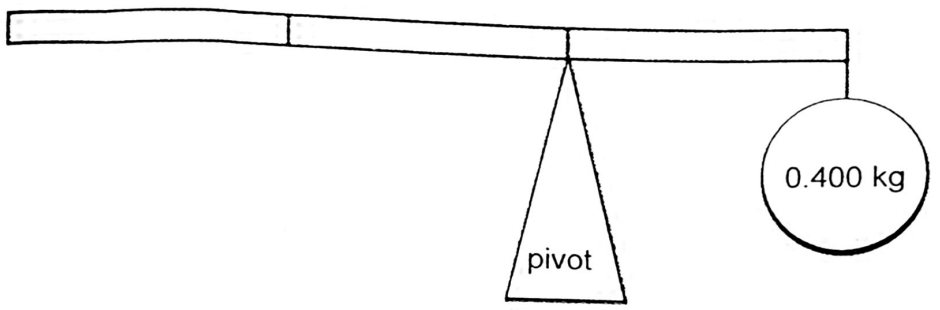
A 0 Nm

B 1.50 Nm

C 2.60 Nm

D 3.00 Nm

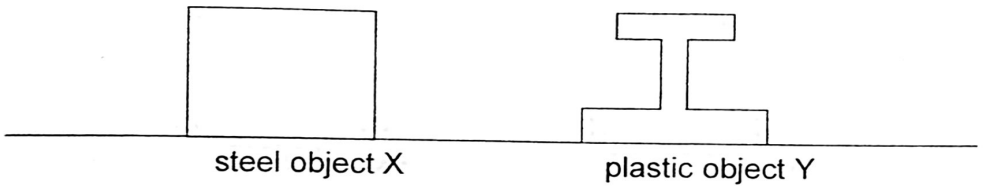
14 The diagram shows a 0.400 kg sphere suspended by a light string from one end of a uniform rod. The markings on the rod divide it into three equal sections. The rod is balanced about the pivot as shown.



What is the mass of the rod?

A 0.200 kg B 0.400 kg C 0.600 kg D 0.800 kg

15 In the diagram, each object is made of materials of uniform density.



Which of the following statements correctly describes the relative positions of the centre of gravity of each object?

A The centre of gravity of X is lower than that of Y, because the density of X is larger than that of Y.

B The centre of gravity of Y is lower than that of X, because the density of Y is lower than that of X.

C The centre of gravity of Y is lower than that of X, because the base of Y is larger than its top.

D Both the centres of gravity of X and Y are at the same height, because they are of the same height.

16 A plane, driven by a forward thrust of 2.00×10^5 N, flew at a constant velocity of 300 km h^{-1} for 40.0 km.

What is the magnitude of the work done by air resistance?

A 0 J

B 1.67×10^7 J

C 6.00×10^7 J

D 8.00×10^9 J

17 A car speeds up as it ascends a slope.

Which of the following describes the changes to its kinetic energy and its gravitational potential energy?

	kinetic energy	gravitational potential energy
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

18 A battery can deliver 3000 J of energy to a small 2.0 W electric motor before the battery is exhausted.

How many minutes does the motor run?

A 25 minutes

B 50 minutes

C 1500 minutes

D 6000 minutes

NAME:	CLASS:	NO:

RAFFLES INSTITUTION

2017 MID-YEAR COMMON TEST

Subject : PHYSICS (SECTION B)

Level : YEAR 3

Date : 5 May 2017 (Friday)

FOR EXAMINER'S USE

Section	Marks	
A		18
B	Q19	5
	Q20	10
	Q21	6
	Q22	9
	Q23	6
	Q24	6
Bonus Question	Q21(c)	3
Penalty		
Total		60

SECTION B CONSISTS OF **11** PRINTED PAGES **EXCLUDING THE COVER PAGE**.

ection B [42 marks]

Vrite your **answers to Questions 19 to 24 in the spaces provided in each question**. Show our workings clearly where necessary. All quantitative answers should include appropriate units nd be quoted to a suitable number of significant figures.

uestion 21 **(c) indicated with an * is optional and will count towards your total marks.**

our total marks will remain limited to a maximum of **60 marks**.

(a) Express the following quantities in the units shown, and leave your answer in the standard form.

(i) 88.8 μs = ... s [1]

(ii) 125 Mm h^{-2} = ... m h^{-2} = ... m s^{-2} [2]

(b) Fig. 19.1 and 19.2 below show the readings on a micrometer screw gauge when it is fully closed, and when it is measuring the diameter of a ball bearing respectively.

State the zero error, and the corrected diameter of the ball bearing.

fully closed

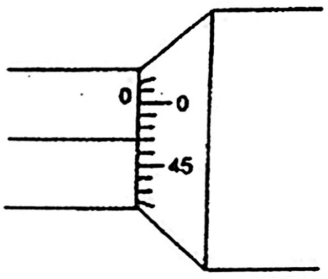


Fig. 19.1

measuring diameter of ball bearing

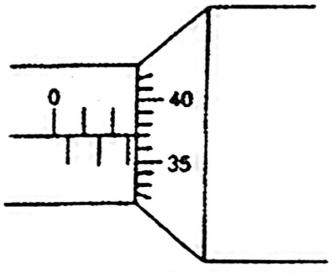


Fig. 19.2

zero error = ... [1]

corrected diameter = ... [1]

20 A soldier is piloting a drone while standing at the edge of a tall cliff. The drone starts from r above the edge of the cliff and travels along a horizontal straight line, as shown in Fig. 20.1.

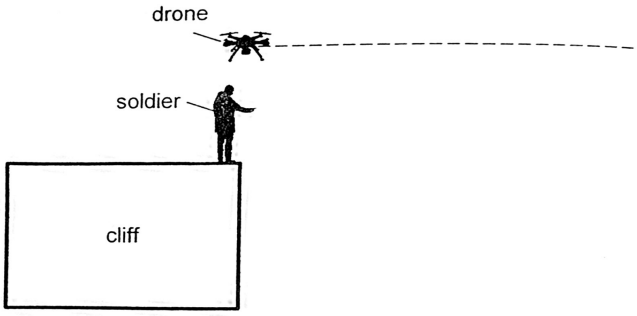


Fig. 20.1

(a) The velocity-time graph of the drone was plotted by the soldier over an interval of time and is shown below in Fig. 20.2.

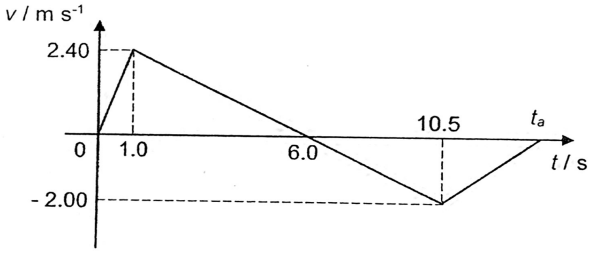


Fig. 20.2

(i) Define acceleration.

.....

..... [1]

(ii) Find the acceleration of the drone from $t = 1.0$ s to $t = 10.5$ s.

acceleration: ..... [1]

(iii) State the time(s) at which the drone reverses its direction of velocity.

..... [1]

(iv) Given that the drone returns to its starting position at $t = t_a$, find t_a.

t_a = ... [3]

b) A parcel is then attached to the drone, which is then flown above a landing spot at the bottom of the cliff, as shown in Fig. 20.3.

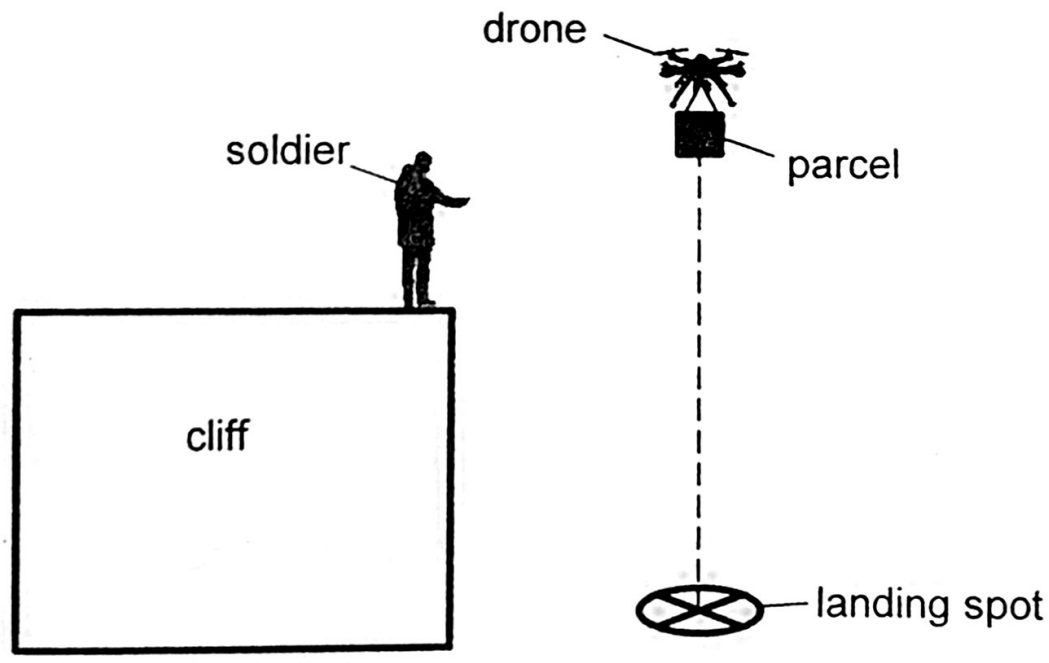


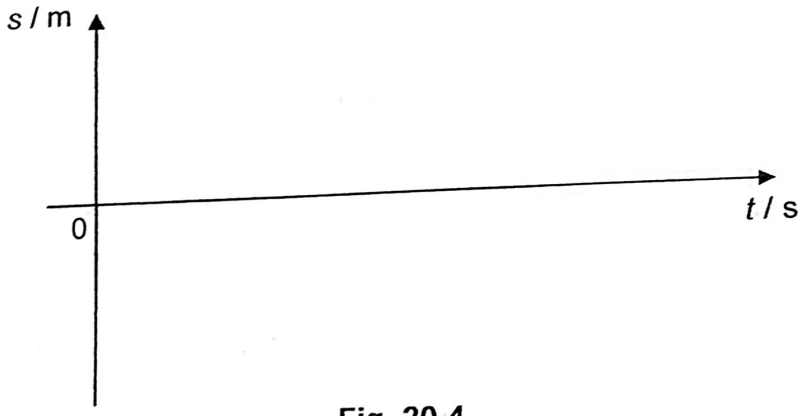
Fig. 20.3

The drone (with the parcel) was then flown vertically upwards at a constant velocity of 3.00 m s^{-1}. When the parcel was 70.0 m above the landing spot, it was released from the drone via remote control. The parcel was then allowed to freely fall onto the landing spot, where it comes to rest instantly.

(i) Find the time taken for the parcel to hit the landing spot from the time of its release. (Ignore all effects of air resistance.)

time taken = ... [2]

(ii) Sketch the displacement-time (*s*-*t*) graph for the parcel from the time of its release to its landing in Fig. 20.4. Take the point of release to be $s = 0$ m and the time of release to be $t = 0$ s. On the axes, label the displacement and time at which the parcel hits the ground.



[2]

Fig. 20.4

21 **(a)** Fig. 21.1 contains a mixture of scalar and vector quantities.

velocity	power
volume	acceleration
speed	moment
work done	mass
weight	displacement

Fig. 21.1

(i) Circle all the vector quantities in Fig. 21.1. [1]

(ii) State the difference between scalar and vector quantities.

.....

.....

[1]

(b) In a game of billiards, the objective for the player is to use a cue stick to strike a ball on top of a table into various holes positioned at the edges of the table, as shown in Fig. 21.2.

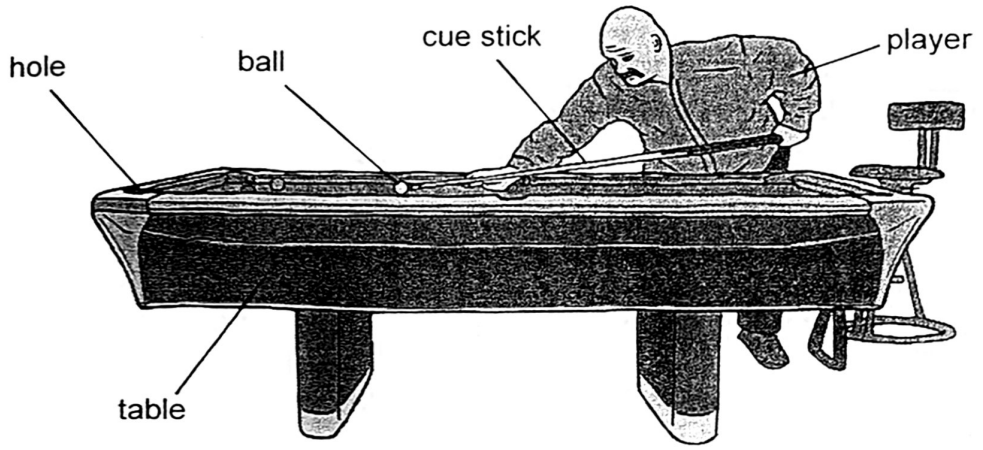


Fig. 21.2

Fig. 21.3 shows a top view of the table, with the position of the ball and the hole indicated. The hole is at a position 60° anticlockwise from the line **AB** with respect to the ball.

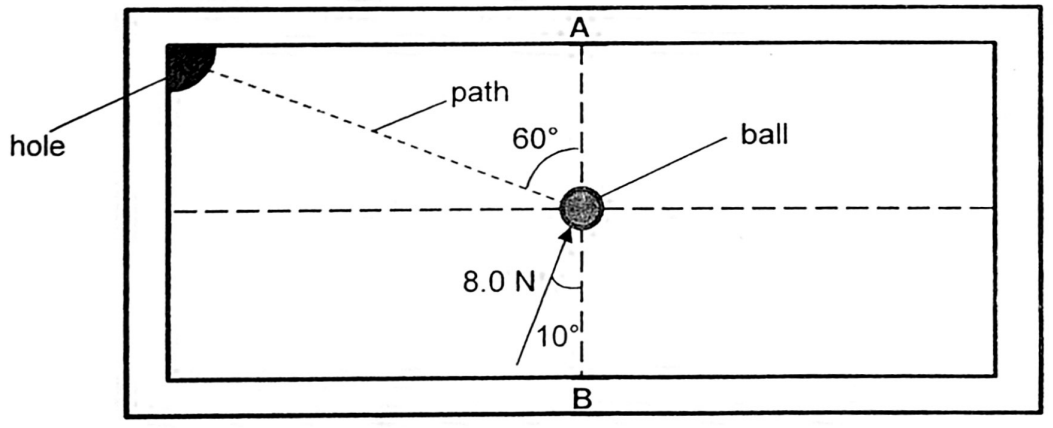


Fig. 21.3

To demonstrate a trick shot, the player hit the ball with the two cue sticks simultaneously. Both cue sticks apply an 8.0 N force parallel to the table surface and towards the centre of the ball. The first force is applied at an angle of 10° from the line **AB**, as shown in Fig. 21.3.

Using a scaled vector diagram, find the direction that the second 8.0 N force has to be applied in order to hit the ball into the hole along the path indicated in Fig. 21.3. Also, find the magnitude of the resultant force.

Use a scale of 1 cm : 1.0 N.

direction of 8.0 N force = ...

magnitude of resultant force = ... [

(c) Unfortunately, the trick shot did not go well and the billiard ball was hit off the table instead. The ball flew off the table (of height 1.2 m) horizontally at a speed of 1.5 m s^{-1}. Fig. 21.4 shows the ball's trajectory before it strikes the ground.

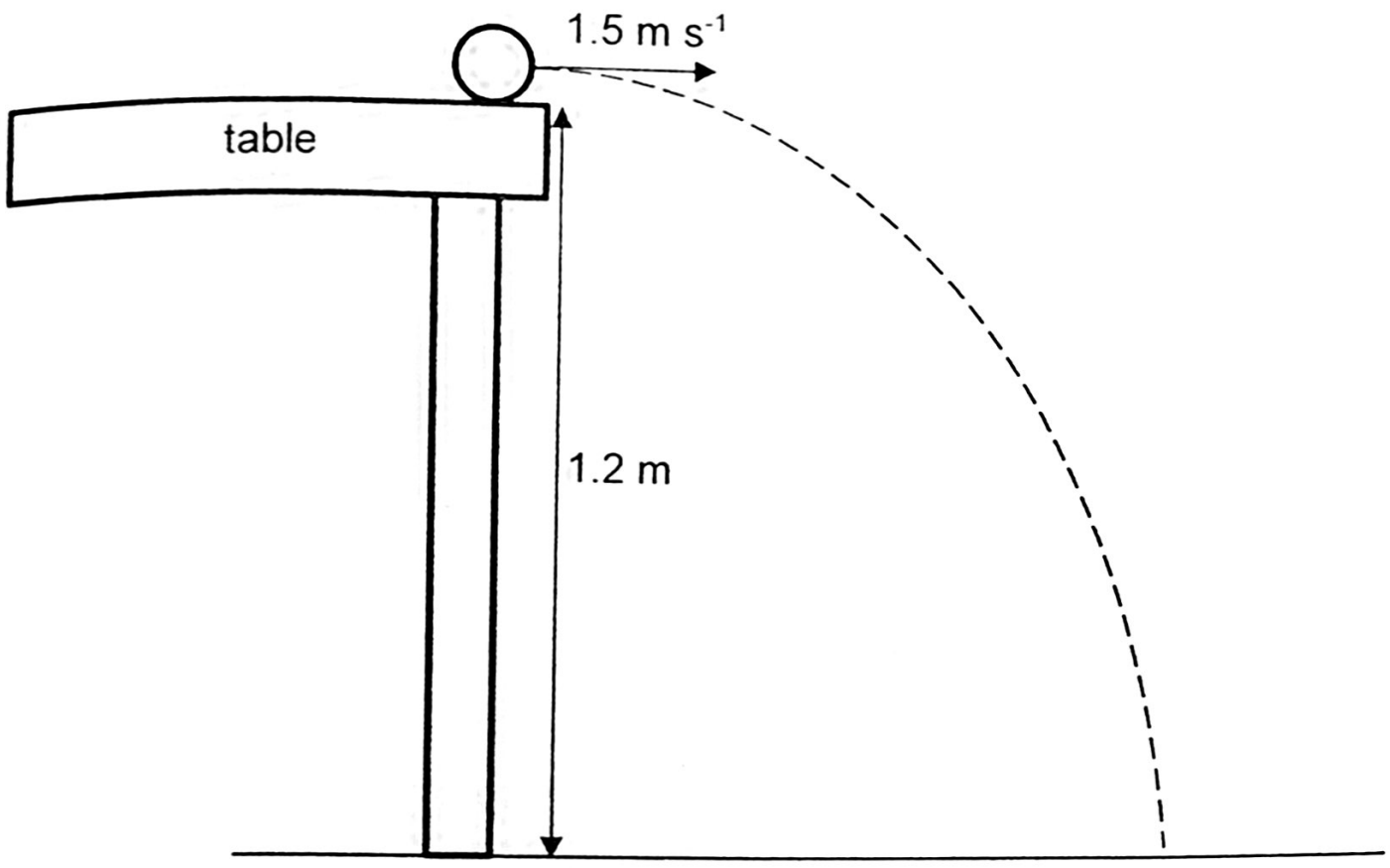


Fig. 21.4

During its motion in the air, the horizontal component of its velocity remains unchanged. Find the velocity at which the ball strikes the ground. (Ignore all effects of air resistance.)

magnitude of velocity = ...

direction of velocity = ... [3]

22 A coin with a mass of 8.00 g is dropped onto some mud. It hits the mud with a velocity of 4.20 m s^{-1}. It experiences a resistive force from the mud, which slows it down to a stop at a depth of 0.020 m.

(a) Determine the average acceleration of the coin as it moves through the mud.

average acceleration = ...

(b) Draw a free body diagram of the coin as it is falling through the mud. Label the forces clearly.

(c) Determine the average resistive force on the coin due to the mud.

average resistive force = ...

(d) Now, the coin is dropped from a tall building. It accelerates initially, but after some time, the coin moves with a constant velocity.

(i) State the value of acceleration of the coin at the instant of release.

acceleration = ... [1]

(ii) Account for the motion of the coin after the instant of release, with reference to the forces acting on it.

.....

.....

.....

.....

..... [2]

23 Fig. 23.1 shows a 4.00 m long uniform rod used to raise a 59.0 kg mass. The rod has a mass 11.0 kg. A force *F* is applied at the end of the rod at A in order to raise the load.

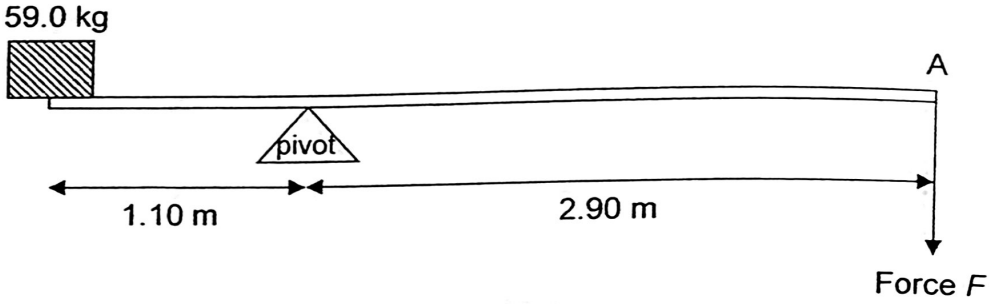


Fig. 23.1

(a) State the principle of moments.

.....

..... [2]

(b) Calculate the moment due to the weight of the rod about the pivot.

moment = ... [2]

(c) Calculate the minimum force *F* that must be applied at A to raise the load.

minimum force = ... [2]

A golf ball of mass 0.0380 kg moves with an initial speed of 79.0 m s^{-1} after being hit by a golf club. Assume that air resistance is negligible.

(a) Calculate the initial kinetic energy of the ball.

initial kinetic energy of ball = ... [2]

(b) The ball rises to a height of 27.0 m.

(i) Calculate the change in gravitational potential energy of the ball.

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

(ii) Calculate the speed of the ball.

speed of ball = ... [2]

END OF PAPER