## Revision exercise

1(a)(i) Define distance and displacement.
(ii) In a tabular form, differentiate between:
(b)(i) distance and displacement (ii) speed and velocity.

2. Explain the significance of distance-time graph in contrast with velocity-time graph.

3. What is acceleration?

4. Define the following terms: (i) displacement (ii) velocity (iii) acceleration.

5. A body falls from rest with an acceleration of $10m/s^2$. What is the velocity after 5s? How far has it fallen by then?

6. A stone is thrown vertically upward from ground level with a speed of 25m/s. At what time is it 5m above the ground?

7. From the top of a cliff, 100m above sea level, a stone is thrown vertically upward with a velocity of 30 m/s. After how many seconds and with what velocity will it hit the sea?

8. The speed of a train is reduced from 80km/h to 40km/h in a distance of 500m on applying the brake. (i) How much further will the train travel before coming to rest? (ii) Assuming the retardation remains constant, how long will it take to bring the train to rest after the application of the brakes?

9. A car travels at a uniform velocity of 30m/s for 5 secs. The brakes are then applied and the car comes to rest with uniform retardation in a further 8 secs. Draw a sketch graph of velocity against time. How far does the car travel after the brakes are applied?

10. A train moving at 30km/h accelerates to a speed of 50km/h in 30secs. Find the average acceleration in $m/s^2$ and the distance travelled in metres during the period of the accleration.

11(a) Using a suitable diagram, explain how the following can be obtained from a velocity-time graph: (i) acceleration (ii) retardation (iii) total distance covered. (b) Show that the displacement S of a body moving with uniform acceleration a is given by $S = ut + \frac{1}{2}at^2$ where u is the velocity of the

body at the time t = 0. (c) A particle moving in a straight line with uniform deceleration has a velocity of 40m/s at a point P, 20 m/s at a point Q and came to rest at a point R where QR = 50m, calculate the (i) distance PQ (ii) time taken to cover PQ (iii) time taken to cover PR.

12(a) Explain the term uniform acceleration and average speed. (b) A body at rest is given an initial uniform acceleration of 8.0m/s² for 30 secs after which the acceleration is reduced to 5 m/s² for the next 20s. The body maintains the speed attained for 60 secs after which it is brought to rest in 20 secs. Draw the velocity -time graph of the motion using the information given above.

(c) Using the graph, calculate the (i) maximum speed attained during the motion (ii) average retardation as the body is being brought to rest. (iii) Total distance travelled during the first 50 secs (iv) Average speed during the same interval as in (ii) (SSCE, August 1991)

13. In the first attempt, a long jumper took off from the spring board with a speed of 8m/s at 30° to the horizontal. He makes second attempt with the same speed at 45° to the horizontal. Given that the expression for the horizontal range of a projectile is $\frac{V^2 \sin\theta}{g}$ where all the symbols have their usual meanings, show that he gains a distance of 0.8576m in his second attempt. (WASSCE, June 2001)

14. A ball thrown vertically upward reaches a maximum height at 50m above the level of projection. Calculate (i) the time taken to reach the height (ii) the speed of the throw ( g = 10 m/s²) (WASSCE, June 2002)

15. A lead shot is projected from the ground level with a velocity u at an angle θ to the horizontal. Given the time t, for the lead shot to reach its maximum height as t

$t = \frac{U\sin\theta}{g}$ where "g" is the acceleration of free fall due to gravity. Show that the greatest height reached by the body is $h_{max} = \frac{U^2\sin^2\theta}{2g}$ (WASSCE, June 2001)

16. Explain what is meant by acceleration of free fall due to gravity g. (b) State two reasons why g varies on the surface of the earth. A stone is projected upwards at an angle of 30° to the horizontal from the top of a tower of height 100m and it hits the ground at a point, Q. If the initial velocity of projection is 100m/s, calculate the (i) maximum height of the stone above the ground. (ii) time it takes to reach this height (iii) time of flight (iv) horizontal distance from the foot of the tower to the point, Q (Neglect air resistance, take g = 10m/s² (SSCE, June 1995)

17. A stone is projected horizontally from the top of a town with a speed of 5m/s. It lands on the ground level at a horizontal distance of 20m from the foot of the tower. Calculate the height of the tower (g = 10m/s²) (SSCE, June 1995)

18. What is a projectile? Give four examples of projectile in everybody's life. (WASSCE, June 2000)

19.(a) Define horizontal range of projectile (b) The horizontal range, R, of a projectile is given by the equation $R = \frac{U^2 \sin 20}{g}$

(i) What does θ in the equation represent? (ii) For what value of θ would R be maximum. (WASSCE, June 2002)

20. A particle starts from rest and moves with a constant acceleration of 0.5m/s². Calculate the time taken by the particle to cover a distance of 25m. [SSCE, June 1993]

21. How far will a body move in 4 seconds if uniformly accelerated from rest at the rate of 2m/s²] [SSCE, June 1993]

22. A body accelerates uniformly from rest at 2m/s². Calculate its velocity after travelling 9m. [SSCE, June 1994]

23. A body moving with uniform acceleration a has two points (`15,15) and (20,60) on the velocity-time graph of its motion. Calculate a. [SSCE, Aug.

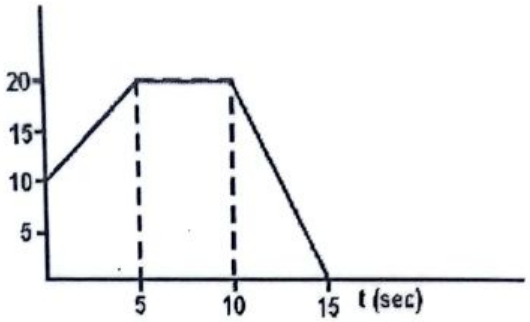
1991]

24. A body accelerated uniformly from rest at the rate of $3m/s^2$ for 8 seconds. Calculate the distance covered by the body during the acceleration. [SSCE, June 1992]

25. A body cycles continously through a distance of 10km in 5 minutes. Calculate its average speed. [SSCE, June 1995]

26. A car travelling at a uniform speed of $120kmh^{-1}$ passes two stations in 4mins. Calculate the distance between the two stations. [SSCE, June 1995]

27.




The above diagram illustrates the velocity-time graph of the motion of a body. Calculate the total distance covered by the body. [SSCE, June 1996]

28. A body accelerates from rest at $0.2m/s^2$ for one-fifth of a minute. Calculate the distance covered by the body. [SSCE, Nov 1998]

29. A bus travelling at 15m/s accelerates uniformly at $4ms^{-2}$. What is the distance covered in 10s. [WASSCE, June 2000]

30. A body which is uniformly retarded comes to rest in 5s after travelling a distance of 10m. What is its initial velocity? [NECO, 2002]

31. If body moving with a velocity of $3ms^{-1}$ is brought to rest by a constant force after travelling 15m. Calculate the retardation. [NECO, 2000]

32. Objects falls freely from a height of 25m onto the root of a building 5m high. Calculate the velocity with which the object strikes the root. [g=10m/s2] [SSCE, June 1997]

33. An object is projected with a velocity of 100m/s from the ground level at an angle θ to the vertical if the total time of flight of the projectile is 10s, calculate θ [$g=10m/s^2$] [SSCE, June 1993]

34. A ball is dropped from a height of 45m ab the ground. Calculate the velocity of the ball before it strikes the ground [neglect air resista and take g=10m/s] [SSCE, June 1994]

35. An orange fruit drop to the ground from top of a tree 45m tall. How long does it take reach the ground ? [$g=10m/s^2$] [SSCE, Aug. 19

36. A ball is thrown upwards from the grou with an initial velocity of 50m/s. What is the to time spent by the ball in the air. [$g=10m/s^2$] [SS , June 1988]

37. A stone is projected horizontally from the to of a tower with a speed of 10m5-1. It lands at horizontal distance of 20m from the foot of th tower. Calculate the height of the tower [g=10m/s] [SSCE, Nov '98]

38. A stone of mass 0.7kg is projected vertically upwards with a speed of 5m/s. Calculate the maximum height reached. [Take $g=10m/s^2$ and neglect air resistance] [WASSCE, June 1999)

39. An object is projected with a velocity of 50m/s from ground level at an angle θ to the vertical. If the total time of flight of the projectile is 5s, what is the value of θ? [NECO, 2002]

40. A body is projected horizontally with a velocity of 40m/s from the top of a tower 160m above the ground. Calculate the: (i) time of flight (ii) distance from the foot of the tower. [$g=10m/s^2$]

41. A bullet is fired with a velocity of $50ms^{-1}$ at an angle θ to the horizontal (a) What is the value θ for maximum range with this velocity (b) Calculate the maximum range [$g=10m/s^2$] [NECO, 2001]

42. A body is projected horizontally from the top of a tower with a velocity of $20ms^{-1}$. It lands on the ground level at a horizontal distance of 60m from the foot of the tower. Calculate the height of the tower. [$g=10,m/s^{-2}$] [NECO, 2002]

43.(a) What is a trajectory? (b) A ball is kicked with a velocity of 8m/s at an angle of 30° to the

horizontal. Calculate the time of flight of the ball. [g=10m/s$^{1}$] NECO, 2002]

44. A ball thrown vertically upward reaches a maximum height of 50m above the level of projection. Calculate the (i) time taken to reach the maximum height, (ii) speed of the throw. [g = 10ms$^{-2}$] (WASSCE June, 2001)

45. A lead shot is projected from the ground level with a velocity u at an angle $\theta$ to the horizontal. Given the time, t, for the lead shot to reach its maximum height as t $= \frac{u \sin \theta}{g}$

where "g" is the acceleration of free fall due to gravity, show that the greatest height reached by the body is

$$h_{max} = \frac{u^2 \sin^2 \theta}{2g}$$

WASSCE June 2001

46(a) Define horizontal range of projectile. (b) The horizontal range R of a projectile is given by the equation $R = \frac{u^2 \sin 2\theta}{g}$

(i) What does $\theta$ in the equation represent?

(ii) For what value of $\theta$ would R be maximum? (WASSCE June 2002)

uneven expansion. The glass near the water expands more than the one outside and since glass is a bad conductor, the stress causes the glass to crack.

2. In hot countries, you can hear cracking noise if you are under a galvanized iron sheet. Because of high intensity of heat, the iron expands and in the evening, another crack is heard, which shows contraction.

3. To allow for expansion, gaps are left between rail sections on a railway line. The ends are held in line with fish plate, which are strips of metal blotted to the end of the rail by slotted holes.

4. If the handle (i.e, an insulator) of a bi-metallic strip is held and the metal part is heated to a very high temperature, we notice that the metal bends inward with brass outside and iron inside because brass has higher co-efficient of expansion compared to iron. When the flame is removed and the metal is allowed to cool, they regain their original shape and size.

The bi-metallic strip is an instrument which is made up of two metals, e.g. iron and steel, iron and brass of different linear expansion. It has a wide application. For example, a bi-metallic strip is used in thermostat.

A thermostat is a device which is made of bi-metallic strip to maintain the temperature of an electrical system, e.g iron, water bath, oven, etc. Thus, the bi-metallic strip is used to regulate temperature.

**Revision exercise**

1. What is thermal expansion?
2. State and describe three experiments demonstrating expansion in solid.
3. What is linear expansivity of a solid?
4. Highlight three effects of expansion and their application.
5. If the linear expansivity of a copper rod is 0.000017/k, calculate the expansion of 10m of copper rod when heated from 10°C to 80°C
6. A cube with side 100cm at 0°C is heated to 100°C. If the side becomes 101cm long, find: (i) the linear expansivity (ii) cubic expansivity
7(i) What is meant by anomalous expansion of water? (ii) Explain the statement "the linear expansivity of a copper rod is 0.000017/k.
8. A brass and iron which are compounded are straighten at room temperature. Draw how the compounded strip would be after it is heated.
9. Distinguish between real and apparent cubic expansivity of a liquid.
10. What is (i) real cubic expansivity (ii) apparent cubic expansivity?
11(a). What is meant by the statement, "the linear expansivity of a solid is $1.0 \times 10^{-5} k^{-1}$? (SSCE June, 1989)

(b)(i) Describe an experiment to determine the linear expansivity of steel rod. (ii) Steel bars, each of length 3m at 28°C are to be used for constructing a rail line. If the linear expansivity of steel is $1.0 \times 10^{-5} k^{-1}$, calculate the safety gap that must be left between successive bars if the highest temperature expected is 40°C?

(c) State three advantages and two disadvantages of thermal expansion of solids. (SSCE Nov., 1989)

12(a). Define the apparent cubic expansivity of a liquid. (b)(i) Describe, with the aid of a labelled diagram, an experiment to determine the apparent cubic expansivity of a liquid. (ii) State two precautions that should be taken to ensure accurate results. (c) A density glass bottle contains 44.25g of a liquid at 0°C and 42.02g at 50°C, calculate the real cubic expansivity of the liquid (linear expansivity of glass = $1.0 \times 10^{-5} k^{-1}$) (SSCE June, 1996)

13. An iron rod of length 30cm is heated through 50 kelvin. Calculate its increase in length. (linear expansivity of iron = $1.2 \times 10^{-5} k^{-1}$) (WASSCE June, 2000)

14. A wire, 20m long, is heated from a temperature of 5°C to 55°C. If the change in length is 0.020m, calculate the linear expansivity of the wire. [SSCE, Aug, 1991]

15. A brass rod is 2m long at a certain temperature. Calculate the linear expansion of the rod for a

temperature change of 100K [take the linear expansivity of brass as $1.8 \times 10^{-5} K^{-1}$] [SSCE, June, '95]

16. The temperature of glass vessel containing $100 cm^3$ of mercury is raised from $10^0C$ to $100^0C$. Calculate the apparent cubic expansion of the mercury. (real cubic expansivity of mercury $= 1.82 \times 10^{-4} K^{-1}$ and cubic expansivity of mercury $= 2.4 \times 10^{-5} K^{-1}$) [SS CE, June, '95]

17. The linear expansivity of a metal, P, is twice that of another metal Q. When these metals are heated through the same temperature change, their increase in length is the same. Calculate the ratio of the original length of P to that of Q ? [SSCE, June, 1996]

18. A solid metal cube of side 10cm is heated from $10^0C$ to $60^0C$. If the linear expansivity of the metal is $1.2 \times 10^{-5} K^{-1}$, calculate the increase in the volume. [SSCE, June, 1993]

19. A metal rod of length 40.0cm at $20^0C$ is heated through a temperature of $45^0C$. If the new length of the rod is 40.05cm, calculate its linear expansivity. [SSCE, June, 1994]

20. A solid material of volume, $100 cm^3$ is heated through a temperature difference of $40^0C$. Calculate the increase in the volume of the material if its linear expansivity is $2.0 \times 10^{-6} K^{-1}$ [SSCE, June '1997]

21. An iron rod of length 50m and at a temperature of $60^0C$ is heated to $70^0C$. Calculate its new length [linear expansivity of iron $= 1.2 \times 10^{-5} K^{-1}$] [WASSCE, June, 1999]

22. The cubic expansivity of mercury is $1.8 \times 10^{-4} K^{-1}$ and the linear expansivity of glass is $8 \times 10^{-6} K^{-1}$. Calculate the apparent expansivity of mercury in a glass container. [WASSCE, June, 2000]

23. A brass of cube of side 10cm is heated through $30^0C$. If the linear expansivity of brass is $2.0 \times 10^{-5} K^{-1}$, what is the increase in its volume? [NECO, 2002]

24. The length of a side of a metallic cube at $20^0C$ is 5.0cm. Given that the linear expansivity of the metal is $4.0 \times 10^{-5} K^{-1}$, find the volume of the cube at $120^0C$ [NECO, 2000]

temperature change of 100K [take the linear expansivity of brass as $1.8 \times 10^{-5} K^{-1}$] [SSCE, June, '95]

16. The temperature of glass vessel containing $100 cm^3$ of mercury is raised from $10^0C$ to $100^0C$. Calculate the apparent cubic expansion of the mercury. (real cubic expansivity of mercury $= 1.82 \times 10^{-4} K^{-1}$ and cubic expansivity of mercury $= 2.4 \times 10^{-5} K^{-1}$) [SS CE, June, '95]

17. The linear expansivity of a metal, P, is twice that of another metal Q. When these metals are heated through the same temperature change, their increase in length is the same. Calculate the ratio of the original length of P to that of Q ? [SSCE, June, 1996]

18. A solid metal cube of side 10cm is heated from $10^0C$ to $60^0C$. If the linear expansivity of the metal is $1.2 \times 10^{-5} K^{-1}$, calculate the increase in the volume. [SSCE, June, 1993]

19. A metal rod of length 40.0cm at $20^0C$ is heated through a temperature of $45^0C$. If the new length of the rod is 40.05cm, calculate its linear expansivity. [SSCE, June, 1994]

20. A solid material of volume, $100 cm^3$ is heated through a temperature difference of $40^0C$. Calculate the increase in the volume of the material if its linear expansivity is $2.0 \times 10^{-6} K^{-1}$ [SSCE, June '1997]

21. An iron rod of length 50m and at a temperature of $60^0C$ is heated to $70^0C$. Calculate its new length [linear expansivity of iron $= 1.2 \times 10^{-5} K^{-1}$] [WASSCE, June, 1999]

22. The cubic expansivity of mercury is $1.8 \times 10^{-4} K^{-1}$ and the linear expansivity of glass is $8 \times 10^{-6} K^{-1}$. Calculate the apparent expansivity of mercury in a glass container. [WASSCE, June, 2000]

23. A brass of cube of side 10cm is heated through $30^0C$. If the linear expansivity of brass is $2.0 \times 10^{-5} K^{-1}$, what is the increase in its volume? [NECO, 2002]

24. The length of a side of a metallic cube at $20^0C$ is 5.0cm. Given that the linear expansivity of the metal is $4.0 \times 10^{-5} K^{-1}$, find the volume of the cube at $120^0C$ [NECO, 2000]