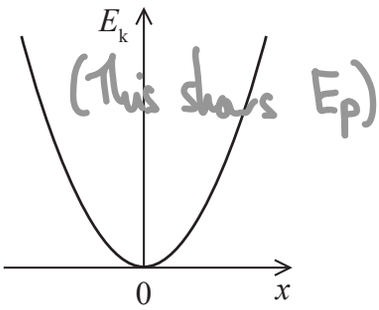
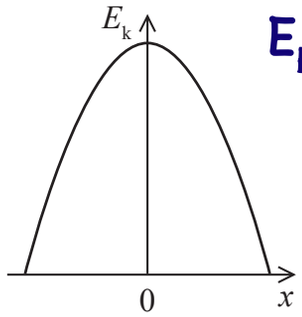
9 An object oscillates with simple harmonic motion. The object has kinetic energy E_k and displacement x.

Which of the following graphs shows the variation of E_k with x for the object?



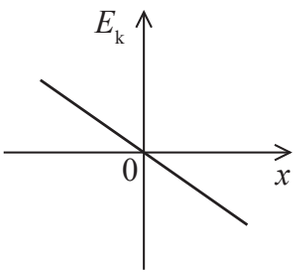
(This shows E_p)

☒ **A**

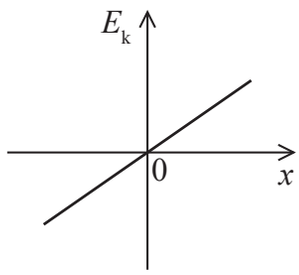


$E_{k\,max}$ at $x = 0$

☒ **B** ✓



☒ **C**



☒ **D**

(Total for Question 9 = 1 mark)

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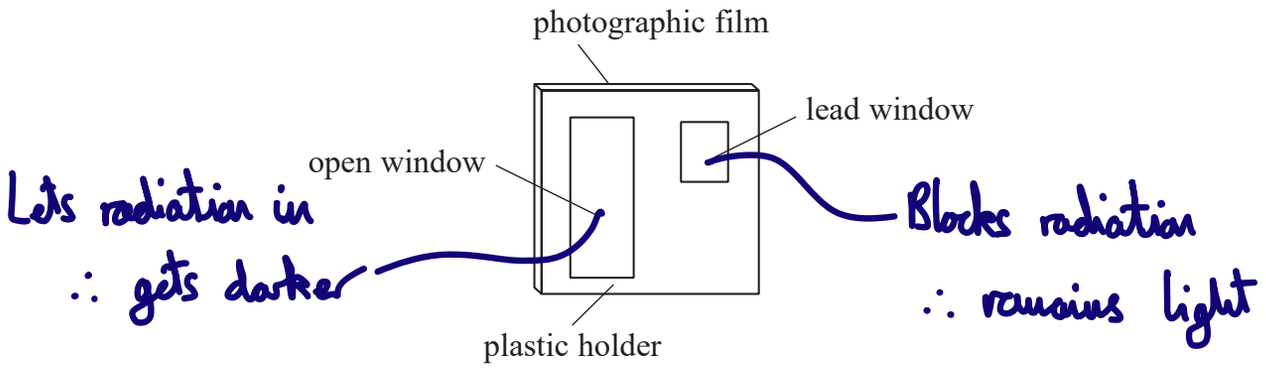
10 A radioactivity monitoring badge is worn by people who might be exposed to radiation. The badge is made from photographic film wrapped in thin paper and then held in a plastic holder that has an open window and a lead window, as shown.

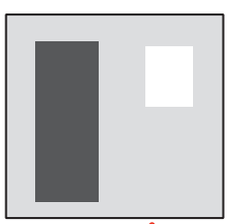


Lets radiation in
∴ gets darker

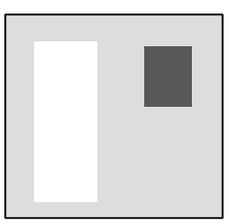
Blocks radiation
∴ remains light

The film gets darker when exposed to ionising radiation.

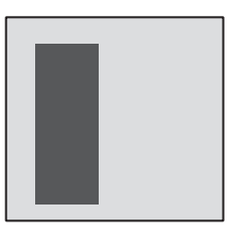
Which of the following represents the film after the badge is exposed to beta radiation?



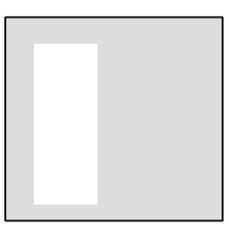
☒ A



☒ B



☒ C



☒ D

(Total for Question 10 = 1 mark)

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11 The photograph shows a stringed instrument called a cello being played with a bow.

(Source: © Vadim Ponomarenko/Alamy Stock Photo)

A standing wave forms on a cello string when the bow moves across the string.

Deduce whether a thicker string will produce a note of higher or lower frequency compared with a thinner string.

Assume each string is the same length and at the same tension.

Thick string has a greater mass per unit length, μ. ✓

$f = \frac{1}{\lambda}\sqrt{\frac{T}{\mu}}$, λ and T constant $\therefore f \propto \frac{1}{\sqrt{\mu}}$ ✓✓

As μ is greater, f is lower. ✓

(Total for Question 11 = 4 marks)

12 A student placed a metal block of mass 220 g in boiling water at 100 °C for several minutes.

The student then transferred the metal block into 300 g of water at 19 °C inside a glass container of mass 50 g. The final temperature of the water was 23 °C.

The table shows specific heat capacity values for copper and tin.

Metal	copper	tin
Specific heat capacity / J kg^{-1} K^{-1}	390	230

Deduce whether the metal block was made from copper or tin.

specific heat capacity of water = 4200 J kg^{-1} K^{-1}
specific heat capacity of glass = 840 J kg^{-1} K^{-1}

Energy lost by metal = Energy gained by water + glass ✓

$\Delta E = m_m c_m \Delta\theta_m$ ✓ $= m_w c_w \Delta\theta_w + m_g c_g \Delta\theta_g$

$$c_m = \frac{0.300 \times 4200 \times (23-19) + 0.050 \times 840 \times (23-19)}{0.220 \times (100-23)}$$ ✓

$c_m = 307.4 \text{ J kg}^{-1} \text{ K}^{-1}$ ✓

Metal must be copper, as some energy is also transferred to the surroundings ∴ calculated value of c lower than the true value. ✓

(Total for Question 12 = 5 marks)

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