Unit 8 - Week 6

Course outline

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Assignment 6

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-10-28, 23:59 IST.

1) If $G(t-t')$ is the Green's function for the harmonic oscillator problem, then $G(t-t')$ satisfies: *1 point*

- $\left(\frac{\partial^2}{\partial t^2}+\omega^2\right)G(t-t')=\delta(t-t')$
- $\left(\frac{\partial^2}{\partial t^2}-\omega^2\right)G(t-t')=\delta(t-t')$
- $\left(\frac{\partial^2}{\partial t^2}-\omega^2\right)G(t-t')=0$
- $\left(\frac{\partial}{\partial t}+\omega^2\right)G(t-t')=\delta(t-t')$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\left(\frac{\partial^2}{\partial t^2}+\omega^2\right)G(t-t')=\delta(t-t')$

2) Which of the following is a candidate for the Green's function for the harmonic oscillator in the path integral formulation? *1 point*

- $G(t)=\int_{-\infty}^{\infty}\frac{dE}{2\pi}\frac{e^{-Et}}{-(E^2-\omega^2+i\varepsilon)}$
- $G(t)=\int_{-\infty}^{\infty}\frac{dE}{2\pi}\frac{e^{-iEt}}{-(E^2-\omega^2+i\varepsilon)}$
- $G(t)=\int_{-\infty}^{\infty}\frac{dE}{2\pi}\frac{e^{-iEt}}{(E^2-\omega^2+i\varepsilon)}$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$G(t)=\int_{-\infty}^{\infty}\frac{dE}{2\pi}\frac{e^{-iEt}}{-(E^2-\omega^2+i\varepsilon)}$

3) On performing a contour integration of the harmonic oscillator Green's function $G(t)$, we obtain the formal expression for the Green's function as: *1 point*

- $G(t)=\frac{i}{2\omega}\exp(-i\omega|t|)$
- $G(t)=\frac{i}{2\omega}\exp\left(\omega|t|^2\right)$
- $G(t)=\frac{1}{2\omega}\exp\left(\sqrt{-i\omega|t|}\right)$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$G(t)=\frac{i}{2\omega}\exp(-i\omega|t|)$

4) The vacuum state expectation value $\langle 0|\hat{q}(t_1)|0\rangle$ of the operator $\hat{q}(t_1)$ for the quantum harmonic oscillator is: *1 point*

- ∞
- 1
- 0
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
0

5) The value of the integral $\int dx\, e^{\frac{i}{\hbar}\varphi(x)}$ in the stationary phase approximation is: *1 point*

- $e^{i\nu\frac{\pi}{4}}\sqrt{\frac{2\pi\hbar}{\varphi(\bar{x})}}e^{\left(\frac{i}{\hbar}\varphi(\bar{x})\right)}$ where $\nu=\mathrm{sgn}\,\varphi''(\bar{x})$
- $e^{i\nu\frac{\pi}{4}}\sqrt{\frac{2\pi\hbar}{\varphi''(\bar{x})}}e^{\left(\frac{i}{\hbar}\varphi(\bar{x})\right)}$ where $\nu=\mathrm{sgn}\,\varphi''(\bar{x})$
- $e^{i\nu\frac{\pi}{4}}\sqrt{\frac{2\pi}{\varphi(\bar{x})}}e^{\left(\frac{i}{\hbar}\varphi(\bar{x})\right)}$ where $\nu=\mathrm{sgn}\,\varphi''(\bar{x})$
- $e^{i\nu\frac{\pi}{4}}\sqrt{\frac{2\pi}{\varphi(\bar{x})}}e^{(i\varphi(\bar{x}))}$ where $\nu=\mathrm{sgn}\,\varphi''(\bar{x})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$e^{i\nu\frac{\pi}{4}}\sqrt{\frac{2\pi\hbar}{\varphi''(\bar{x})}}e^{\left(\frac{i}{\hbar}\varphi(\bar{x})\right)}$ where $\nu=\mathrm{sgn}\,\varphi''(\bar{x})$

6) Given that $f(t,\vec{x})=\frac{1}{(2\pi)^{3/2}\sqrt{2E_p}}\exp\left[i\left(E_pt-\vec{p}.\vec{x}\right)\right]$ is a solution of the Klein Gordon equation with $E_p^2=\vec{p}^2+m^2$, we have: *1 point*

- $i\frac{\partial f(t,\vec{x})}{\partial t}=-E_pf(t,\vec{x})$
- $i\frac{\partial f(t,\vec{x})}{\partial t}=-E_p^2f(t,\vec{x})$
- $i\frac{\partial f(t,\vec{x})}{\partial t}=(\vec{p}^2+m^2)f(t,\vec{x})$
- $i\frac{\partial f(t,\vec{x})}{\partial t}=E_p^2f(t,\vec{x})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$i\frac{\partial f(t,\vec{x})}{\partial t}=-E_pf(t,\vec{x})$

7) We define the inner product by $\langle f|g\rangle=i\int d^3x\left(f^*\partial_tg-\partial_tf^*g\right)$ for $f(t,\vec{x})$ and $g(t,\vec{x})$ being solutions of the Klein Gordon equation. Then, given $f(t,\vec{x})=\frac{1}{(2\pi)^{3/2}\sqrt{2E_p}}\exp\left[i\left(E_pt-\vec{p}.\vec{x}\right)\right]$ and $g(t,\vec{x})=\frac{1}{(2\pi)^{3/2}\sqrt{2E_p}}\exp\left[-i\left(E_pt-\vec{p}.\vec{x}\right)\right]$, the value of $\langle f|g\rangle$ is: *1 point*

- 1
- $\delta(\vec{p}-\vec{p}')$
- 0
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
0

8) We define the inner product by $\langle f|g\rangle=i\int d^3x\left(f^*\partial_tg-\partial_tf^*g\right)$ for $f(t,\vec{x})$ and $g(t,\vec{x})$ being solutions of the Klein Gordon equation. Then, given $f_1(t,\vec{x})=\frac{1}{(2\pi)^{3/2}\sqrt{2E_{p,1}}}\exp\left[i\left(E_{p,1}t-\vec{p}_1.\vec{x}\right)\right]$ and $f_2(t,\vec{x})$ similarly, the value of $\langle f_1|f_2\rangle$ is: *1 point*

- 1
- $-\delta(\vec{p}_1-\vec{p}_2)$
- 0
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$-\delta(\vec{p}_1-\vec{p}_2)$

9) Consider a beam of quantum particles of energy *E* incident on a potential barrier of height V_0. If $E-m<V_0$ (in natural units) i.e. when the kinetic energy is smaller than V_0: *1 point*

- The entire beam gets exponentially damped
- The entire beam gets reflected back
- Reflected and transmitted waves both occur but the transmitted wave is exponentially damped
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
Reflected and transmitted waves both occur but the transmitted wave is exponentially damped

10) The propagator is related to the time evolution operator *U(t",t')* as $K(q',t';q'',t'')=\langle q''|U(t'',t')|q'\rangle$. The initial condition on time evolution operator $U(t',t')=1$ manifests itself a conditioning the propagator $K(q',t';q'',t'')$ as: *1 point*

- $K(q',t';q',t'')=\delta(t'-t'')$
- $K(q',t';q'',t')=\langle q''|q'\rangle=\delta(q'-q'')$
- $K(q',t';q',t')=0$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$K(q',t';q'',t')=\langle q''|q'\rangle=\delta(q'-q'')$