Pieczęć

**Konkurs przedmiotowy z fizyki**

**dla uczniów gimnazjów**

14 marca 2015 r. – zawody III stopnia (finałowe)

# Witamy Cię na trzecim etapie konkursu i życzymy powodzenia.

**Pamiętaj, aby w rozwiązaniach zadań obliczeniowych   
przedstawiać kolejne czynności prowadzące do wyników końcowych.**

## Maksymalna liczba punktów – 60. Czas rozwiązywania zadań – 120 minut.

Rozwiązując zadania, możesz przyjąć przybliżone wartości:

* liczby π –
* przyspieszenia grawitacyjnego w pobliżu Ziemi –
* wartości prędkości dźwięku w powietrzu –
* wartości prędkości światła –

**Zadanie 1.**

Dokończ zdania. Wybierz odpowiedź A albo B i jej drugą część – 1. albo 2. Wybrane odpowiedzi otocz kółkiem.

*Dwie metalowe kule, A i B, o jednakowych promieniach ustawiono na izolowanych statywach   
w niewielkiej odległości od siebie. Kula A została naelektryzowana ładunkiem +8* C, a kulę B naelektryzowano ładunkiem -2 C.

1. *Po zetknięciu kul ze sobą i ponownym rozsunięciu całkowity ładunek układu*

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| **A.** | *zmalał* | **1.** | *i wynosił +3* C. |
| **B.** | *nie zmienił się* | **2.** | *i wynosił +6* C. |

1. *Po zetknięciu kul ze sobą i ponownym ich oddaleniu między kulami działała siła*

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| **A.** | *przyciągania elektrostatycznego,* | **1.** | *ponieważ część ładunków dodatnich przeszła z kuli A na kulę B, dzięki czemu ładunek kuli B stał się dodatni.* |
| **B.** | *odpychania elektrostatycznego,* | **2.** | *ponieważ część ładunków ujemnych przeszła z kuli B na kulę A.* |

**W zadaniu 2. oceń prawdziwość zdań i zaznacz znakiem X właściwą odpowiedź.**

**Zadanie 2.**

Badając ruch klocków na poziomym, bardzo gładkim stole, uczniowie zbudowali dwa układy przedstawione na rysunkach **A** i **B**. W obu przypadkach klocki zostały wprawione w ruch przez stałe siły.

**Rysunek A Rysunek B**

**B**

**A**

**m1 = 2kg m1 = 2kg**

**m2 = 1 kg**

**F2 = 10 N**

1. Wartość siły nacisku klocka A na stół jest równa wartości siły reakcji stołu. **Prawda 🞎 Fałsz 🞎**
2. Wartości przyspieszeń klocków A i B są jednakowe. **Prawda 🞎 Fałsz 🞎**
3. Wartość prędkości klocka A będzie rosła proporcjonalnie do czasu.

**Prawda 🞎 Fałsz 🞎**

1. Przesuwając klocek na drodze , siła (rysunek B.) wykona pracę .

**Prawda 🞎 Fałsz 🞎**

1. Jeżeli energia potencjalna opadającego klocka zmaleje o , to energia kinetyczna klocka A wzrośnie o tę samą wartość.

**Prawda 🞎 Fałsz 🞎**

1. Całkowita energia mechaniczna układu klocek-stół (rysunek B) jest stała. **Prawda 🞎 Fałsz 🞎**

**Zadanie 3.**

Wymień nazwy dwóch urządzeń, których podstawę działania można wyjaśnić za pomocą prawa Pascala.

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2. ……………………………………………………………………………………………………………………………………….....

**Zadanie 4.**

Poruszający się trasą szybkiego ruchu samochód przejechał trzy czwarte zaplanowanej drogi   
ze średnią szybkością , a pozostałą część drogi – z powodu utrudnień w ruchu – przebył w wolniejszym tempie. Średnia szybkość pojazdu na całej trasie wyniosła 96.   
Oblicz w średnią szybkość pojazdu na odcinku, na którym panowały utrudnienia w ruchu.

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**Zadanie 5.**

Winda towarowa o masie 500 kg rusza w górę ze stałym przyspieszeniem o wartości , zwiększając prędkość przez , a następnie kontynuuje ruch przez kolejne ze stałą prędkością.

1. Narysuj wykres zależności wartości prędkości od czasu i wykres zależności wartości przyspieszenia od czasu w opisanym ruchu.

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1. Na jaką wysokość wzniosła się winda w czasie ?

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1. Biorąc pod uwagę dwie fazy ruchu, oblicz wartości sił naciągu liny wciągającej windę.

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**Zadanie 6.**

Na lekkiej lince o długości 1,5 m zawieszono swobodnie drewniany klocek o masie 0,45 kg.   
W kierunku klocka wystrzelono poziomo pocisk o masie 0,05 kg i szybkości . Pocisk wbił się w klocek i ugrzązł w nim.

1. Oblicz szybkość układu klocek-pocisk tuż po zderzeniu.

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1. Na jaką maksymalną wysokość wzniesie się klocek z pociskiem?

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1. Jaką szybkość początkową powinien mieć klocek z tkwiącym w nim pociskiem, aby linka odchyliła się od pionu o kąt większy niż 90o?

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**Zadanie 7.**

Okres drgań wahadła matematycznego można obliczyć ze wzoru , gdzie oznacza długość wahadła, a wartość przyspieszenia grawitacyjnego na powierzchni Ziemi.   
Do obliczania okresu drgań ciężarka zawieszonego na sprężynie służy wzór ,  
w którym oznacza masę ciężarka, a to współczynnik sprężystości – stała fizyczna charakteryzująca sprężynę. Jej jednostka to .

1. Jaką długość powinno mieć wahadło matematyczne, aby mogło wykonywać drgania   
   o częstotliwości ? Wynik podaj w metrach z dokładnością do 1 mm.

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1. Kuba postanowił zbudować układ składający się z ciężarka zawieszonego na sprężynie, którego okres drgań byłby taki sam jak okres drgań wahadła matematycznego o długości . W tym celu wykorzystał sprężynę o współczynniku sprężystości .   
   Nie obliczając okresu drgań, uczeń przeprowadził rachunek, z którego wywnioskował,   
   że powinien zawiesić na sprężynie ciężarek o masie . Stosując metodę Kuby, sprawdź   
   i oceń poprawność jego obliczeń.

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1. Wyraź jednostkę współczynnika sprężystości za pomocą jednostek podstawowych układu SI.

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1. W rzeczywistości drgania wahadeł po pewnym czasie ustają. Na co zamienia się   
   ich energia mechaniczna?

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**Zadanie 8.**

Otaczającą nas przestrzeń wypełniają sygnały pochodzące z rozgłośni radiowych całego świata. Każdej stacji nadawczej przydzielono osobną częstotliwość nośną (a więc i długość fali) sygnału radiowego, aby docierające do radioodbiornika fale elektromagnetyczne mogły być rozdzielone, a słuchacz nie odbierał ich jednocześnie.

Historia polskiego radia ma już 90 lat. Pierwszy próbny sygnał radiowy o mocy 224 W wysłano za pomocą nadajnika 1 lutego 1925 roku. Audycję transmitowano przez godzinę,   
a pierwsze historyczne dla radia słowa wypowiedział inżynier Roman Rudniewski:

*– Tu próbna stacja radionadawcza Polskiego Towarzystwa Radiowego. Fala 385 metrów.*

W latach dwudziestych ubiegłego wieku radiofonia w naszym kraju rozwijała się szybko – powstała spółka „Polskie Radio”, która rozpoczęła regularne nadawanie audycji w 1927 roku,   
a w maju 1931 roku uruchomiła najsilniejszą wówczas w Europie stację radiową w Raszynie, pracującą na fali 1339 metrów, o zasięgu (dla odbiorników lampowych) 4000 km.

1. Na jakiej częstotliwości nośnej nadano pierwszy w Polsce sygnał radiowy? Wynik podaj   
   w kHz z dokładnością do trzech cyfr znaczących.

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1. Jaką energię miała fala elektromagnetyczna wyemitowana podczas pierwszej próbnej audycji?

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1. Po ilu milisekundach od chwili wysłania przez antenę nadawczą sygnał stacji radiowej docierał do najodleglejszych odbiorników?

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**Zadanie 9.**

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| **Lp.** | **Wielkość fizyczna** | **Wartość** |
|  | ciepło właściwe |  |
|  | ciepło topnienia |  |
|  | temperatura topnienia |  |
|  | gęstość |  |

W tabeli przedstawiono niektóre stałe fizyczne charakteryzujące ołów.

Ołowiana kula o masie 0,01 kg i temperaturze uderza w stalową płytę z prędkością o wartości 63 i równomiernie ogrzewa się. Podczas zderzenia 80% energii mechanicznej kuli rozprasza się do otoczenia.

1. Oblicz objętość kuli.

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1. Wykonując obliczenia, wykaż, że po zderzeniu kula ogrzeje się do temperatury topnienia.

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1. Czy podczas zderzenia cała kula stopi się? Jeśli nie cała, to jaka część jej masy ulegnie stopieniu? Uzasadnij odpowiedź.

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**Zadanie 10.**

Na osi poziomej przedstawiono długość fali akustycznej. Zaznaczone wartości określają granice przedziału dźwięków słyszalnych przez człowieka. Wskaż zakresy długości fali odpowiadające infradźwiękom i ultradźwiękom, wpisując ich nazwy w puste pola otoczone linią przerywaną.

**dźwięki słyszalne**

**17 mm 17 m długość fali**

**Zadanie 11.**

Uzupełnij tabelę, wpisując w puste miejsca wybraną cechę obrazu utworzonego przez soczewkę.

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|  |  |  | **Cechy obrazów** | | |
| **Rodzaj soczewki** | **Odległość obrazu od soczewki** | *powiększony,*  *taki sam, pomniejszony* | *rzeczywisty,*  *pozorny* | *odwrócony,*  *prosty* |
|  | skupiająca |  |  |  |  |
|  | skupiająca |  |  |  |  |
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**Zadanie 12.**

Zaproponuj doświadczenie mające na celu wyznaczenie biegunów magnetycznych bardzo słabo namagnesowanej żelaznej sztabki. Planując je, wykorzystaj fakt, że przewodniki, przez które płynie prąd elektryczny, są źródłem pola magnetycznego.

1. Wymień pomoce potrzebne do wykonania doświadczenia.
2. Narysuj schemat układu doświadczalnego.
3. Opisz dokładnie przebieg doświadczenia. Podaj sposób wyznaczenia biegunów magnetycznych, powołując się na odpowiednie prawo (regułę), rysunek uzupełnij   
   o niezbędne oznaczenia.

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