

PART E Advanced Mathematics and Advanced Physics

- 73** Curve C has equation $y = 9 - x^2$

Line L has equation $y = 5$

What is the area enclosed between C and L ?

- A** $\frac{32}{3}$
- B** $\frac{62}{3}$
- C** $\frac{92}{3}$
- D** $\frac{122}{3}$
- E** $\frac{152}{3}$

- 74** An aircraft moves from rest with uniform acceleration along a horizontal runway. After travelling 1600 m it reaches a speed of 80 ms^{-1} .

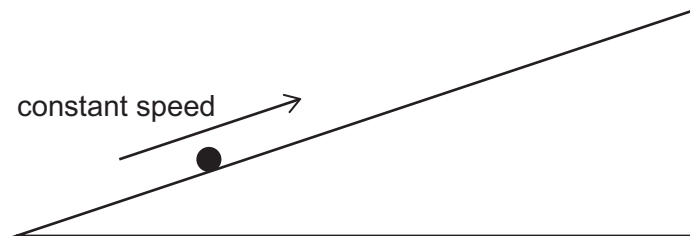
What is the acceleration of the aircraft?

- A** 0.025 ms^{-2}
- B** 0.050 ms^{-2}
- C** 0.10 ms^{-2}
- D** 0.50 ms^{-2}
- E** 2.0 ms^{-2}
- F** 4.0 ms^{-2}
- G** 10 ms^{-2}
- H** 20 ms^{-2}

75 How many solutions of the equation $2\sin^3 \theta = \sin \theta$ lie in the interval $-\frac{\pi}{2} \leq \theta \leq \pi$?

- A 2
- B 3
- C 4
- D 5
- E 6
- F 7

76 The diagram represents a mass that is moving in a straight line at constant speed up a slope of constant gradient.



Which statement about the forces acting on the mass **must** be correct?

- A All the forces acting on the mass are equal in magnitude.
- B Only three forces act on the mass.
- C The force of friction on the mass is equal to the driving force.
- D The weight of the mass acts in the opposite direction to the contact force.
- E There is no air resistance acting on the mass.
- F There is no resultant force acting on the mass.

- 77 The line $y = x + k$, where k is a constant, is a tangent to the curve $y = 3x^2 - 2x + 1$

What is the value of k ?

- A -2
- B -1
- C $\frac{1}{4}$
- D $\frac{1}{3}$
- E $\frac{1}{2}$
- F $\frac{3}{4}$
- G 1
- H 2

- 78 The diagram shows four objects W, X, Y and Z, of masses 3.0 kg, 4.0 kg, 6.0 kg and 2.0 kg respectively, connected by light, inextensible rods.

The objects are pulled along a smooth, horizontal surface by a constant force of 30 N in the direction indicated.



What is the tension in the rod connecting X and Y?

- A 8.0 N
- B 10 N
- C 12 N
- D 14 N
- E 16 N

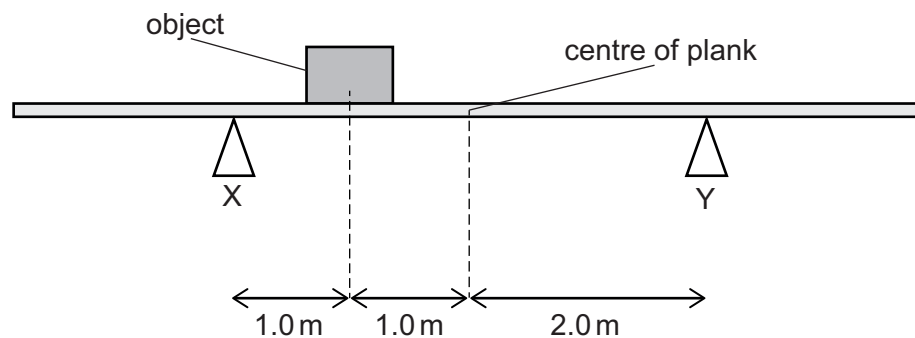
79 In a particular arithmetic progression:

- the 13th term is six times the 1st term
- the 11th term is 1 less than twice the 5th term

What is the 3rd term of the progression?

- A** -14.5
B -11
C $\frac{29}{19}$
D 3.5
E 11
F 14.5

80 An object of mass 40 kg is placed on a uniform, horizontal plank of mass 10 kg between two supports X and Y as shown in the diagram.



What is the contact force at X?

(gravitational field strength = 10 N kg^{-1})

- A** 15 N
B 35 N
C 150 N
D 250 N
E 300 N
F 350 N
G 375 N

81 Evaluate

$$\log_2\left(\frac{5}{4}\right) + \log_2\left(\frac{6}{5}\right) + \log_2\left(\frac{7}{6}\right) + \cdots + \log_2\left(\frac{64}{63}\right)$$

- A** -2
- B** 3
- C** 4
- D** 6
- E** $\log_2(3!)$
- F** $\log_2 60$

82 An object X of mass 2.0 kg is initially moving at a speed of 4.5 m s^{-1} on a smooth, horizontal surface.

A 5.0 N force is applied to X in the direction of its motion for 3.0 seconds.

A short time later it collides head on with, and sticks to, a stationary object Y of mass 3.0 kg.

What is the speed of X and Y as they move off together after the collision?

- A** 1.8 m s^{-1}
- B** 3.0 m s^{-1}
- C** 3.6 m s^{-1}
- D** 4.8 m s^{-1}
- E** 5.4 m s^{-1}

- 83** Circle C has equation $(x + 3)^2 + (y - 2)^2 = 5$

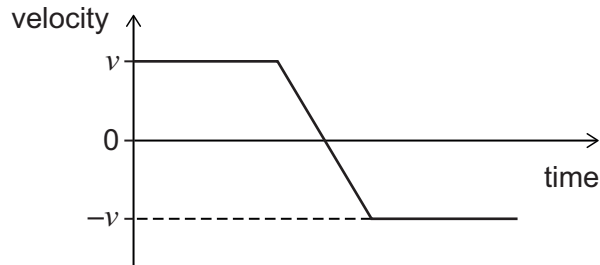
The length of the tangent from the circle C to the point P is $5\sqrt{3}$

What is the shortest distance from P to C ?

- A** $5\sqrt{3}$
- B** $5\sqrt{3} + \sqrt{5}$
- C** $3\sqrt{5}$
- D** 5
- E** 10

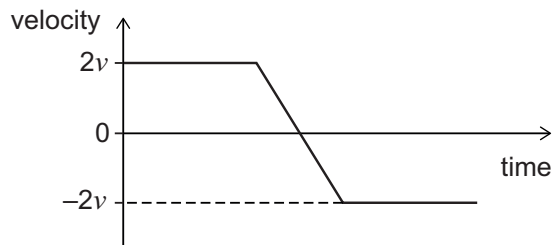
- 84** Two solid spheres X and Y have masses m and $2m$ respectively. They travel in opposite directions towards each other along the same line with speeds v and $2v$ respectively and collide head on.

The graph shows the variation of velocity with time for sphere X before, during, and after the collision.

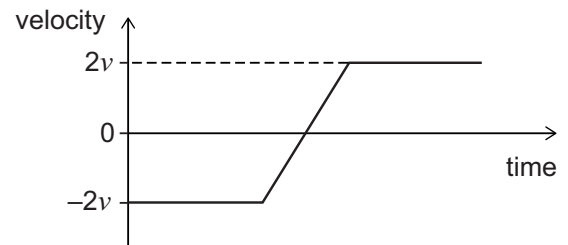


Which sketch shows the variation of velocity with time for sphere Y?

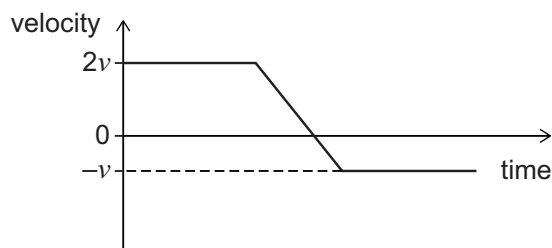
A



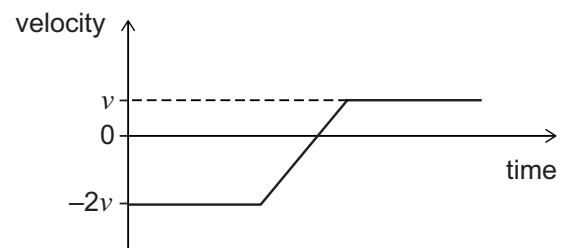
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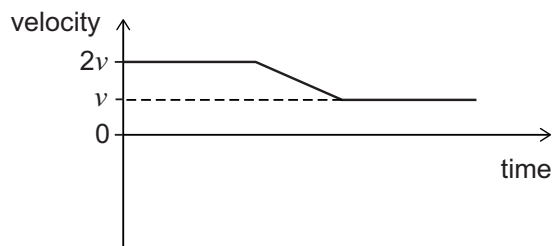
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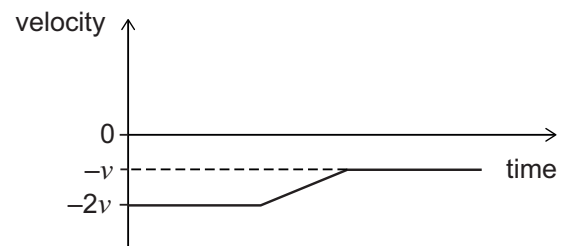
D



E



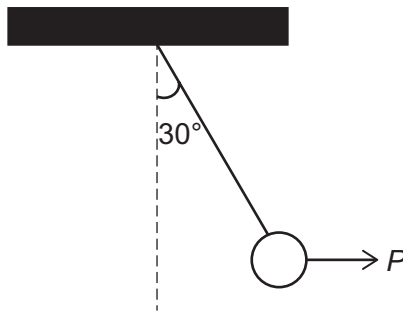
F



85 What is the coefficient of x^3 in the expansion of $(1 - 2x)^5(1 + 2x)^5$?

- A -6400
- B -640
- C -80
- D 0
- E 80
- F 800
- G 960

86 A metal ball suspended from a steel cable is held at rest by a horizontal force P . The cable makes an angle of 30° to the vertical as shown in the diagram. The cable exerts a force T on the ball.



What is the magnitude of P ?

- A $\frac{T}{2}$
- B T
- C $2T$
- D $\frac{T}{\sqrt{2}}$
- E $\frac{T}{\sqrt{3}}$
- F $\frac{2T}{\sqrt{3}}$
- G $\frac{\sqrt{3}T}{2}$

87 Given that

$$\int_0^2 x^m dx = \frac{16\sqrt{2}}{7}$$

and

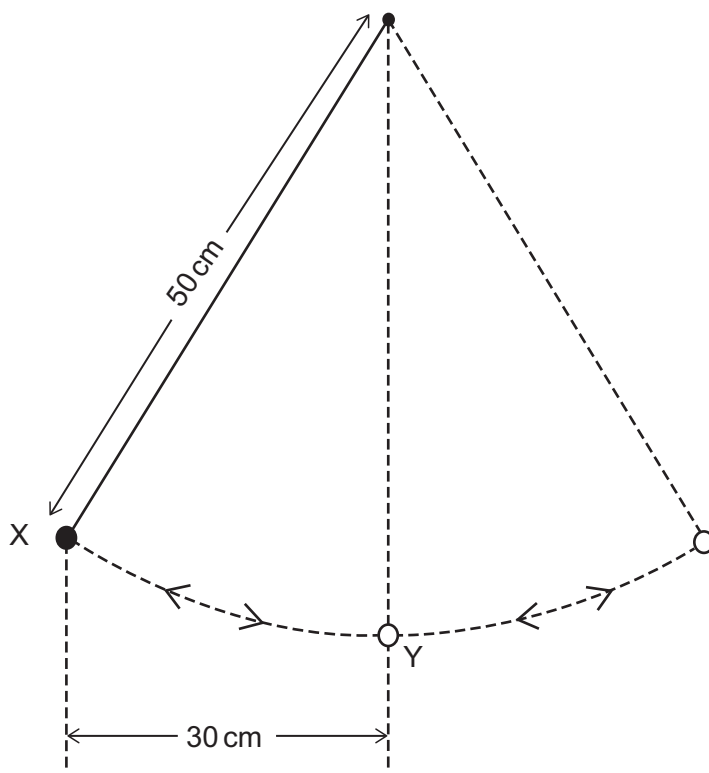
$$\int_0^2 x^{m+1} dx = \frac{32\sqrt{2}}{9}$$

what is the value of m ?

- A $-\frac{11}{2}$
- B $-\frac{9}{2}$
- C $-\frac{22}{29}$
- D $\frac{7}{22}$
- E $\frac{5}{2}$
- F $\frac{7}{2}$

- 88** A pendulum bob of mass 10 g is suspended by a light, inextensible string of length 50 cm.

The bob is released from rest at position X.



What is the speed of the bob as it passes through position Y?

(gravitational field strength $g = 10 \text{ N kg}^{-1}$; assume that resistive forces are negligible)

- A** $\sqrt{2} \text{ ms}^{-1}$
- B** $\sqrt{4} \text{ ms}^{-1}$
- C** $\sqrt{6} \text{ ms}^{-1}$
- D** $\sqrt{8} \text{ ms}^{-1}$
- E** $\sqrt{10} \text{ ms}^{-1}$

- 89** The dimensions of a solid cuboid, in cm, are x , $2x$ and y

The volume of the cuboid is 576 cm^3 .

At this volume, the surface area of the cuboid has its maximum value.

What is the area, in cm^2 , of the face that has the largest area?

A $2(288)^{\frac{2}{3}}$

B 72

C 96

D 432

E $4(144)^{\frac{2}{3}}$

- 90** An object is thrown vertically upwards from ground level with an initial velocity of 40 m s^{-1} .

2.0 seconds later another object is released from a height above the ground and falls vertically from rest.

Both of the objects hit the ground at the same time.

From what height above the ground was the second object released?

(gravitational field strength $g = 10\text{ N kg}^{-1}$; air resistance can be ignored)

A 80 m

B 180 m

C 320 m

D 500 m

E 900 m

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