Unit 7 - Week 5

Assessment 5

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

Due on 2020-10-21, 23:59 IST.

1) The Lagrangian for the harmonic oscillator with a time independent source term J can be written as: *1 point*

- $L=\frac{1}{2}m\dot{\bar{x}}^2-\frac{1}{2}m\omega^2\bar{x}^2-\frac{J^2}{2m\omega^2}$ where $\bar{x}=\left(x-\frac{J}{m\omega^2}\right)$
- $L=\frac{1}{2}m\dot{\bar{x}}^2-\frac{1}{2}m\omega^2\bar{x}^2+\frac{J^2}{2m\omega^2}$ where $\bar{x}=\left(x+\frac{J}{m\omega^2}\right)$
- $L=\frac{1}{2}m\dot{\bar{x}}^2-\frac{1}{2}m\omega^2\bar{x}^2+\frac{J^2}{2m\omega^2}$ where $\bar{x}=\left(x-\frac{J}{m\omega^2}\right)$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$L=\frac{1}{2}m\dot{\bar{x}}^2-\frac{1}{2}m\omega^2\bar{x}^2+\frac{J^2}{2m\omega^2}$ where $\bar{x}=\left(x-\frac{J}{m\omega^2}\right)$

2) The transition amplitude in the path integral framework in phase space, can be written in the form: *1 point*

- $K(q',t';q'',t'')=\int[Dq][Dp]\exp\left\{\frac{i}{\hbar}\int_{t'}^{t''}d\tau(p\dot{q}-H(p,q))\right\}$
- $K(q',t';q'',t'')=\int[Dp]\exp\left\{\frac{i}{\hbar}\int_{t'}^{t''}d\tau(p\dot{q}-H(p,q))\right\}$
- $K(q',t';q'',t'')=\int[Dp]\exp\left\{\frac{i}{\hbar}\int_{t'}^{t''}d\tau H(p,q)\right\}$
- $K(q',t';q'',t'')=\int[Dp]\exp\left\{\frac{i}{\hbar}H(p,q)\right\}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$K(q',t';q'',t'')=\int[Dq][Dp]\exp\left\{\frac{i}{\hbar}\int_{t'}^{t''}d\tau(p\dot{q}-H(p,q))\right\}$

3) The transition amplitude in the Feynman path integral framework in co-ordinate space (if the momentum dependence is confined to a quadratic term, the kinetic energy), can be written in the form: *1 point*

- $K(q',t';q'',t'')=N\int[Dp]\exp\left\{\frac{i}{\hbar}S[q,\dot{q}]\right\}$
- $K(q',t';q'',t'')=N\int[Dq]\exp\left\{\frac{i}{\hbar}S[q,\dot{q}]\right\}$
- $K(q',t';q'',t'')=\int[Dq]\exp\left\{\frac{i}{\hbar}L[q,\dot{q}]\right\}$
- $K(q',t';q'',t'')=N\int[Dp]\exp\left\{\frac{i}{\hbar}H[p,\dot{q}]\right\}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$K(q',t';q'',t'')=N\int[Dq]\exp\left\{\frac{i}{\hbar}S[q,\dot{q}]\right\}$

4) Which of the following is a viable candidate for the free particle transition amplitude? *1 point*

- $K(q',t';q'',t'')=\sqrt{\left[\frac{m}{2\pi i\hbar(t''-t')}\right]}\exp\left[\frac{im}{2\hbar}\frac{(q''-q')^2}{(t''-t')}\right]$
- $K(q',t';q'',t'')=\sqrt{\left[\frac{m}{2\pi i\hbar(t''-t')}\right]}\exp\left[\frac{im}{2\hbar}\frac{(q''-q')}{(t''-t')}\right]$
- $K(q',t';q'',t'')=\sqrt{\left[\frac{m}{2\pi i\hbar(t''-t')}\right]}\exp\left[\frac{m}{2\hbar}\frac{(q''-q')}{(t''-t')}\right]$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$K(q',t';q'',t'')=\sqrt{\left[\frac{m}{2\pi i\hbar(t''-t')}\right]}\exp\left[\frac{im}{2\hbar}\frac{(q''-q')^2}{(t''-t')}\right]$

5) $\int_{-\infty}^{\infty}dx\exp(ikx^2)$ is equal to: *1 point*

- $\sqrt{\pi/k}$
- $\sqrt{2\pi/k}$
- $\sqrt{i\pi/k}$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\sqrt{i\pi/k}$

6) $\int_{-\infty}^{\infty}dx\,x^2\exp(ikx^2)$ *1 point*

- $\left(\frac{1}{k}\right)\sqrt{i\pi/k}$
- $\left(\frac{1}{2k}\right)\sqrt{\pi/k}$
- $\left(\frac{i}{2k}\right)\sqrt{1/k}$
- $\left(\frac{i}{2k}\right)\sqrt{i\pi/k}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\left(\frac{i}{2k}\right)\sqrt{i\pi/k}$

7) The 2-point time ordered product $\langle q'',t''|T[\hat{q}(t_i)\hat{q}(t_j)]|q',t'\rangle$ in the path integral framework takes the form: *1 point*

- $\int[Dq][Dp]q(t_i)q(t_j)\exp\left[\frac{i}{\hbar}\int_{t'}^{t''}Hd\tau\right]$
- $\int[Dq]q(t_i)q(t_j)\exp\left[\frac{i}{\hbar}L(q,\dot{q})\right]$
- $\int[Dq][Dp]q(t_i)q(t_j)\exp\left[\frac{i}{\hbar}\int_{t'}^{t''}(p\dot{q}-H)d\tau\right]$
- $\int[Dp]q(t_i)q(t_j)\exp\left[\frac{i}{\hbar}\int_{t'}^{t''}S(q,\dot{q})d\tau\right]$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\int[Dq][Dp]q(t_i)q(t_j)\exp\left[\frac{i}{\hbar}\int_{t'}^{t''}(p\dot{q}-H)d\tau\right]$

8) We define: *1 point*

$\langle q'',t''|q',t'\rangle_f=\int[Dq][Dp]\left\{\exp\left[\frac{i}{\hbar}\int_{t'}^{t''}d\tau(p\dot{q}-H(p,q)+fq)\right]\right\}$

Then, $\langle q'',t''|T[\hat{q}(t_1)\hat{q}(t_2)]|q',t'\rangle$ is given by:

- $-\frac{\delta}{\delta f(t_1)}\frac{\delta}{\delta f(t_2)}\langle q'',t''|q',t'\rangle$
- $\langle q'',t''|q',t'\rangle\big|_{f=0}$
- $\frac{\delta}{\delta f(t_1)}\frac{\delta}{\delta f(t_2)}\langle q'',t''|q',t'\rangle\Big|_{f=0}$
- $\left(\frac{\hbar}{i}\right)^2\frac{\delta}{\delta f(t_1)}\frac{\delta}{\delta f(t_2)}\langle q'',t''|q',t'\rangle\Big|_{f=0}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\left(\frac{\hbar}{i}\right)^2\frac{\delta}{\delta f(t_1)}\frac{\delta}{\delta f(t_2)}\langle q'',t''|q',t'\rangle\Big|_{f=0}$

9) The expression $\exp(-i\theta)$ in the limit $\theta\to\infty$: *1 point*

- Diverges to $-\infty$
- Converges to zero
- Exhibits undamped oscillatory behaviour
- Exhibits damped oscillatory behaviour

No, the answer is incorrect.
Score: 0
Accepted Answers:
Exhibits undamped oscillatory behaviour

10) Which of the following is/are not true? *1 point*

- The contribution of each path to the integral is of equal modulus and its phase is given by the action functional.
- The normalization is constant for all paths and hence, does not contain any physics. The physics is encoded in the path integral because it contains the functional dependence of the physical quantities.
- Only the endpoints q_1 and $q_{N+1}=q$ are fixed in the discretized version of the path integral.
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
None of the above