Section B

Answer **one** question from this Section in the spaces provided.

8 (a) (i) The distance *s* moved by an object in time *t* may be given by the expression

$$s = \frac{1}{2}at^2$$

where *a* is the acceleration of the object.

State two conditions for this expression to apply to the motion of the object.

1……

……

2……

…… [2]

(ii) A student takes a photograph of a steel ball of radius 5.0 cm as it falls from rest.
The image of the ball is blurred, as illustrated in Fig. 8.1.
The image is blurred because the ball is moving while the photograph is being taken.

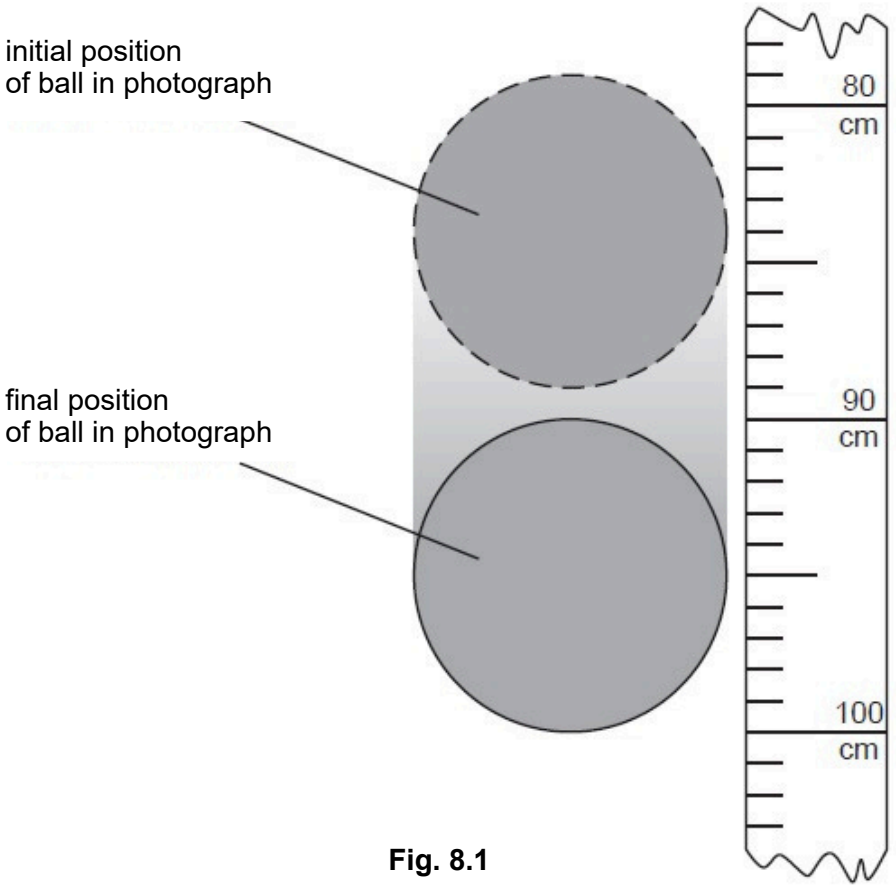

Fig. 8.1

The scale shows the distance fallen from rest by the ball. At time $t = 0$, the top of the ball is level with the zero mark on the scale. Air resistance is negligible.

1. Calculate the time the ball falls before the photograph is taken,

time = …….s [2]

2. Calculate the time interval *T* during which the photograph is taken.

T = …….s [2]

3. The time for which the shutter stays open is marked as $\frac{1}{30}$ s.
Comment on whether your answer in **(ii)2.** confirms this time.

…….....

…….…….[2]

(iii) Thestudent in **(ii)** takes a second photograph starting at the same position on the scale.The ball has the same radius but is less dense, so that air resistance is not negligible.

State and explain the changes that will occur in the photograph.

…….....

…….....

…….....

……... [2]

(b) (i) State the relation between force and momentum.

…….... [1]

(ii) Arigid bar of mass 450 g is held horizontally by two supports A and B, as shown in Fig.8.2.

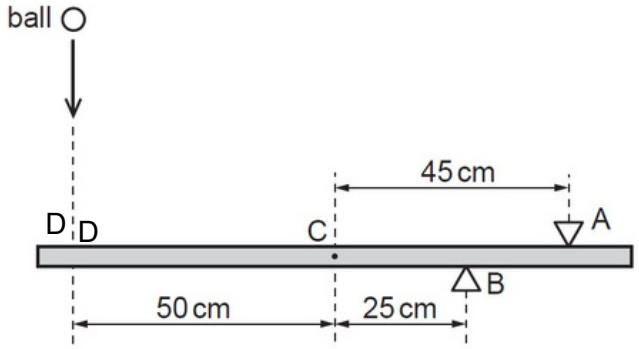

Fig.8.2

Thesupport A is 45 cm from the centre of gravity C of the bar and support B is 25cm from C.

Aball of mass 140 g falls vertically onto the bar such that it hits the bar at point D, adistance of 50 cm from C, as shown in Fig. 8.2.

Thevariation with time *t* of the velocity *v* of the ball before, during and after hitting thebar is shown in Fig. 8.3.

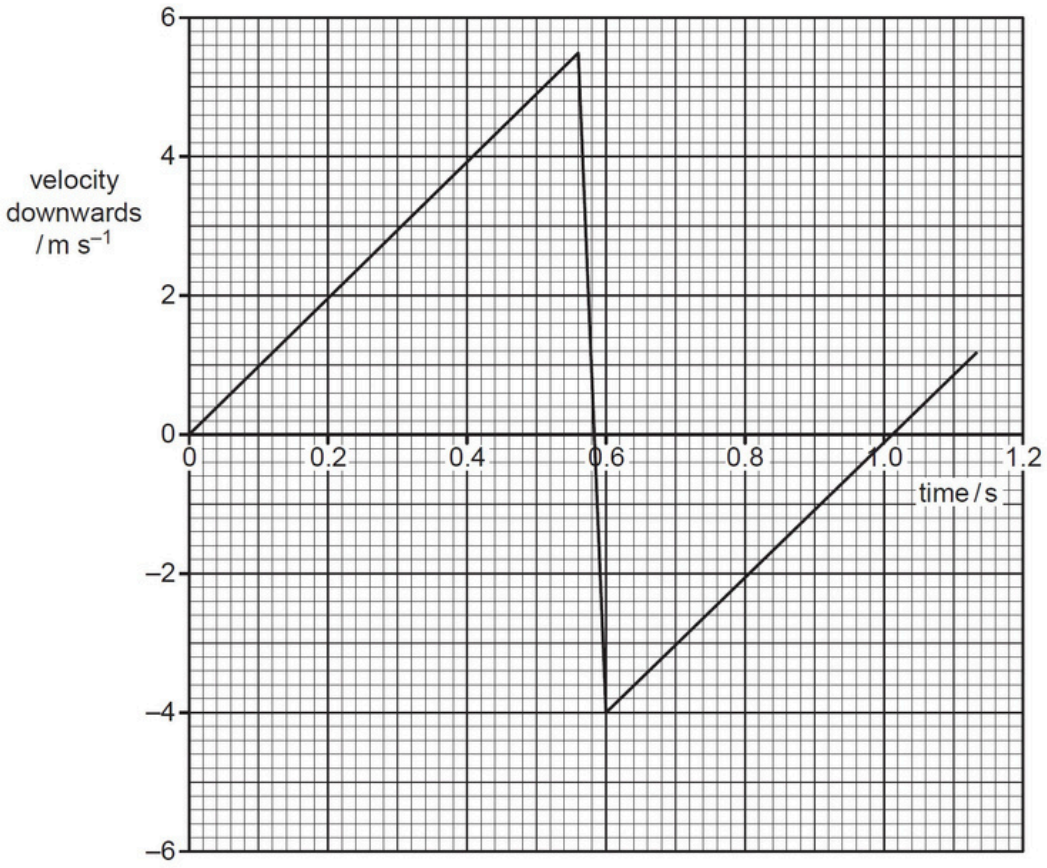

Fig. 8.3

For the time that the ball is in contact with the bar, use Fig. 8.2 and 8.3

1. to determine the change in momentum of the ball,

change in momentum = …….kg m s−1 [2]

2. toshow that the magnitude of the average force exerted by the ball on the bar is35 N,

[2]

3. to calculate the average force exerted on the bar by the support A.

force = …….N [3]

(iii) The bar is now cushioned with a light sponge at point D.

State and explain the effect on your answer to **(b)(ii)3** when the ball makes contact with the bar.

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…….....

…….....

……..... [2]

[Total20]