**Edwest Stage 2 Physics 2A/2B Solutions 2010**

Section A

1. C-12 and C-14 are isotopes, which means that they have the same number of protons

but a different number of neutrons. Carbon 12 has 6 neutrons and carbon 14 has 8 neutrons.

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**2**

**4**

**7**

**4**

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 3 |
| **Sample** | **Activity** | **Corrected count** |
| 0.5 g sample of ancient papyrus | 84 | **62** |
| 1.0 g sample of new papyrus | 196 | **174** |
| Background reading | 22 |  |

1. a)

b) New papyrus activity = 174 Bq/g and old papyrus activity = 62/.05 = 124Bq/g

 Ratio = 124/174 = 0.713.

c) Trying in different values of n: n ≈ 0.49 half lives (0.488),

So t = 0.488 x 5730 ≈ 2800 years.

Distances

6

F/2

2ϴ

ϴ

48 N

ϴ

Forces

1. ϴ = 21.8o

15

Cos 21.8 = so F/2 = 48cos21.8 = 44.57. F = 89.1 N

1. When stretching the elastic the forces on her hand are in equilibrium so her hand must pull with the same force as that on the elastic (89.1 N). This is much larger than the force needed just to hold the slingshot without stretching the elastic.
2. a) a = F/m = 89.1/0.055 = 1.62 ms-2
3. v2 =u2 +2as so v2 = 0 + 2 x 1.62 x 0.15 = 486. So v = 22.0 ms-1.
4. Water has a higher specific heat capacity than the land so when the surrounding air gets colder in winter heat is transferred to the air from the land and the water.

The water will cool down less for the same amount of heat transferred and so the towns near the water will be warmer due to the higher temperature of the water.

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1. Assume the water heats up from 200 to 1000 so ΔT = 800C
H = Pt = 2000 x 90 = 1.80 x 105 J m = 0.538 kg.

Answer mass is about 0.5 kg of water.

**3**

1. (i) Hot water rises due to convection currents. With the heater at the bottom hot water will

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 circulate to the top and so all the water in the kettle will mix and reach an even temperature.

(ii) The shiny metal plate reflects the radiant heat (IR) so that IR rays travelling downwards will not cause conduction through the base, but will be reflected upwards to further heat the water above.

**3**

**4**

**2**

**5**

**4**

1. Heat lost by beer = 0.35 x 4180 x (30 - 5) = 36,575 J

Let mass of ice = m

Heat gained by ice = (3.34 x 105m) + (m x 4180 x 5) = 354,900m

m = 0.103 kg.

1. The table-tennis ball has equal number of + and – charges but when the + rod is brought close to the left side the negative electrons are attracted to that side.

**+**

**+**

**+**

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The ball would be attracted because the – charge (attractive) is closer than the + charge (repulsive). The attractive force is therefore greater than the repulsive force.

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| --- | --- | --- |
|  |  | **Relative Brightness** |
| S1 OPEN | S2 OPEN | **3** |
| S1 CLOSED | S2 OPEN | **1** |
| S1 OPEN | S2 CLOSED | **2** |
| S1 CLOSED | S2 CLOSED | **1** |

1. The yellow/green cable is called the Earth wire. It is connected from the toaster’s metal case to earth (at zero volts).

In the case of a fault where the case becomes live (240 V) then the current can run straight to earth, rather than through the person touching it..

1. a) M1 = ammeter

M2 = voltmeter

b) = 552. Hence total resistance of the circuit = 552 Ω.

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 c) 250 + R = 552, so R = 3.02 x 102 Ω.

Section B

1. a)

b) No, Suzie is not correct. The result is likely to be quite inaccurate because, although the measuring instruments have a high precision, a large error will arise from her judgement of when to start and stop the stopwatch.

 c) Uncertainty in length is ± 0.05 cm in 15 cm.

|  |  |  |
| --- | --- | --- |
| **Variable** | **Must be the same** | **Doesn’t matter** |
| Diameter of the ball |  |  |
| Distance X-Y |  |  |
| Type of timer |  |  |
| Size of measuring cylinder |  |  |
| Weight of ball |  |  |
| Type of liquid |  |  |

 d)

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Using s = ut + ½at2, s = 0 + ½ (-9.8)(1.75)2 = 15.0 m.

2. a) EP at start = EK at end so ½ x ~~3500~~ x v2 = ~~3500~~  x 9.8 x 5

 = 9.90 ms-1.

b) Total momentum (mv) is conserved so 3500 x 9.90 = 8000v

v = 4.33 ms-1.

c) Kinetic energy is ½ x 8000 x 4.332 = 7.50 x 104 J

d) Kinetic energyis converted to work in stopping so EK = Fs

 7.50 x 104 = 250 x 103 x s

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 S = 0.300 m

3. a) The breeze causes the water to evaporate. In evaporating, latent heat is transferred to the water from the air inside and so the air around the food cools down.

 b) (i) Q = mL = 0.015 x 3.34 x 105 = 5.01 x 103 J.

 (ii) Volume = 3.5 x 5.2 x 6.1 = 111.02 m3

 Mass = 111.02 x 1.22 = 135 kg.

 (iii) Q = mcΔT so 5.01 x 103 = 135 x 995 x ΔT

 ΔT = 3.73 x 10-2 oC.

(iv) Air with high humidity contains a lot of water vapour. If it is close to saturation level

then the air cannot absorb much more water vapour so the water used in the air conditioner will not be able to evaporate effectively.

c) Heat needed to cool the water from 20 to 0oC = 0.35 x 4180 x 20 = 2.926 x 104 J

 Heat needed to freeze the water = 0.35 x 3.34 x 105 = 1.169 x 105 J

 Total heat extracted =2.926 x 104 + 1.169 x 105 = 1.462 x 105 J

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 H = Pt, so the time taken will be or 15.7 min.

4. a)

 Radiation emitted is α particles.

 b) Radon is a gas and can therefore end up inside the body, ingested through the lungs.

 Outside of the body α-rays are not harmful but in the lungs they can destroy cells.

1. (i) 2.5 x 10-3 + 5.4 x 10-3 = 7.9 x 10-3 mJ per day x 365 = 2.88 J per year.

 Absorbed dose = 2.88/95 = 3.03 x 10-2 Gy.

1. Effective Dose for α particles

Effective Dose for β particles

Total effective dose = 0.213 Sv.

1. 240mBq reduced to 15 mBq is a reduction by a factor of 16 so the decay is for 4 half-lives

**12**

4 x T½ = 60.8 d, so = 15.2 days.

5. a) (i) A non-ohmic conductor is one which does not obey Ohm’s Law i.e. I is not proportional to V.

 (ii) Graph B is the correct one. With I and V reversed the graph shows a small resistance

 becoming greater as the lamp gets hotter.

200 Ω

V1

200 Ω

200 Ω

V2

b) P = VI so 0.18 = 6I I = 0.03 A

 R = V/I = 6/0.03 = 200 Ω.

c) L2 and L3 in parallel will have a resistance of 100 Ω

 Total R = 300 Ω.

 V α R so V1 must be 2 x V2.

 V2 must not exceed 6 V so V1 must not exceed 12 V.

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 Therefore Vs = 12 + 6 = 18 V.

**Section C**

|  |  |  |
| --- | --- | --- |
| Length L (cm) | Current I (amp) | 1/L (cm-1) |
| 2 | 15.5 | 0.500 |
| 3 | 10.3 | 0.333 |
| 5 | 3.1 | 0.200 |
| 7 | 2.2 | 0.143**values** |
| 10 | 1.6 | 0.100 |

a)

*I think* ***\_*Minh***is correct because* As the length increases the current gets **smaller.**

b)

* **Scaling**
* **Points**
* **Line of best fit**

c) (i) Gradient = 33 = k

 (ii) A = πr2 = π(0.25 x 10-3)2 = 1.96 x 10-7m2

 (iii) = 1.43 x 10-6

1. Minimum gradient = 15.6

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Maximum gradient 31.0.